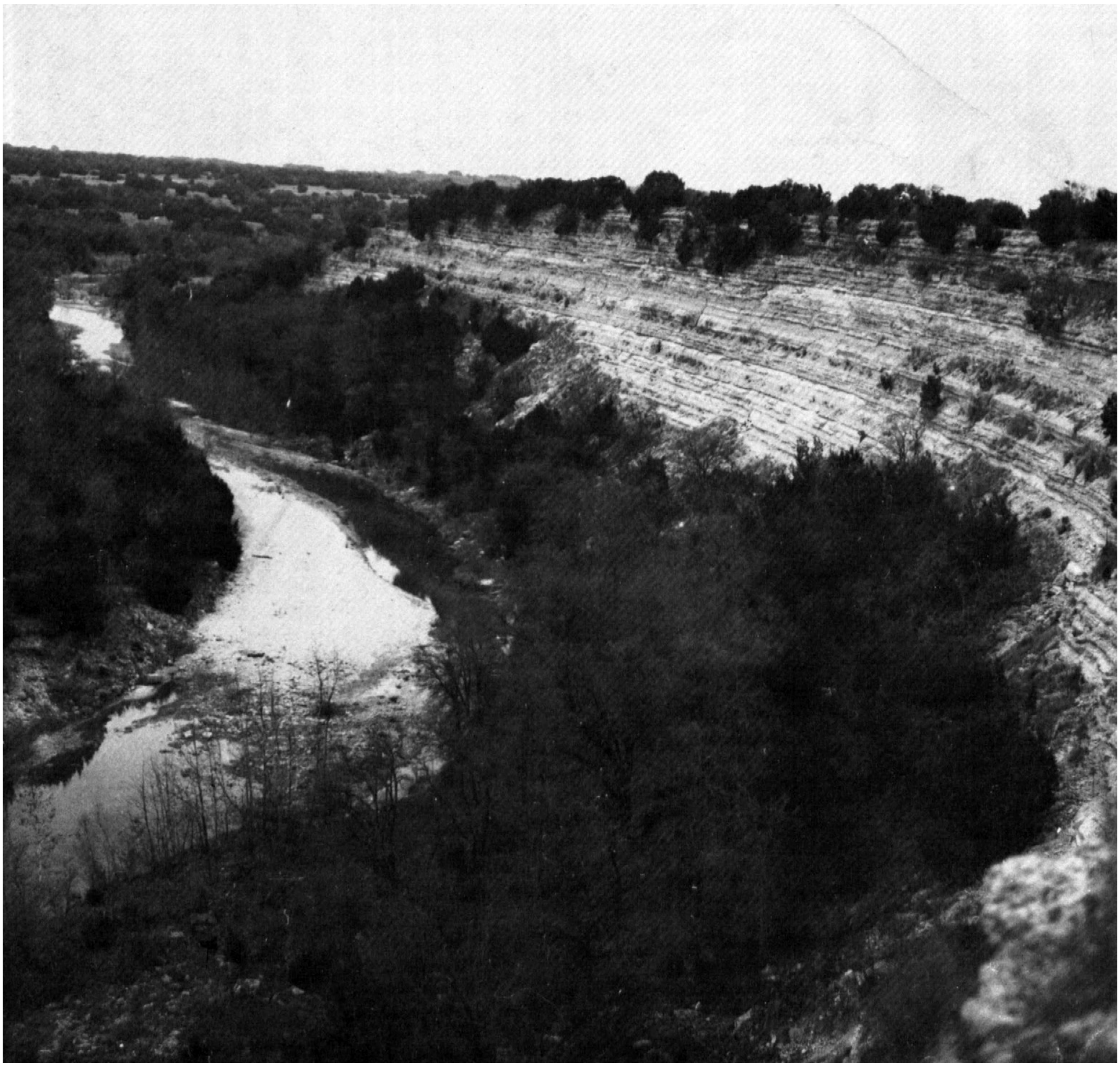
United States Department of Agriculture

Soil Conservation Service

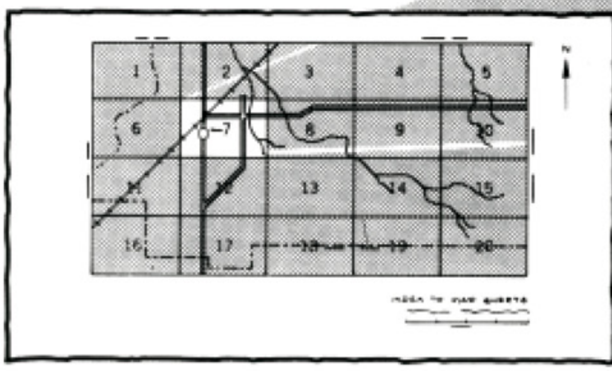
In cooperation with Texas Agricultural Experiment Station and United States Department of the Army, Fort Hood, Texas

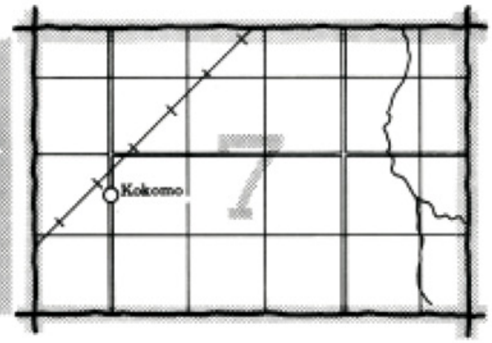
Soil Survey of Coryell County, Texas



HOW TO USE

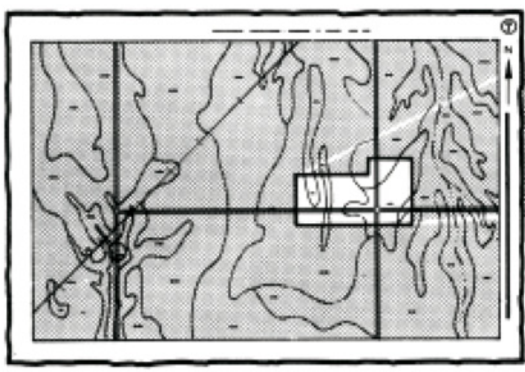
1. Locate your area of interest on the "Index to Map Sheets"

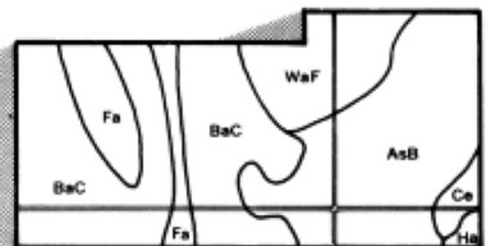




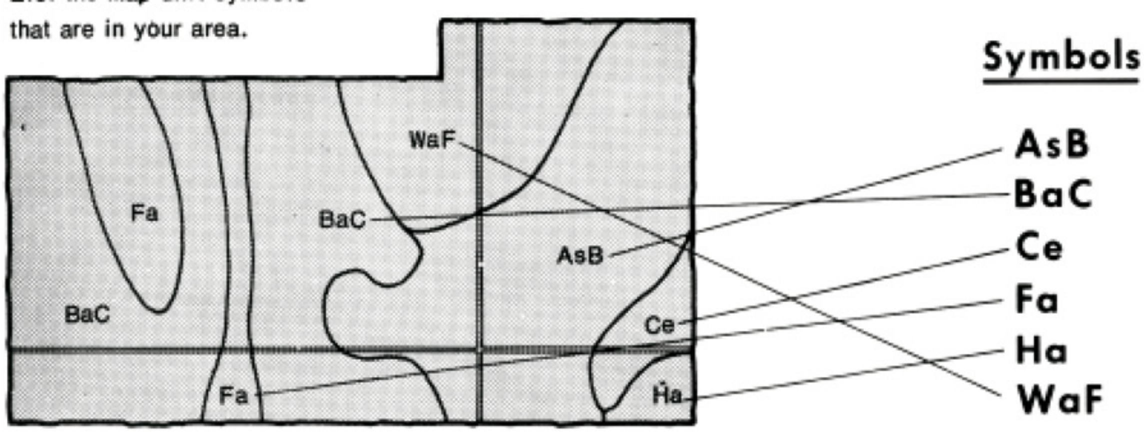
2. Note the number of the map sheet and turn to that sheet.

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



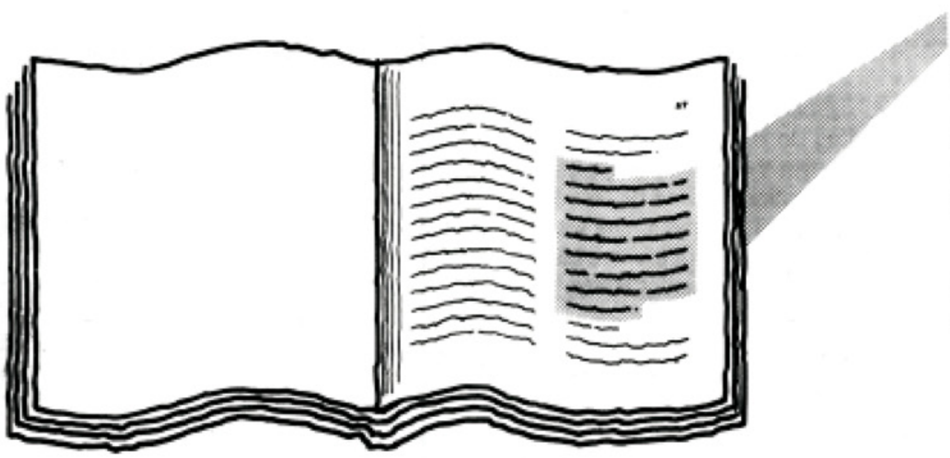


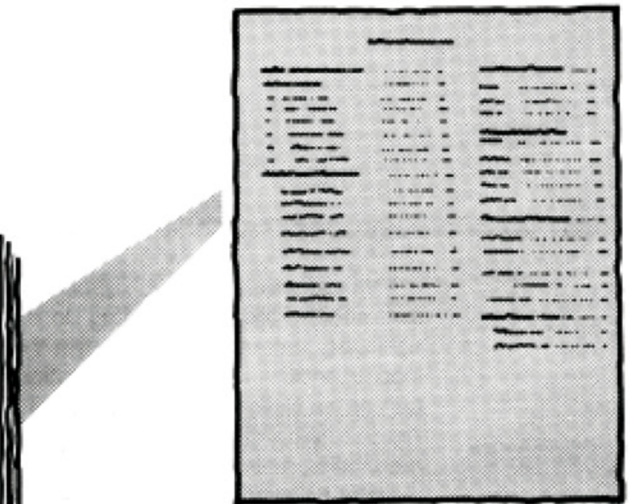
4. List the map unit symbols that are in your area.



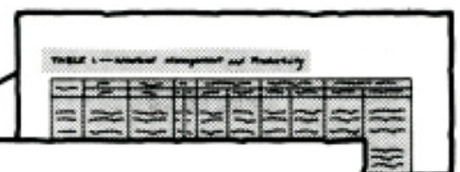
THIS SOIL SURVEY

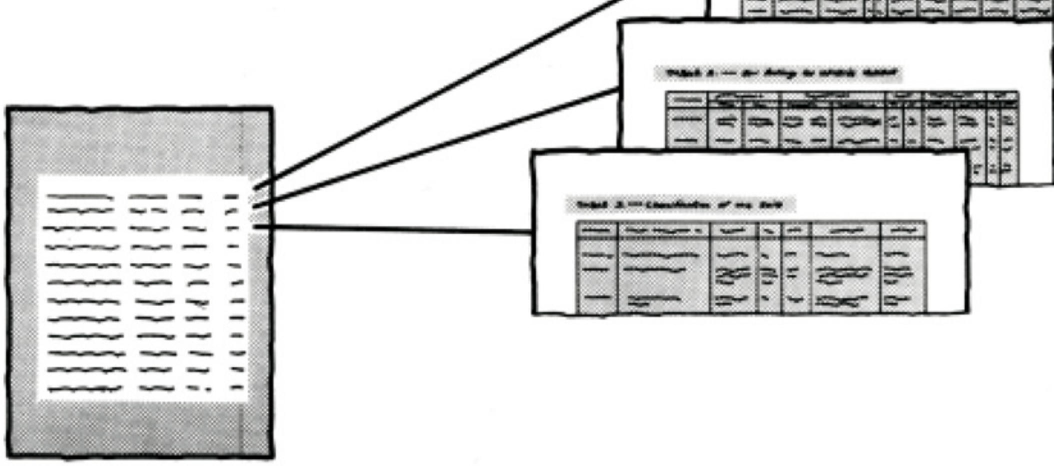
5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.





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





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

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

Major fieldwork for this soil survey was completed in 1982. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service, the Texas Agricultural Experiment Station, and the United States Department of the Army, Fort Hood, Texas. It is part of the technical assistance furnished to the Hamilton-Coryell Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: *Scenic view along Cowhouse Creek. The exposed rock is Glen Rose limestone; the soils are in the Doss-Real-Krum general soil map unit.*

Contents

Soil Series

Issued May 1985

Index to Map Units

Summary of Tables

Foreword

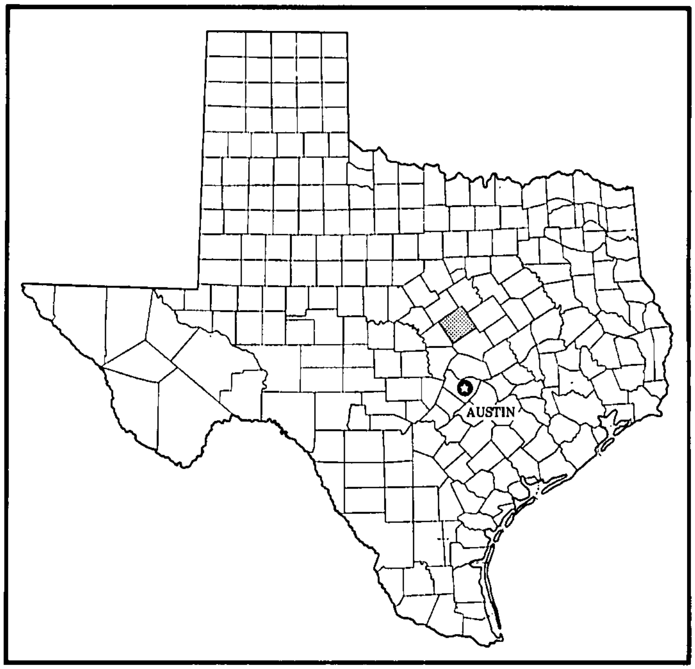
This soil survey contains information that can be used in land-planning programs in Coryell County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Billy C. Griffin
State Conservationist
Soil Conservation Service



Location of Coryell County in Texas.

Soil Survey of
Coryell County, Texas

By Nathan L. McCaleb, Soil Conservation Service

Fieldwork by Eddie D. Bearden, Laurie N. Kiniry, Nathan L. McCaleb,
Larry T. West, and Dennis L. Williamson, Soil Conservation Service

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

Coryell County is located in central Texas. It is square in shape and has an area of about 1,057 square miles, or 676,249 acres. Gatesville, the county seat, is near the center. In 1980, according to the Bureau of the Census, the population of the county was 56,767. The Ft. Hood-Copperas Cove area had 43,520 inhabitants, about 77 percent of the county's population.

Coryell County is in the Grand Prairie region of Texas. The Leon River flows through the center of the county. Topographically, the county consists of an undulating dissected limestone plain underlain by hard limestone on the higher ridges and softer limestone and marly clay on the rolling hills and plateaus.

About 187,000 acres of Coryell County is within the boundaries of the Ft. Hood Military Reservation. Ft. Hood has the largest concentration of tanks and armored vehicles in the world. There are two armored divisions and numerous support units. In addition, 21,000 military dependents reside off-post, in the surrounding towns and communities.

Because of its hazardous nature, the impact area, which includes the artillery firing range, bombing range, and other live ammunition ranges, was surveyed using helicopters and pilots provided by Ft. Hood. Also, many of the pits evaluated in this survey were opened using backhoe equipment and personnel provided by Ft. Hood.

The major agricultural land uses in Coryell County are cattle ranching, farming, and pecan production. In 1983, about 68 percent of the county was rangeland, 18 percent was cropland, 2 percent was pastureland and hayland, and 2 percent was urban and built-up areas.

There are 27 kinds of soil in Coryell County. The soils vary widely in texture, depth, reaction, natural drainage, and other characteristics. Slopes, depth to bedrock, and natural fertility are major factors which influence agricultural uses of the soils.

The descriptions and names of the soils in this survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of the soils or of the extent of the soils within the survey area.

General Nature of the Survey Area

History

Coryell County was originally part of Mexico. After the Texas Revolution, Ft. Gates was established in 1849 to protect the settlers from Indian raids. In 1854, the Texas Legislature authorized the creation of Coryell County, made up of parts of Milam and Bell Counties. The county was named in honor of James Coryell, a hero of the Texas Revolution.

Between 1850 and 1880, open range conditions caused problems between farmers and cattle ranchers. One of the Feeder Routes of the Chisholm Trail crossed Coryell County, intensifying the conflict. Indian raids continued to plague farmers and ranchers until 1871.

In 1882, the railroad came to Coryell County. One railroad came to Gatesville from Waco, and another railroad crossed the southwestern corner of the county at Copperas Cove. The coming of the railroad, the use of barbed wire, the establishment of cotton gins, and the introduction of well drilling brought about an agricultural boom for Coryell County.

At the beginning of World War II, almost 187,000 acres of Coryell County was incorporated into Ft. Hood. Although most of Ft. Hood is used for intensive military training, most areas are available at times for cattle grazing.

Natural Resources

About 499,444 acres in Coryell County is in farms that are used for the production of crops and livestock. In addition, most of the Ft. Hood and Belton reservoir areas is leased to farmers and ranchers for grazing livestock. Both areas are also used for recreation, providing good hunting and fishing.

Coryell County has two main streams, the Leon River and Cowhouse Creek. The Leon River runs through the center of the county, from the northwest to the southeast. It begins in Eastland County and runs through Comanche, Erath, and Hamilton counties before entering Coryell County. Since the completion of Proctor Lake, in Comanche County, the water flow has become steady, and the hazard of flooding has been reduced. Cowhouse Creek heads in Hamilton County and is intermittent in flow.

Wildlife is abundant in Coryell County. Deer, turkey, and quail are common in most areas of the county. Improved range and pasture conditions have greatly enhanced habitat for all wildlife.

Coryell County has a large supply of limestone rock. The rock taken from quarries in the county is used as building and road material and for cement.

Archeological Sites

Henry B. Moncure, research archeologist, Texas Archeological Society, prepared this section.

Soil is one of the more important of the biophysical variables which combine to form the habitats that determine where a human population chooses to live. Soil, therefore, directly influences the formation of an archeologic site. It also affects the state of preservation of the site, its surface visibility, the diversity of its contents, and even the appearance of the remains.

Under a given climate and exposure, those properties of the soil which influence vegetation, its type, density, diversity, and growth limits, affect the entire biotic spectrum attainable in a given area, and thus the food supply available to early human populations. Because early inhabitants lacked the knowledge to deliberately alter the soil, their habitat options were limited to those locations offering access to their subsistance base. The earliest inhabitants were hunter-gatherers, with the emphasis on the gathering. It is no surprise that soil areas showing high fertility factors also show a high incidence of archeologic sites where those areas are relatively undisturbed.

Surface visibility of a site and the preservation of its contents are influenced by soil chemistry and physiology. The more active chemical processes tend to destroy or alter cultural remains, whereas less active processes coupled with the sealing effect of overlying soil layers, can allow unusual preservation of remains which would otherwise quickly deteriorate. The physical characteristics of a soil either assist in burying and obscuring site components or cause them to be revealed. Additionally, soil characteristics affect the vegetation supported, which in turn either masks or emphasizes a site.

Coryell County was the subject of deliberate archeologic investigation early in this century. Frank Simmons investigated a portion of the Leon River valley as early as 1914 (*17*). Simmons and others, notably Frank Bryant of the Central Texas Archeological Society, examined much of the county (*7*). Reporting procedures for sites were, at the time, not standardized, and although general areas of site concentrations can be identified from pre-World War II archives, many specifics are lacking. In general, areas that were once productive, continue, on resurvey, to reveal new sites. The Ft. Hood Military Reservation, about 27 per cent of the county, has been subjected to much more intense professional scrutiny than areas outside the reservation. There are 276 sites officially recorded with the Texas Archeological Research Laboratory, 226 of them on Ft. Hood (*7*). Additionally, early data from the ongoing survey of Ft. Hood indicate that the number of sites in Coryell County will increase significantly (*8*).

A comparison of known sites with general soil areas places 95 per cent of the sites within the Bosque-Frio-Lewisville map unit and the adjacent Eckrant-Real-Rock outcrop map unit. The Bosque-Frio-Lewisville unit's high potential for the support of robust vegetation, its proximity to generally reliable water sources, and its potential for providing a good wildlife habitat appear to be major factors in site location. These attractive characteristics are somewhat tempered by the hazard of flooding, which possibly explains the site density within the less hospitable but nearby Eckrant-Real-Rock outcrop unit. The Bosque-Frio-Lewisville habitat could be exploited from the adjacent safer areas. It is likely the Bosque-Frio-Lewisville unit contains sites that were buried by episodic flooding.

The Bastsil-Minwells map unit, like the Bosque-Frio-Lewisville unit, is particularly well situated and has favorable characteristics for archeological sites. However, the Bastsil-Minwells unit constitutes a relatively small percentage of the county and is found outside the area where most archeological survey has been concentrated. The present low site density is the result more of a lack of investigation than a lack of potential.

The actual age of the archeological sites in Coryell County is difficult to determine. Most of the sites are estimated to be between 12,000 and 20,000 years old.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Coryell County is hot in summer. In winter, occasional surges of cold air cause a sharp drop in otherwise mild temperatures. Rainfall is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfalls are infrequent. Total annual precipitation is normally adequate for cotton, feed grains, and small grains.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Gatesville, Texas, in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 49 degrees F, and the average daily minimum temperature is 36 degrees. The lowest temperature on record, which occurred at Gatesville on February 2, 1951, is 0 degrees. In summer the average temperature is 83 degrees, and the average daily maximum temperature is 96 degrees. The highest recorded temperature, which occurred at Gatesville on August 12, 1962, is 112 degrees.

Growing degree days are shown in table 3. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 34 inches. Of this, 19 inches, or 55 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 8.35 inches at Gatesville on June 16, 1964. Thunderstorms occur on about 45 days each year, and most occur in summer.

The average seasonal snowfall is 2 inches. The greatest snow depth at any one time during the period of record was 4 inches. On an average of 0 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Survey Procedures

Before the actual fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on quad-centered aerial photographs flown in 1978 and enlarged to a scale of 1:24,000. U.S. Geological Survey topographic maps and photographs were studied to relate land and image features.

Traverses were made by truck on the existing network of roads and trails. Where there were no roads or trails, traverses were made on foot. In the Ft. Hood Military Reservation Impact Area, which was inaccessible by foot, traverses were made by helicopter. However, limited landing areas prevented complete traverses in some places.

Soil examinations along the traverses were made about 50 to 500 yards apart, depending on the landscape and soil pattern (*14*). Observations of such items as landforms, trees blown down, vegetation, roadbanks, and animal burrows were made continuously without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of hand auger, spade, or power probe to a depth of about 6 feet or to bedrock if bedrock was at a depth of less than 6 feet. Many pedons described as typical were observed and studied in pits that were dug using a backhoe.

At least three delineations of each map unit were chosen to be representative of the map unit and were transected to determine the composition of the map unit and to record the kind of vegetation. Most transects had at least 10 observations spaced from 50 to 300 feet apart.

Samples for chemical and physical analyses were taken from the site of the typical pedon of the major soils in the survey area. The analyses were made by the National Soil Survey Laboratory, Lincoln, Nebraska; Texas A&M University, College Station, Texas; and the Texas Department of Highways and Public Transportation, Austin, Texas.

After completion of the soil mapping on quad-centered aerial photographs, map unit delineations were transferred by hand to orthophotographs at a scale of 1:24,000. Surface drainage was mapped in the field. Cultural features were transferred from U.S. Geological Survey 7-1/2-minute topographic maps and were recorded from visual observations. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

General Soil Map Units

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

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Eckrant-Real-Rock outcrop

Very shallow to shallow, gently sloping to steep, cobbly and gravelly, clayey and loamy soils and rock outcrop; on uplands

This map unit is made up of Eckrant soils on ridgetops, on tops of "mountains" or high divides, and in broad smooth areas having gentle slopes; Real soils on steep side slopes of "mountains" and ridges; and Rock outcrop in long, narrow bands along escarpments, cliffs, and slope breaks (fig. 1). These soils formed in hard and soft limestones.

This unit makes up about 29 percent of the county. It is about 28 percent Eckrant soils, 18 percent Real soils, 10 percent Rock outcrop, and 44 percent other soils.

Typically, the surface layer of the Eckrant soil is very dark grayish brown, mildly alkaline, cobbly silty clay about 5 inches thick. Very dark grayish brown, mildly alkaline, very cobbly silty clay extends to a depth of 12 inches. The underlying material is hard limestone.

Typically, the surface layer of the Real soil is a dark brown, moderately alkaline gravelly clay loam about 5 inches thick. Moderately alkaline, dark brown very gravelly clay loam extends to a depth of 17 inches. Interbedded weakly to strongly cemented limestone is below a depth of 17 inches.

Typically, the Rock outcrop is limestone, generally 3 to 12 inches thick, but as much as 30 feet thick in places. In places a thin mantle of soil overlies the rock. In other places large boulders have broken from escarpments and fallen downslope.

Of minor extent on uplands are the shallow, gently sloping, loamy Doss soils, the shallow, clayey Evant and Oglesby soils, the moderately deep, gently sloping, loamy Bolar soils, and the deep, clayey Denton soils. The deep, gently sloping, clayey Krum and Slidell soils are along drainageways.

The soils in this unit are mainly used as rangeland. They are best suited to this use. The main limitations are depth to rock, slope, and limestone fragments on the surface. The vegetation is typically tall grasses in a live oak savannah; however, juniper has invaded many of the more rugged areas.

The major soils are not suited to cultivated crops. Slope, rock outcrops, and shallow rooting depth are the main limitations. Some of the deeper included soils, such as Denton, Krum, and Slidell soils, are used for small grains, sorghum, and pasture.

The soils in this unit can be used for urban and recreational sites. The bedrock provides a good foundation for houses and streets; however, it is difficult to excavate. Disposal of wastes in septic systems is severely limited because of the underlying fractured rock. Steep slopes are subject to erosion. Some areas provide scenic vistas, making them valuable as homesites. The limestone in this unit is suitable for construction material.

2. Nuff-Cho

Deep and shallow to very shallow, gently sloping to sloping, very stony and loamy soils; on uplands

This map unit is made up of Nuff soils on the sides of low ridges and stream divides and Cho soils on ridgetops (fig. 2). These soils formed in interbedded marl, shale limestone, and limy earth.

This unit makes up about 21 percent of the county. It is about 52 percent Nuff soils, 17 percent Cho soils, and 31 percent other soils.

Typically, the surface layer of the Nuff soil is moderately alkaline, dark gray very stony silty clay loam to a depth of 11 inches. The subsoil extends to a depth of 36 inches and is moderately alkaline silty clay loam that is brown in the upper part grading to light olive

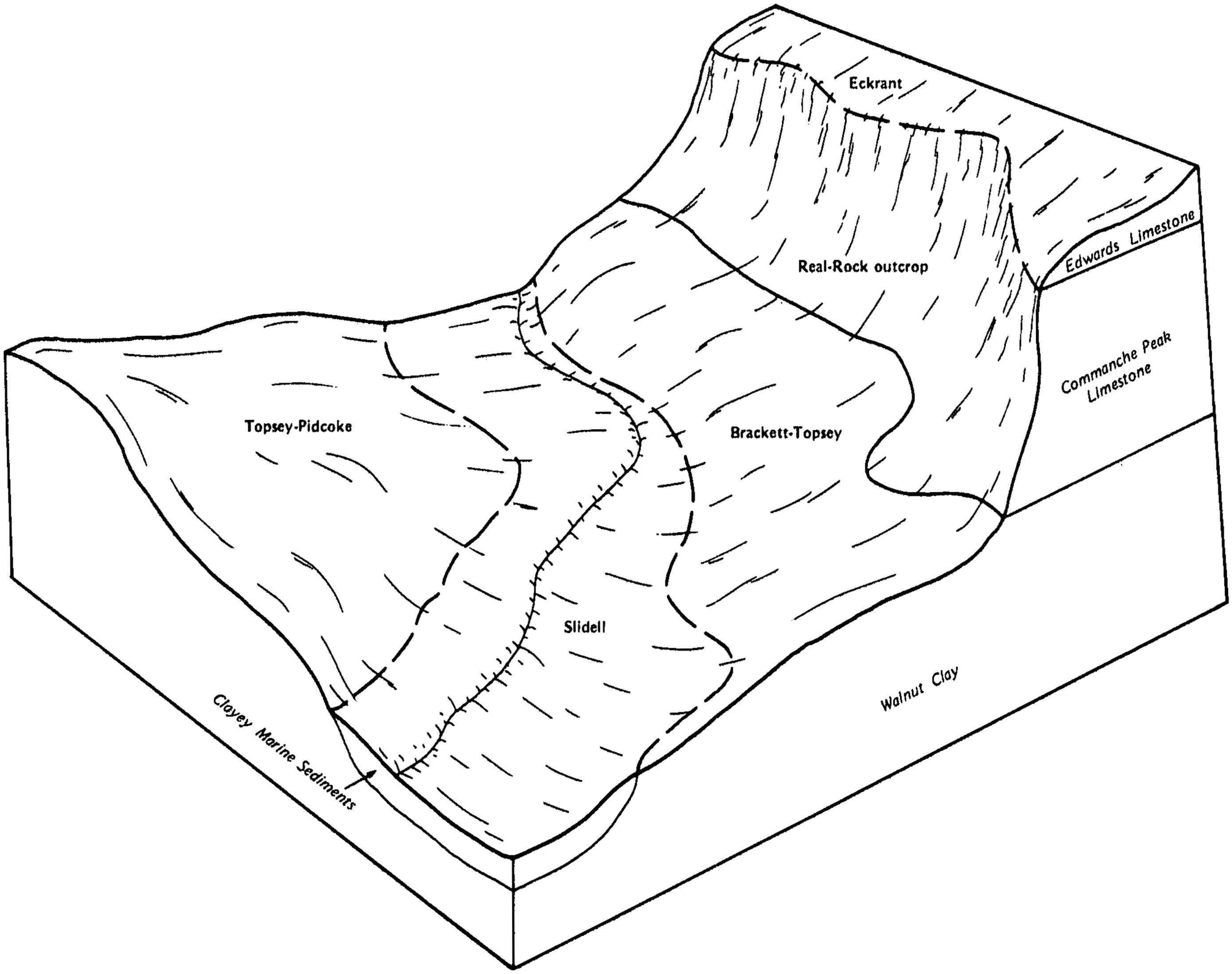


Figure 1.—Typical pattern of soils in the Eckrant-Real-Rock outcrop map unit and the Slidell-Topsey-Brackett map unit.

brown in the lower part. The lower part is about 30 percent stones by volume. Interbedded layers of marly and shaly silty clay loam and silty clay are below a depth of 36 inches.

Typically, the surface layer of the Cho soil is moderately alkaline, dark grayish brown clay loam to a depth of 11 inches. It is about 45 percent, by volume, caliche fragments in the lower 3 inches. Indurated white caliche extends to a depth of 22 inches. Very pale brown limy earth is below a depth of 22 inches.

Of minor extent on uplands are the deep, gently sloping, loamy Cisco, Topsey, and Wise soils and the shallow, gently sloping and sloping Doss and Real soils. The deep, gently sloping Slidell soils are along drainageways.

The soils in this unit are mainly used as rangeland and pasture. They are best suited to these uses. The main limitations are large stones and shallow depth to a cemented pan. The vegetation on the Nuff soil is typically tall grasses in a live oak savannah, whereas that on the Cho soil is a prairie of mid and tall grasses.

The major soils are not suited to cultivated crops or are poorly suited to this use because of large stones or shallow depth. Some of the deeper soils such as Slidell are used for small grains, sorghum, and pasture.

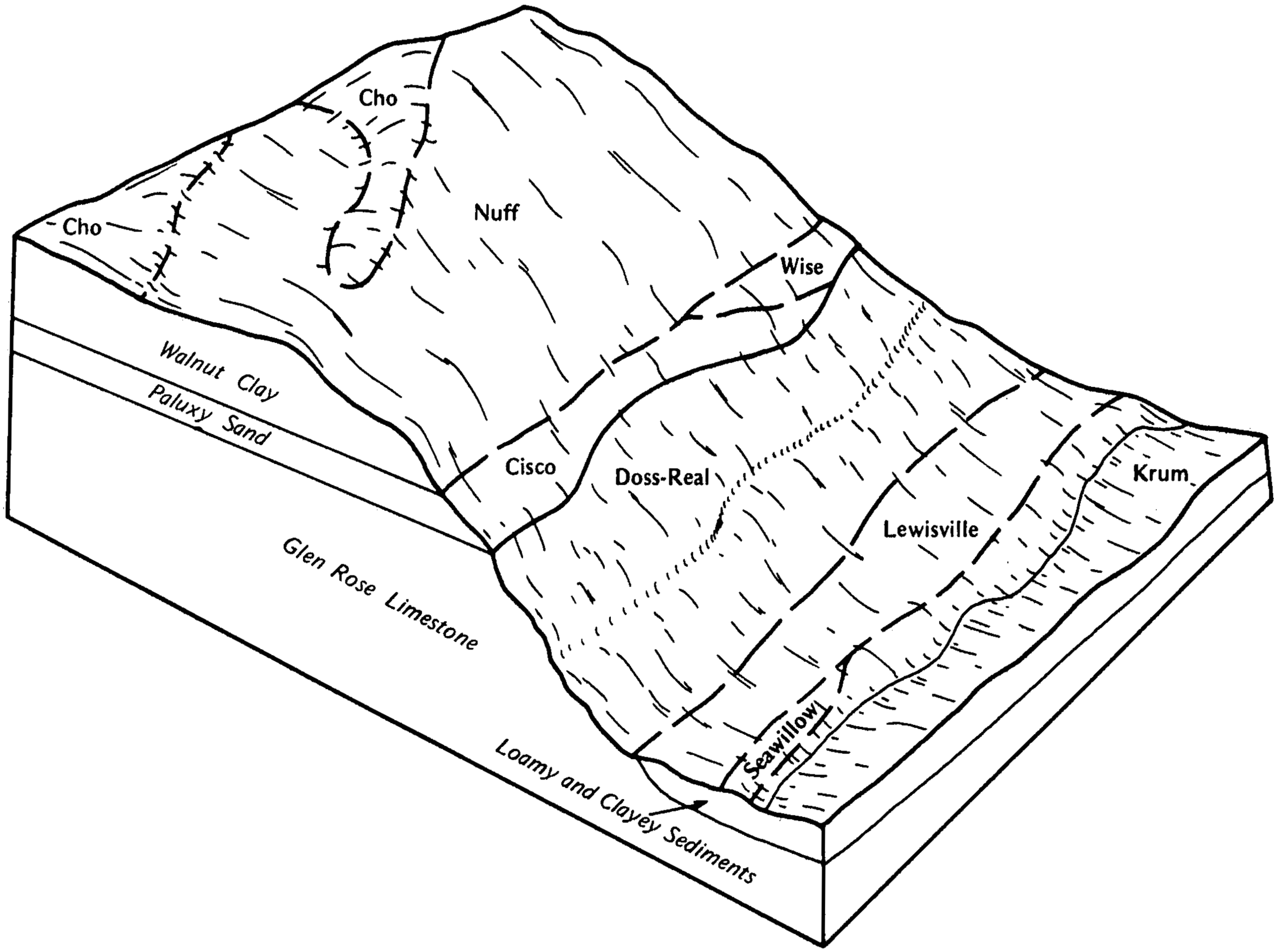


Figure 2.—Typical pattern of soils in the Nuff-Cho map unit and the Doss-Real-Krum map unit.

The soils in this unit can be used for most urban and recreational purposes; however, large stones, low strength, and depth to a cemented pan are limitations. These limitations can partly be overcome by good design and careful installation. The caliche and limy earth of the Cho soils are used for road construction.

3. Slidell-Topsey-Brackett

Deep, gently sloping and undulating, clayey and loamy and gravelly soils; on uplands

This map unit is made up of Slidell soils in gently sloping valley fill areas along drainageways, Topsey soils on broad, undulating uplands, and Brackett soils on undulating uplands (fig. 1). These soils formed in clay and interbedded marl and shale.

This unit makes up about 17 percent of the county. It is about 32 percent Slidell soils, 31 percent Topsey soils, 12 percent Brackett soils, and 25 percent other soils.

Typically, the surface layer of the Slidell soil is dark gray silty clay about 6 inches thick. The subsurface layer to a depth of 18 inches is dark gray silty clay. Gray and grayish brown silty clay extends to a depth of 66 inches. The underlying material to a depth of 80 inches is light gray clay mottled with yellow and brown. The soil is moderately alkaline throughout.

Typically, the surface layer of the Topsey soil is dark grayish brown clay loam about 8 inches thick. Grayish brown clay loam extends to a depth of 14 inches. Light yellowish brown loam and silt loam extends to a depth of 28 inches; the upper 5 inches is about 30 percent fossil shells. Interbedded loamy marl and shale extends to a depth of 67 inches. The soil is moderately alkaline throughout.

Typically, the surface layer of the Brackett soil is pale brown gravelly loam about 6 inches thick. Pale yellow loam extends to a depth of 17 inches. Interbedded loamy marl and shaly clay is below a depth of 17 inches. The soil is moderately alkaline throughout.

Of minor extent on uplands are the deep, gently sloping to sloping Cranfill soils, the shallow, undulating, loamy Pidcoke soils, and the more steeply sloping, shallow Real soils.

The soils in this unit are used as rangeland and pasture. They are best suited to these uses. The vegetation is that of a tall grass prairie. Grain sorghum and small grains are grown on the Slidell soils. Slope, hazard of erosion, and high content of lime are the main limitations on the Topsey and Brackett soils.

The soils in this unit can be used for most urban and recreational purposes. Shrink-swell potential, corrosivity, clayey texture, and depth to limestone are limitations. However, these limitations can be overcome by good design and proper installation. Foundations and streets will crack and buckle if not properly constructed.

4. Doss-Real-Krum

Shallow and deep, gently sloping to sloping, loamy and gravelly and clayey soils; on uplands

The Doss and Real soils in this map unit are in a complex on benched or "stair-stepped" hillsides; the parent rock is interbedded limestone and marl. The Krum soils are on gently sloping stream terraces and filled valleys that contain clayey sediment (fig. 2).

This unit makes up about 12 percent of the county. It is about 34 percent Doss soils, 17 percent Real soils, 12 percent Krum soils, and 37 percent other soils.

Typically, the surface layer of the Doss soil is dark grayish brown clay loam about 8 inches thick. Light yellowish brown clay loam extends to a depth of 18 inches. This layer is underlain by weakly cemented limestone interbedded with loamy marl. The soil is moderately alkaline throughout.

Typically, the surface layer of the Real soil is dark brown gravelly clay loam about 8 inches thick. Dark brown very gravelly clay loam that is about 40 percent by volume limestone fragments extends to a depth of 15 inches. White weakly cemented limestone interbedded with loamy marl is below a depth of 15 inches. The soil is moderately alkaline throughout.

Typically, the surface layer of the Krum soil is dark gray silty clay about 5 inches thick. Dark grayish brown silty clay extends to a depth of 25 inches. Grayish brown silty clay that is about 5 percent by volume calcium carbonate concretions extends to a depth of 57 inches. Brown silty clay extends to a depth of 80 inches. The soil is moderately alkaline throughout.

Of minor extent on uplands are the deep, gently sloping to sloping, loamy Cisco, Topsey, and Wise soils and the deep, gently sloping, sandy Patilo soils. Also of minor extent are the deep, gently sloping, loamy Lewisville and Seawillow soils on terraces.

The soils in this unit are mainly used as rangeland; they are best suited to this use. The limiting factors are low available water capacity and depth to rock. The vegetation is mid and tall grass prairie.

The deep Krum soil and some of the deeper, less extensive soils are used as cropland and pastureland. The main crops are small grains and sorghums. Pecan trees are also grown.

The soils in this unit can be used as sites for most urban and recreation uses. The major limitations are depth to bedrock, small stones on the surface, slope, and corrosivity to uncoated steel.

5. Denton-Bolar

Deep to moderately deep, gently sloping, clayey and loamy and gravelly soils; on uplands

This map unit consists of Denton soil on mid slopes and Bolar soil on low knolls and ridgetops (fig. 3). These soils formed in interbedded limestone and marl.

This unit makes up about 8 percent of the county. It is about 48 percent Denton soils, 31 percent Bolar soils, and 21 percent other soils.

Typically, the surface layer of the Denton soil is dark brown silty clay 13 inches thick. Reddish brown silty clay extends to a depth of 19 inches. Reddish yellow silty clay loam extends to a depth of 36 inches. Strong brown marly soil extends to a depth of 52 inches. Indurated slightly weathered limestone bedrock is below a depth of 70 inches. The soil is moderately alkaline throughout.

Typically, the surface layer of the Bolar soil is dark brown gravelly clay loam to a depth of 9 inches. The subsoil extends to a depth of 38 inches and is yellowish brown gravelly silty clay loam in the upper part and very pale brown gravelly loam and loam in the lower part. Hard limestone interbedded with marly earth is below a depth of 38 inches. The soil is moderately alkaline throughout.

Of minor extent on uplands are the shallow, gently sloping, clayey Eckrant and Oglesby soils and the moderately deep, gently sloping, clayey Crawford soils. The deep, gently sloping, clayey Slidell soils are along drainageways.

The soils in this unit are mainly used as cropland. Low available water capacity on the Bolar soil and the hazard of water erosion are the main limitations. Grain sorghum, small grains, and hay crops are grown, as well as some cotton. Terraces and waterways are an integral part of the gently rolling prairie landscape.

These soils are well suited to rangeland. The vegetation is that of a tall grass prairie.

The soils in this unit are suited to most urban and recreational uses. Shrinking and swelling as a result of changes in moisture, corrosivity to uncoated steel, and

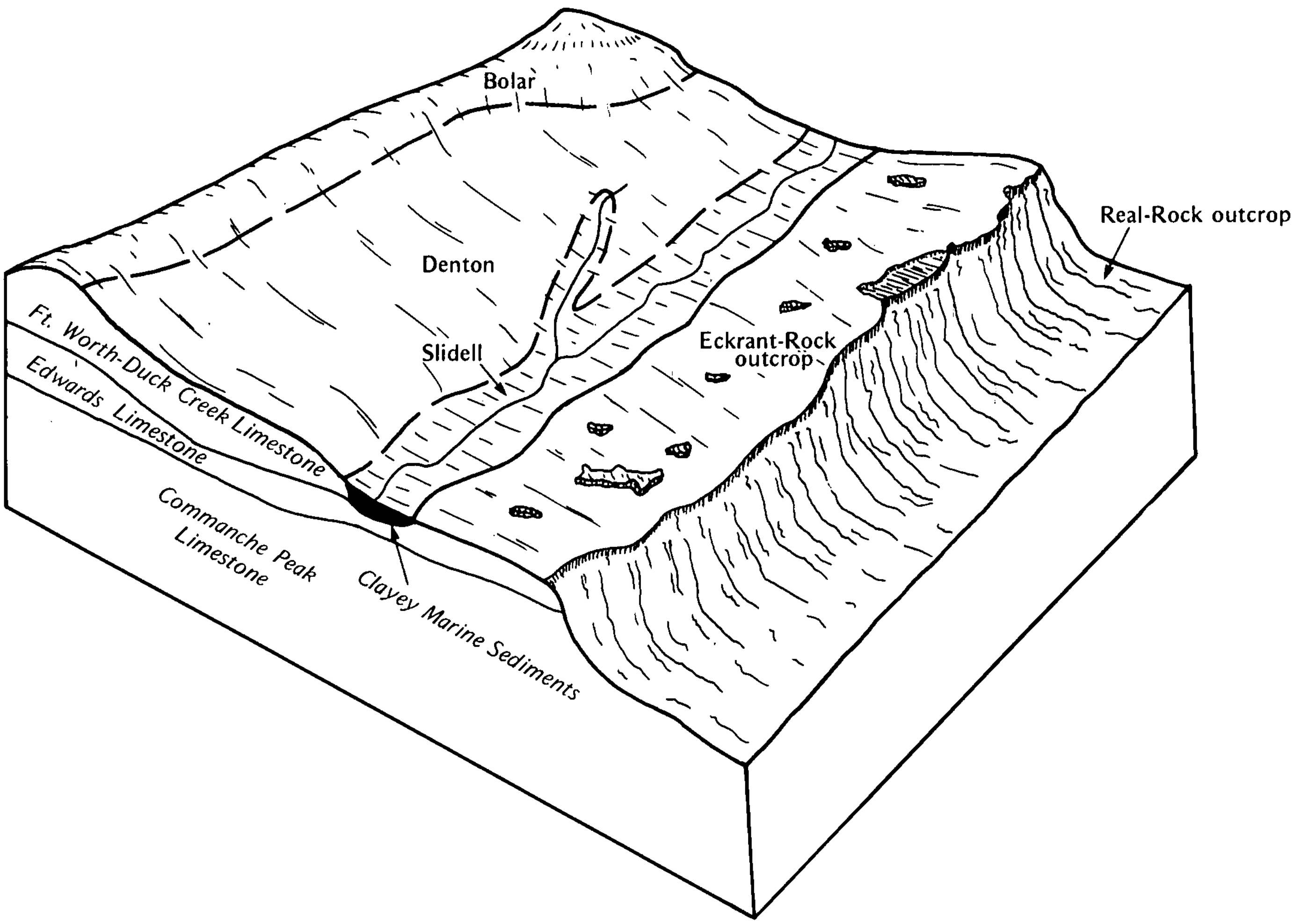


Figure 3.—Typical pattern of soils in the Denton-Bolar map unit and the Eckrant-Real-Rock outcrop map unit.

low strength affecting streets and roads are the main limitations. These limitations can be partially overcome by proper design and installation.

6. Bosque-Frio-Lewisville

Deep, nearly level to gently sloping, loamy and clayey soils; on bottomlands and terraces

This map unit consists of Bosque and Frio soils on flood plains of major streams and Lewisville soils on the terraces of these streams (fig. 4). The Bosque and Frio soils formed in recent alluvium, and the Lewisville soils formed in older alluvium. All of the alluvium is of limestone origin.

This unit makes up about 7 percent of the county. It is about 50 percent Bosque soils, 23 percent Frio soils, 11 percent Lewisville soils, and 16 percent other soils.

Typically, the surface layer of the Bosque soil extends to a depth of 23 inches and is dark grayish brown clay loam in the upper part and dark brown clay loam in the lower part. Dark grayish brown clay loam extends to a depth of 54 inches. From 54 to 96 inches is brown clay loam. The soil is moderately alkaline throughout.

Typically, the surface layer of the Frio soil is dark grayish brown silty clay about 8 inches thick. Dark grayish brown clay loam extends to a depth of 22 inches. Dark grayish brown silty clay loam extends to a depth of 40 inches. Grayish brown silty clay extends to a depth of 80 inches. The soil is moderately alkaline throughout.

Typically, the surface layer of the Lewisville soil is very dark grayish brown clay loam about 12 inches thick. The subsoil extends to a depth of 54 inches and is brown

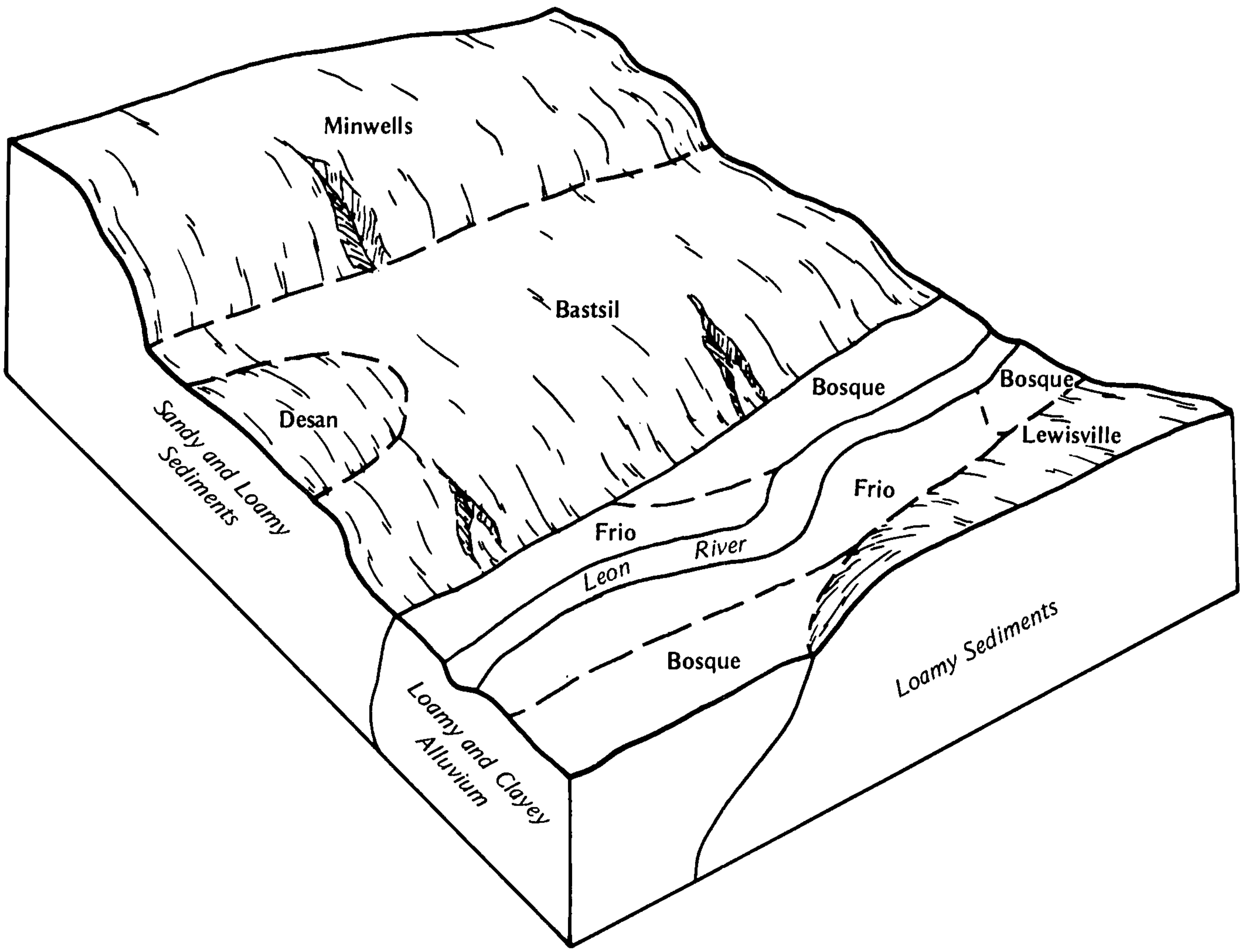


Figure 4.—Typical pattern of soils in the Bosque-Frio-Lewisville map unit and the Bastsil-Minwells map unit.

clay loam. Reddish yellow clay loam extends to a depth of 77 inches. The soil is moderately alkaline throughout.

The less extensive soils on stream terraces are the deep, gently sloping, loamy Bastsil and sandy Desan soils that formed in noncalcareous sediment washed from distant sandstones outside the county. The deep, gently sloping loamy Seawillow soils are along gentle slope breaks. The deep, gently sloping, clayey Krum soils are along drainageways. The shallow, moderately steep to steep, loamy Real soils are on uplands along the outer edges of the flood plains and terraces.

The soils in this unit are mainly used as cropland and pasture. They are well suited to these uses. The main crops are small grains, grain sorghum, and improved bermudagrass. Pecan orchards are also common. The hazard of flooding is the main limitation to use as cropland.

These soils are well suited to use as rangeland. The vegetation is mid and tall grasses with a tree canopy of pecan, elm, hackberry, oaks, and cottonwood.

The soils in this unit are poorly suited to most urban uses. Flooding is the main limitation and is very difficult to overcome. The soils in this unit are suited to most recreational uses; however, the hazard of flooding should be considered when planning camping areas.

7. Crawford-Purves-Slidell

Shallow to deep, gently sloping, clayey and gravelly soils; on uplands

This map unit is made up of moderately deep Crawford soils on broad, smooth areas underlain by hard limestone, shallow Purves soils on low ridges and side slopes underlain by hard limestone, and deep Slidell soils that formed in clay along small drainageways.

This unit makes up about 4 percent of the county. It is about 33 percent Crawford soils, 17 percent Purves soils, 16 percent Slidell soils, and 34 percent other soils.

Typically, the surface layer of the Crawford soil is dark brown silty clay about 21 inches thick. The subsoil extends to a depth of 28 inches and is dark reddish brown silty clay. Indurated, fractured limestone that has dark reddish brown clay in the crevices is below a depth of 28 inches. The soil is neutral.

Typically, the surface layer of the Purves soil is dark brown gravelly silty clay to a depth of 6 inches. Dark brown very gravelly silty clay extends to a depth of 14 inches. Fractured limestone bedrock is below a depth of 14 inches. The soil is moderately alkaline throughout.

Typically, the surface layer of the Slidell soil is dark gray silty clay about 3 inches thick. The subsurface layer extends to a depth of 18 inches and is dark gray silty clay. Gray and grayish brown silty clay extends to a depth of 66 inches. The underlying material to a depth of 80 inches is light gray clay mottled with yellow and brown. The soil is moderately alkaline throughout.

Of minor extent on uplands are shallow, clayey Eckrant and Oglesby soils, deep, clayey Denton soils, deep, loamy Topsey soils, and moderately deep, loamy Bolar soils.

The soils in this unit are mainly used as cropland. The main crops are small grains, sorghum, and pasture grasses. The Purves soils are poorly suited to use as cropland because of depth to rock, surface stones, and low available water capacity.

These soils are well suited to use as rangeland. The vegetation is that of a mid and tall grass prairie.

The soils in this unit can be used for most urban and recreational uses. However, shrinking and swelling as a result of changes in moisture, depth to rock, permeability, corrosivity to uncoated steel, and the clayey texture are limitations. Buildings and streets buckle and crack if not properly constructed. The very slow permeability and depth to rock are problems in septic systems. The soils are sticky and muddy when wet, causing difficulties for pedestrians and vehicles.

8. Bastsil-Minwells

Deep, gently sloping, loamy soils; on terraces

This map unit is made up of Bastsil soils that are loamy throughout and Minwells soils that have a clayey and gravelly subsoil. These soils formed in sediment carried from distant sources outside the county. They are along the Leon River (fig. 4).

This unit makes up about 2 percent of the county. It is about 27 percent Bastsil soils, 26 percent Minwells soils, and 47 percent other soils.

Typically, the surface layer of the Bastsil soil is brown fine sandy loam about 8 inches thick. Light brown fine sandy loam extends to a depth of 15 inches. The subsoil extends to a depth of 62 inches and is red clay loam grading to sandy clay loam in the lower part. Yellowish red sandy clay loam extends to a depth of 80 inches. The soil is slightly acid throughout.

Typically, the surface layer of the Minwells soil is dark brown, fine sandy loam about 6 inches thick. The subsoil extends to a depth of 18 inches and is reddish brown sandy clay loam that is about 10 percent siliceous pebbles. Red gravelly sandy clay that is about 30 percent siliceous pebbles extends to a depth of 52 inches. Red clay that is about 5 percent masses and concretions of calcium carbonate extends to a depth of 63 inches. The underlying material is reddish yellow gravelly sandy clay loam that is about 30 percent siliceous pebbles and 10 percent masses and concretions of calcium carbonate. The soil is neutral above a depth of 52 inches and moderately alkaline below.

Of minor extent on terraces are deep, gently sloping, sandy Desan soils and deep, gently sloping, loamy Lewisville soils. The deep, nearly level, clayey Frio soils and loamy Bosque soils are along streams. The shallow, gently sloping to sloping, clayey Eckrant soils and loamy Doss soils are on uplands.

The soils in this unit are mainly used as pasture. Adapted grasses are improved bermudagrass and kleingrass. The soils are also suited to use as cropland. Small grains and grain sorghum are grown. There are a few pecan orchards.

These soils are suited to use as rangeland. The vegetation is typically tall grasses in a post oak savannah.

The soils in this unit are suited to most urban and recreational uses. The main limiting factors are corrosivity to uncoated steel, moderate shrinking and swelling as a result of changes in moisture, and low strength. Careful design and installation of structures can overcome these limitations.

In places, the material beneath these soils is mined for siliceous gravel and sand.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Eckrant cobbly silty clay, 1 to 3 percent slopes, is one of several phases in the Eckrant series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Doss-Real complex, 1 to 8 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Topsey-Pidcoke association, 2 to 8 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

BaB—Bastsil fine sandy loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on terraces of the Leon River. Most areas are horseshoe shaped and are bordered by limestone bluffs. The areas range from 50 to 350 acres.

Typically, the surface layer is brown fine sandy loam about 8 inches thick. Light brown fine sandy loam extends to a depth of 15 inches. Red clay loam grading to sandy clay loam in the lower part extends to a depth of 62 inches. Yellowish red sandy clay loam extends to a depth of 80 inches. Reaction is slightly acid throughout.

This soil is well drained. Permeability is moderate, and available water capacity is medium. Runoff is medium, and the hazard of erosion is slight. This soil is easily worked within a wide range of moisture conditions. The deep root zone is easily penetrated by plant roots. Some areas are strip mined for sand and gravel in layers below a depth of 80 inches.

Included with this soil in mapping are small areas of Minwells and Desan soils. Minwells soils are in higher positions and have a more clayey subsoil. Desan soils are in similar positions and have a thick sandy surface layer. Also included are a few areas of Bastsil soil that have slopes of more than 3 percent.

This Bastsil soil is mainly used as pasture and is well suited to this use. Adapted pasture grasses are improved bermudagrass and kleingrass. Proper management includes weed control, fertilizing with nitrogen and phosphorus, and controlling grazing.

This soil is well suited to use as cropland. Small grains and grain sorghum are grown. In a few areas this soil is used for pecan orchards. A cropping system that controls erosion and maintains soil tilth is needed.

This soil is moderately suited to most urban uses. The most restrictive limitations are shrinking and swelling as a result of changes in moisture and corrosivity to uncoated steel. These limitations can be easily overcome by good design and proper installation. This soil is well suited to most recreational uses.

Areas that have not been cleared provide excellent food and cover for deer, quail, turkey, and doves.

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

BgB—Bolar gravelly clay loam, 1 to 4 percent slopes. This is a moderately deep, gently sloping loamy soil on convex knolls and ridgetops. Areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is mildly alkaline, dark brown gravelly clay loam to a depth of 9 inches. The subsoil extends to a depth of 38 inches and is moderately alkaline, yellowish brown gravelly clay loam in the upper part and very pale brown gravelly loam and loam in the lower part. Hard limestone interbedded with marly earth of loamy texture extends to a depth of 53 inches.

This soil is well drained. Permeability is moderate, and available water capacity is low. Surface runoff is medium, resulting in a moderate hazard of water erosion. The root zone is moderately deep and is easily penetrated by plant roots.

This map unit is 60 to 70 percent Bolar soil. The remainder of this unit consists of areas of Denton soils downslope from the Bolar soil and areas of soils that have less gravel in the surface layer.

The Bolar soil is mainly used for cultivated crops. It is moderately suited to use as cropland. Grain sorghum, wheat, and oats are the main crops. The major limitations are the low available water capacity, which limits production, and slope. In some places surface rocks can be a limitation for farm equipment. The main objectives of management are controlling erosion, improving soil tilth and fertility, and conserving soil moisture. Terraces, farming on the contour, and grassed waterways help reduce erosion. Growing crops that produce large amounts of residue and leaving the residue on the soil helps improve tilth, control erosion, and conserve soil moisture. Growing deep-rooted legumes helps improve tilth and fertility.

This Bolar soil is moderately suited to use as pasture. Coastal bermudagrass and kleingrass are the main pasture grasses. Low available water capacity is the main limitation. Management objectives include fertilization, weed control, proper stocking rates, and controlled grazing.

This soil is moderately suited to most urban uses. Shrinking and swelling of the soil as a result of moisture changes, depth to rock, corrosivity to uncoated steel, and low strength are the main limitations. These limitations can be overcome by good design and careful installation. This soil is moderately suited to most recreational uses. Surface stones are the major restriction.

Areas of this map unit provide good habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, and cottontail rabbits.

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

Bo—Bosque clay loam, rarely flooded. This is a deep, nearly level soil on flood plains along major streams. Most areas are subject to flooding only under unusual weather conditions. Areas are long and narrow and include most of the flood plain along Cowhouse Creek and its tributaries.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam to a depth of 25 inches. The subsoil extends to a depth of 54 inches and is moderately alkaline, grayish brown clay loam in the upper part and brown clay loam in the lower part. Moderately alkaline, dark grayish brown clay extends to a depth of 80 inches.

This soil is well drained. Permeability is moderate, and available water capacity is high. Runoff is slow. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are areas of occasionally flooded soils, in depressions and adjacent to the stream channel.

This Bosque soil is mainly used as cropland and pasture and is well suited to these uses. Small grains, grain sorghum, and pecan trees are commonly grown (fig. 5). Management objectives include improving tilth and fertility and conserving soil moisture. Leaving crop residue on the surface helps achieve these objectives. Coastal bermudagrass and kleingrass are the common pasture grasses. Pasture management includes fertilization, weed control, and controlled grazing.

Areas of this map unit furnish good habitat for bobwhite quail, mourning doves, meadowlark, numerous songbirds, cottontail rabbits, squirrels, white-tailed deer, and turkeys.

This soil is poorly suited to most urban uses. The main limitation is the hazard of flooding, which is very difficult to overcome.

Figure 5.—Pecan orchard on Bosque clay loam, rarely flooded.

This Bosque soil is well suited to most recreational uses. Flooding is the major restriction, especially for camping.

This soil is in capability class I and in Loamy Bottomland range site.

Bs—Bosque clay loam, occasionally flooded. This is a deep, nearly level soil on flood plains along major streams. This soil formed in loamy calcareous alluvium. Most areas are subject to flooding about once every 2 to 10 years. Areas are narrow and generally continuous. These areas range from 20 acres to several thousand acres.

Typically, to a depth of 23 inches the soil is moderately alkaline, dark grayish brown clay loam in the upper part and dark brown clay loam in the lower part. To a depth of 54 inches it is moderately alkaline, dark grayish brown clay loam. Moderately alkaline, brown clay loam extends to a depth of 80 inches.

This soil is well drained. Permeability is moderate, and available water capacity is high. Runoff is slow. The root zone is deep and easily penetrated by plant roots.

This map unit consists of 75 to 95 percent Bosque soil. The remainder of the unit includes areas of Frio soils and soils similar to Bosque except for not having a dark surface layer. All inclusions are in similar landscape positions.

This Bosque soil is mainly used as cropland and pasture, and it is well suited to these uses. Small grains, grain sorghum, and pecan trees are commonly grown.

Management objectives include tilth and fertility and conserving soil moisture. Leaving crop residue on the surface helps achieve these objectives. Coastal bermudagrass and kleingrass are the common grasses. Pasture management includes fertilization, weed control, and controlled grazing.

Areas of this map unit furnish good habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, cottontail rabbits, squirrels, white-tailed deer, and turkeys.

This soil is poorly suited to most urban uses. The main limitation is the hazard of flooding, which is very difficult to overcome. This Bosque soil is moderately suited to most recreational uses. Flooding is the major restriction, especially for camping.

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

BtC2—Brackett-Topsey association, 3 to 8 percent slopes, eroded. This association consists of deep, loamy soils on undulating uplands. Erosion has removed much of the surface layer and has left rills and gullies 1 foot to 4 feet deep and 1 foot to 5 feet wide in most areas. The rills and gullies are at intervals of 100 to 500 feet.

Brackett soils make up 40 to 60 percent of the association, Topsey soils make up 30 to 45 percent, and other soils make up 10 to 20 percent. The Brackett soils are on the summits of knolls and low hills. The Topsey soils are lower on the landscape, on side slopes, in concave positions. These soils were mapped as a single unit because their expected long-term use as rangeland did not justify mapping the areas separately.

Typically, the surface layer of the Brackett soils is pale brown gravelly loam about 6 inches thick. Pale yellow loam extends to a depth of 17 inches. Interbedded loamy marl and shaly clay is below a depth of 17 inches. Reaction is moderately alkaline throughout.

The Brackett soil is well drained. Permeability is moderately slow, and available water capacity is medium. Runoff is medium, and the hazard of erosion is moderate. The root zone is deep and is easily penetrated by plant roots.

Typically, the surface layer of the Topsey soils is dark grayish brown clay loam about 8 inches thick. Grayish brown clay loam extends to a depth of 14 inches. Light yellowish brown gravelly loam extends to a depth of 19 inches and light yellowish brown silt loam to a depth of 28 inches. Interbedded loamy marl and shale extends to a depth of 67 inches. Reaction is moderately alkaline throughout.

The Topsey soil is well drained. Permeability is moderately slow, and available water capacity is medium. Runoff is medium, and the hazard of erosion is severe. The root zone is deep and is easily penetrated by plant roots.

Included with this association in mapping are small areas of Krum and Slidell soils along drains, Cho soils on lower slopes than the Topsey soils, and Pidcoke soils on higher slopes than the Brackett soils.

These soils are used mainly as rangeland. These soils are poorly suited to use as cropland. Slope, the severe hazard of erosion, and the high content of lime in the subsoil are the main limitations. Management objectives are controlling erosion, improving soil tilth, and conserving soil moisture. Growing closely spaced crops that produce large amounts of residue and leaving the residue on the soil helps slow runoff, improve tilth, and conserve soil moisture.

These soils are moderately suited to pasture. Adapted pasture species include improved bermudagrass, kleingrass, indiangrass, switchgrass, and improved bluestem. Proper management includes weed control, fertilization, and controlled grazing.

These soils are moderately suited to most urban uses. Shrinking and swelling as a result of changes in moisture and corrosivity to uncoated steel are the main limitations. The limitations can be overcome by good design and careful installation. This association is well suited to recreational uses.

Areas of this map unit provide habitat for mourning dove, meadowlarks, numerous songbirds, quail, and rabbits.

These soils are in capability subclass IVe. The Brackett soil is in Adobe range site, and the Topsey soil is in Clay Loam range site.

ChB—Cho clay loam, 1 to 3 percent slopes. This is a very shallow and shallow, gently sloping soil on convex ridgetops. Areas are irregular in shape and range from 10 to 450 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam to a depth of 11 inches. It is about 45 percent, by volume, caliche fragments in the lower 3 inches. Indurated white caliche extends to a depth of 22 inches. Very pale brown limy earth is below a depth of 22 inches.

The Cho soil is well drained. Permeability is moderate in the upper 11 inches; however, it is slow in the caliche layer. Available water capacity is low. Runoff is medium, and the hazard of erosion is moderate. The root zone is restricted; however, plant roots can penetrate fractures in the cemented pan.

This map unit is 60 to 80 percent Cho soils. The remainder of the map unit consists of areas of similar soils that are more shallow than the Cho soil and similar soils that have a gravelly surface layer.

The Cho soil is mainly used as rangeland; in a few small areas it is in improved pasture and cropland. It is poorly suited to these uses because of low water holding capacity and shallow depth to a cemented pan.

This soil is poorly suited to use as wildlife habitat because of inadequate cover, food, and water.

Figure 6.—These gullies in an area of Cisco fine sandy loam, 1 to 5 percent slopes, eroded, formed when the soil was used as cropland and still persist, even though the soil is now used as rangeland.

It is moderately suited to most urban uses; however, the shallow depth to a cemented pan poses severe limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills. These limitations can only be overcome by good design and careful installation.

This Cho soil is poorly suited to recreational uses. Small stones and shallow depth to a cemented pan are the major limitations.

This soil is in capability subclass IVs and Very Shallow range site.

CoB2—Cisco fine sandy loam, 1 to 5 percent slopes, eroded. This is a deep, gently sloping soil on convex slopes on uplands. The areas are irregular in shape and from 10 to 80 acres. Water erosion has removed part of the surface layer in about 20 to 40 percent of most mapped areas. Gullies that are about 2 to 6 feet deep, 4 to 20 feet wide, and 100 to 500 feet apart make up 25 to 30 percent of most mapped areas (fig. 6).

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil, to a depth of 41 inches, is reddish brown and red clay loam. Yellowish red fine sandy loam that has films and threads of calcium carbonate extends to a depth of 68 inches. The underlying material to a depth of 80 inches is white pack sand.

This soil is well drained. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Organic matter content and natural fertility are moderately low. The hazard of water erosion is severe.

The Cisco soils are mainly in abandoned, eroded cropland areas that are currently used as rangeland and for wildlife habitat.

This soil is poorly suited to use as cropland and moderately suited to use as pasture. The main limitations are slope and the hazard of erosion. Terraces, contour farming, and grassed waterways are needed to help control erosion.

This soil is moderately suited to most urban uses. The main limitations are slope and shrinking and swelling of the soil as a result of moisture changes.

This soil is well suited to most recreational uses.

This soil provides good habitat for deer, quail, turkeys, and various varmints.

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

CrD—Cranfill gravelly clay loam, 3 to 8 percent slopes. This is a deep, gently sloping to sloping soil on convex foot slopes. Areas are irregular in shape and range from 20 to about 300 acres. Slopes average about 6 percent.

Typically, the surface layer is moderately alkaline, grayish brown gravelly clay loam about 11 inches thick. The subsoil, from a depth of 11 to 57 inches, is moderately alkaline gravelly clay loam that is very pale brown in the upper part and light yellowish brown in the lower part. Moderately alkaline, very pale brown gravelly clay loam extends to a depth of 74 inches.

This soil is well drained. Permeability is moderate, and available water capacity is medium. Runoff is medium, and the hazard of erosion is moderate. The root zone is easily penetrated by plant roots.

Included with this soil in mapping are small areas of Real and Topsey soils. Real soils are on upper slopes. Topsey soils are on lower slopes. These included soils make up less than 25 percent of any mapped area.

This soil is moderately suited to use as pasture. Kleingrass and coastal bermudagrass are the main pasture grasses. Proper pasture management includes controlled grazing, fertilization, and weed control.

The Cranfill soil is poorly suited to use as cropland. Low natural fertility, runoff, and slope limit production. Terracing and farming on the contour help slow runoff and allow more water to enter the soil. Growing closely spaced crops such as small grains and leaving crop residue on the surface help control erosion and improve soil tilth.

This soil is moderately suited to most urban uses. Shrinking and swelling as a result of changes in moisture, slope, low strength, and corrosivity to uncoated steel are the main limitations. These limitations can be overcome by using good design and careful installation.

The Cranfill soil is moderately suited to most recreational uses. Slope and the gravelly clay loam surface layer, which is sticky when wet, are the main limitations. A good grass cover or use of loamy fill material can help overcome the limitation of the sticky surface during wet periods.

Areas of this map unit are inhabited by deer, turkeys, doves, and quail. Grain crops and a wide variety of native plants provide cover, browse, mast, and seed.

This soil is in capability subclass IVe and Adobe range site.

CwB—Crawford silty clay, 1 to 3 percent slopes. This is a moderately deep, gently sloping, clayey soil on broad, smooth uplands. Areas are irregular in shape and range from 35 to about 300 acres.

Typically, the surface layer is neutral, dark brown silty clay about 21 inches thick. The subsoil, from a depth of 21 to 28 inches, is neutral, dark reddish brown silty clay. Indurated, fractured limestone that has dark reddish brown clay in the crevices is below a depth of 28 inches.

This soil is well drained. Permeability is very slow when the soil is saturated and rapid when it is dry and cracked. Available water capacity is low, and runoff is slow. The soil is difficult to work during extremes in moisture conditions. The root zone is moderately deep; however, plant roots penetrate slowly. The hazard of erosion is moderate.

This map unit is about 65 to 80 percent Crawford soils. The remainder of this unit consists of areas of Purves soils in slightly higher positions and Slidell soils in drains and depressions downslope.

This Crawford soil is used mainly as cropland. It is well suited to use as cropland. The main crops are cotton, grain sorghum, and small grains. The low available water capacity reduces the yield of summer crops. The management objectives are controlling erosion and maintaining soil tilth. Farming on the contour, growing closely spaced crops, and leaving the crop residue on the soil help control erosion, maintain soil tilth, and allow more water to enter the soil. Growing deep-rooted legumes helps aerate the soil and improve fertility.

This soil is well suited to use as pasture. Adapted pasture plants are improved bermudagrass and kleingrass. Fertilization, weed control, and controlled grazing are management objectives.

The Crawford soil is poorly suited to most urban uses. Shrinking and swelling as a result of changes in moisture, depth to rock, permeability, corrosivity to uncoated steel, and the clayey texture are the main limitations. Good design and careful installation can help to overcome these limitations.

This soil is moderately suited to most recreational uses. Permeability and the clayey surface layer, which is sticky when wet, are the main limitations. Maintaining a good grass cover or use of a loamy fill material can help overcome these limitations.

Areas of this map unit are regularly inhabited by doves and quail in the fall because of the abundant food provided by the grain crops.

This soil is in capability subclass IIIe and Deep Redland range site.

DeB—Denton silty clay, 1 to 3 percent slopes. This is a deep, gently sloping, clayey soil on uplands. This soil is on midslopes between drainageways and ridgetops or summits. Areas range from 20 to about 200 acres.

Typically, the surface layer is moderately alkaline, dark brown silty clay to a depth of 13 inches. The layer below that, between 13 and 19 inches, is moderately alkaline, reddish brown silty clay. The layer below that, between 19 and 36 inches, is moderately alkaline, reddish yellow silty clay loam. Moderately alkaline, strong brown marly earth extends to a depth of 52 inches. The underlying material to a depth of 70 inches is indurated slightly weathered limestone bedrock.

This soil is well drained. Permeability is slow, and available water capacity is medium. Surface runoff is medium, and the hazard of erosion is moderate. Deep cracks extend to the surface when the soil is dry. The soil is difficult to work during extremes in moisture conditions. The high content of calcium carbonate causes chlorosis in some plants. The root zone is deep; however, plant roots penetrate slowly.

This map unit contains about 60 to 85 percent Denton soils. The remainder of this unit contains areas of Bolar soils upslope, Slidell soils in drains and depressions downslope, and a soil that is similar to the Denton soil but is less than 20 inches deep to rock.

The Denton soil is mainly used as cropland, and it is well suited to this use. Cotton, grain sorghum, small grains, and hay crops are grown. The management objectives are controlling erosion and maintaining soil tilth. Growing closely spaced crops or crops that produce large amounts of residue, terracing, and farming on the contour help to control erosion and maintain soil tilth.

This soil is well suited to use as pastureland. Kleingrass and improved bermudagrass are commonly grown. Proper management includes fertilization, weed control, and controlled grazing.

The Denton soil is moderately suited to most urban and recreational uses. Shrinking and swelling as a result of changes in moisture, corrosivity to uncoated steel, and low strength affecting streets and roads are the main limitations for urban uses. The silty clay surface that cracks when dry and is sticky when wet is the main limitation for recreational uses. Good design and careful installation can partially overcome these limitations.

Areas of this map unit are preferred by quail and doves during the fall months because of the abundant food and cover provided by the grain crops.

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

DnB—Desan fine sand, 1 to 3 percent slopes. This is a deep, gently sloping, sandy soil on terraces of the Leon River. The areas are oval and range from 20 to 175 acres.

Typically, the surface layer is medium acid, brown fine sand about 8 inches deep. Reddish yellow fine sand extends to a depth of 77 inches. Reddish yellow fine sandy loam extends to a depth of 90 inches.

The Desan soil is somewhat excessively drained. There is no runoff because of the thick sand. Permeability is rapid above a depth of 77 inches but is moderate below that depth. Available water capacity is low. Soil blowing is a severe hazard if the soil is bare of vegetation. The root zone is deep and is easily penetrated by plant roots.

Included with this soil in mapping are small areas of Bastsil soil and soils similar to Desan that have less than 40 inches of fine sand. These included soils make up less than 20 percent of any one mapped area.

This Desan soil is mainly used as pasture. It is moderately suited to this use. The major limitations are low available water capacity and the thick sand. Grass seedlings are difficult to establish because of blowing sand and the difficulty of obtaining a firm seedbed. Fertilizer should be added for sustained forage production. Applications should be at planned intervals throughout the growing season. Erosion control, weed control, and controlled grazing are the major management objectives.

This map unit is moderately suited to use as cropland. The low available water capacity and thick sand are the main limitations. Leaving crop residue on the surface helps to maintain the content of organic matter and control soil blowing.

This map unit is well suited to building site development. The main limitations are the thick sand, seepage, and corrosivity to steel and concrete.

This Desan soil is poorly suited to most recreational uses. The deep, loose sand that tends to blow when the soil is bare of vegetation and does not provide support for walking or driving is the main limitation.

Areas of this map unit are used by deer, rabbits, turkeys, doves, quail, and songbirds.

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

DrC—Doss-Real complex, 1 to 8 percent slopes. The soils in this complex are shallow, loamy, and gently sloping to sloping. These soils are on side slopes that have a benched appearance because of horizontal limestone strata that outcrop every 5 to 10 feet. Limestone pebbles and cobbles on the surface range from a few to common. The areas are irregular in shape and range from 100 to 1,000 acres.

Typically, the surface layer of the Doss soil is moderately alkaline, dark grayish brown clay loam about 8 inches thick. Moderately alkaline, light yellowish brown

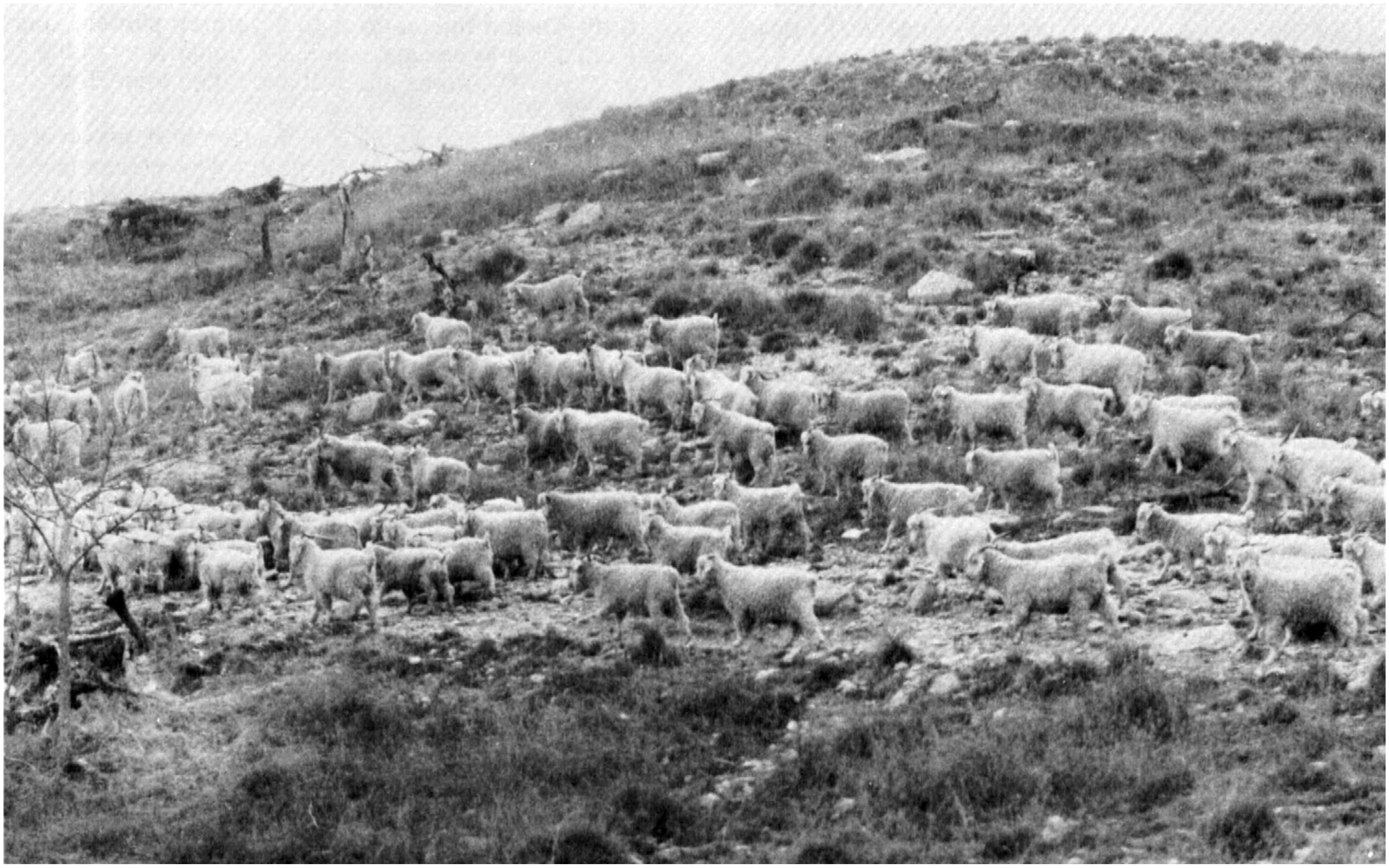


Figure 7.—Angora goats grazing in an area of Doss-Real complex, 1 to 8 percent slopes.

clay loam extends to a depth of 18 inches. Weakly cemented limestone interbedded with loamy marl is below a depth of 18 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is very low. Runoff is medium to rapid, and the hazard of erosion is moderate. The root zone is shallow. The high concentration of calcium carbonate causes chlorosis in sensitive plants.

Typically, the surface layer of the Real soil is moderately alkaline, dark brown gravelly clay loam about 8 inches thick. Moderately alkaline, dark brown very gravelly clay loam that is about 40 percent by volume limestone fragments extends to a depth of 15 inches. White weakly cemented limestone interbedded with loamy marl is below a depth of 15 inches.

This soil is well drained. Permeability is moderate, and available water capacity is very low. Runoff is medium to rapid, and the hazard of erosion is moderate. The root zone is shallow.

This map unit is 45 to 65 percent Doss soils and 20 to 40 percent Real soils. The remainder consists of areas of Cisco and Wise soils upslope from this complex and Krum and Lewisville soils in drains and depressions downslope. Also included are small areas of soils that are deeper than 20 inches, soils that have a light colored surface, rock outcrops, and soils that are underlain by hard limestone.

These soils are used mostly as rangeland (fig. 7). They are poorly suited to use as cropland and pasture because of slope, low available water capacity, and depth to rock.

The soils in this complex are poorly suited to most urban and recreational uses. The major limitations are depth to bedrock, small stones on the surface, slope, and corrosivity to uncoated steel.

Areas of this map unit are regularly inhabited by quail, doves, deer, raccoons, and turkeys. Cover for protection is excellent.

This complex is in capability subclass VIs. The Doss soil is in the Shallow range site, and the Real soil is in the Adobe range site.

EcB—Eckrant cobbly silty clay, 1 to 3 percent slopes. This is a shallow and very shallow, gently sloping clayey soil on broad plane areas and convex ridgetops. The areas are irregular in shape and range from 100 to 1,200 acres.

Typically, the surface layer is very dark grayish brown cobbly silty clay that is about 30 percent by volume cobbles and pebbles to a depth of about 5 inches. From 5 to 15 inches is very dark grayish brown very cobbly silty clay that is 50 percent cobbles and pebbles. Indurated limestone is below a depth of 15 inches.

This soil is well drained. Permeability is moderately slow, and surface runoff is rapid. Available water capacity is very low. The root zone is shallow; the limestone severely limits root growth.

This map unit is 70 to 80 percent Eckrant soils. The remainder of the map unit is made up of Bolar soils upslope and Oglesby soils in similar positions as the Eckrant soil. Also included are soils deeper than 40 inches to bedrock, and soils that have stones on the surface.

This Eckrant soil is mainly used as rangeland. The main limitations are depth to rock, limestone fragments on the surface, and very low available water capacity.

This soil is not suited to use as cropland. The main limitations are depth to rock, limestone on the surface and in the soil, and very low available water capacity.

This soil is poorly suited to most urban and recreational uses. Depth to rock, shrinking and swelling of the soil as a result of moisture changes, and limestone cobbles on the surface and in the soil are the main limitations.

Areas of this map unit provide habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, cottontail rabbits, squirrels, and white-tailed deer.

Limestone is mined in some areas of this map unit.

This soil is in capability subclass VIIs and Low Stony Hill range site.

ErB—Eckrant-Rock outcrop complex, 1 to 3 percent slopes. The soils in this complex are shallow and very shallow and gently sloping. They are on plane areas and convex ridgetops underlain by hard limestone. Areas of Rock outcrop are typically long and narrow. They are 2 to 15 feet across and 4 to 50 feet long, and are as much as 6 inches higher than the associated Eckrant soils. Areas of the complex are irregular in shape and range from 75 to 500 acres. Slopes average about 2 percent.

This complex is 55 to 65 percent Eckrant soil, 15 to 30 percent Rock outcrop, and less than 20 percent other soils. Included in mapping are areas of Oglesby soils which are intermixed with areas of the Eckrant soil and Evant soils upslope. Areas of the Eckrant soil and Rock outcrop are so intricately mixed that it was not possible to map them separately.

Typically, the surface layer of the Eckrant soil is mildly alkaline, very dark grayish brown cobbly silty clay about 5 inches thick. Mildly alkaline, very dark grayish brown very cobbly silty clay extends to a depth of 12 inches. Coarse fragments make up 35 to 70 percent of the pedon; the percentage increases with depth. Indurated limestone is below a depth of 12 inches.

The Eckrant soil is well drained. Permeability is moderately slow, and available water capacity is very low. Runoff is rapid, and the hazard of erosion is slight. The root zone is restricted; however, plant roots can penetrate fractures in the rock.

This map unit is primarily used as rangeland and for wildlife habitat. It is poorly suited to rangeland. The major limitations are depth to rock, stoniness, very low available water capacity, and Rock outcrop.

This map unit is moderately suited to wildlife habitat for deer, rabbits, turkeys, and doves.

This map unit is not suited to use as cropland and tame pasture because of depth to rock, stoniness, very low available water capacity, and Rock outcrop.

It is poorly suited to most urban and recreational uses. Depth to rock, stoniness, and Rock outcrop are the major limitations. However, many areas provide scenic vistas of the valley below.

This complex is in capability subclass VIIs. The Eckrant soil is in the Low Stony Hill range site.

EuB—Eckrant-Urban land complex, 1 to 3 percent slopes. The soils in this complex are shallow and very shallow and are gently sloping. This complex is on plane to convex ridgetops underlain by hard limestone. Areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer of the Eckrant soil is mildly alkaline, very dark grayish brown cobbly silty clay about 4 inches thick. From a depth of 4 to 11 inches is mildly alkaline, dark grayish brown very cobbly silty clay that is about 35 to 70 percent, by volume, coarse fragments. Indurated limestone is below a depth of 11 inches.

The Eckrant soil is well drained. Permeability is moderately slow, and available water capacity is very low. Runoff is rapid, and the hazard of erosion is slight. The root zone is restricted; however, plant roots can penetrate fractures in the rock.

The Urban land part of this complex consists of residential houses, streets, sidewalks, driveways, and patios. Some areas have been disturbed by cutting, grading, and filling during construction. These construction activities have altered the soil to the extent that classification is not practical in many areas.

This complex is 45 to 55 percent Eckrant soil, 15 to 30 percent Urban land, and less than 30 percent other soils. Included in this map unit are small areas of Evant soils which are upslope on ridgetops. Areas of the Eckrant soil and Urban land in this complex are so intricately mixed that mapping them separately was impractical.

The Eckrant is poorly suited to most urban and recreational uses. Depth to rock, stoniness, and corrosivity to uncoated steel are the main limitations. However, some areas have scenic views of the lower valley.

This complex is not assigned to a capability subclass or a range site.

EvB—Evant silty clay, 1 to 3 percent slopes. This is a shallow, gently sloping soil on plane to convex uplands. The areas are irregular in shape and range from 20 to 1,000 acres.

Typically, the surface layer from 0 to 8 inches is neutral, dark brown silty clay in the upper part and slightly acid, reddish brown silty clay in the lower part. The subsoil extends to a depth of 19 inches and is medium acid to neutral dark red clay in the upper part and mildly alkaline dark reddish brown clay in the lower part. Pinkish white strongly cemented material plugged with carbonates extends to a depth of 27 inches. Interbedded hard and soft limestone is below a depth of 27 inches.

This soil is well drained. Permeability is slow, and available water capacity is very low. Surface runoff is slow. The root zone is shallow.

This map unit has about 60 to 75 percent Evant soils. The remainder of the map unit is comprised of Eckrant and Oglesby soils and soils similar to Evant except for having a hard limestone contact. Also included are soils that have a solum deeper than 20 inches and are upslope from the Evant soil.

This Evant soil is mainly used as rangeland. Major limitations include shallow rooting depth and low available water capacity.

This soil is poorly suited to use as cropland and pasture because of depth to a root-limiting layer and low available water capacity.

This soil is poorly suited to urban uses because of depth to rock, shrinking and swelling as a result of changes in moisture, corrosivity to uncoated steel, low strength, and the clayey surface layer.

This soil is poorly suited to recreational uses. The main limitations are depth to rock and the clayey surface layer.

This soil is moderately suited to wildlife habitat for deer, rabbits, turkeys, and doves.

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

Fr—Frio silty clay, occasionally flooded. This is a deep, nearly level, clayey soil on flood plains of major streams. It is flooded every 3 to 10 years for a duration of less than a day. The areas are longer than they are wide and continuous along the drain. Slopes range from 0 to 2 percent; they are mainly less than 1 percent.

Typically, the surface layer to a depth of 22 inches is dark grayish brown silty clay and clay loam. Dark grayish brown silty clay loam extends to a depth of 40 inches. Grayish brown silty clay extends to a depth of 80 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Runoff is slow, and the hazard of erosion is slight. The root zone is deep and is easily penetrated by plant roots.

This map unit is 90 to 100 percent Frio soils. Included in mapping are small areas of Bosque soils in slightly higher positions.

This Frio soil is well suited to use as cropland. It is used for small grains, hay, and grain sorghum. The major objectives of management are maintaining tilth and fertility. Leaving crop residue on the surface helps to improve tilth, conserve soil moisture, and maintain fertility.

This soil is well suited to use as pasture. It is well suited to improved bermudagrass, kleingrass, switchgrass, vetch, and indiangrass. Proper pasture management includes fertilization, weed control, and controlled grazing.

This soil is well suited to growing pecans. The management objectives include clearing of underbrush and proper maintenance of pecan trees.

The hazard of flooding is the main limitation for urban uses. This soil is poorly suited to most recreational uses. The silty clay surface layer is the main limitation. Because of the hazard of flooding, this soil is poorly suited to use as campsites.

Areas of this map unit furnish excellent habitat for quail, doves, deer, squirrels, and raccoons. Many songbirds frequent the areas for food, cover, and nesting.

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

KrB—Krum silty clay, 1 to 3 percent slopes. This is a deep, gently sloping clayey soil on stream terraces and in filled valleys. The areas are longer than they are wide and range from 40 to more than 400 acres.

Typically, the surface layer is dark gray silty clay about 5 inches thick. Dark grayish brown silty clay extends to a depth of 25 inches. The layer below that, between 25 and 57 inches, is grayish brown silty clay that is about 5 percent by volume calcium carbonate concretions. Brown silty clay that has films and threads of calcium carbonate extends to a depth of 80 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Runoff is medium, and the hazard of erosion is moderate. When the soil is dry, cracks extend to the surface and water enters the soil rapidly. When the soil is wet and the cracks are sealed, water enters the soil slowly. The surface layer is very hard and difficult to till when dry. The root zone is deep, but plant roots penetrate slowly because of the clayey texture.

This map unit is 60 to 95 percent Krum soils. Included with this soil in mapping are small areas of Lewisville soils in similar positions and Bosque and Frio soils on flood plains at lower elevations.

This Krum soil is mainly used as cropland; however, a significant acreage is used as pasture. This soil is well suited to use as cropland. It is mainly used for small grains and grain sorghum. The main objectives of management are controlling erosion and maintaining tilth. Terracing and farming on the contour help to slow runoff and control erosion. Leaving crop residue on the soil helps to improve soil tilth and conserve moisture.

This soil is well suited to use as pasture. Suitable pasture species are improved bermudagrass and kleingrass. Fertilization, weed control, and controlled grazing are management objectives. The Krum soil is well suited to pecan trees. Management objectives include control of underbrush and proper maintenance of trees.

The Krum soil is poorly suited to most urban uses. The main limitations are shrinking and swelling as a result of changes in moisture and corrosivity to uncoated steel. These limitations can be partly overcome by good design and careful installation.

This soil is moderately suited to most recreational uses. The main limitation is the clayey surface layer that is sticky when the soil is wet. Using loamy fill material and maintaining a good grass cover can help overcome this limitation.

Areas of this soil are regularly inhabited by doves, turkey, and quail. Deer from adjacent woods use the abundant supply of forbs as a food supply.

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

LeB—Lewisville clay loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on major stream terraces. Most areas are long and narrow and range in size from 25 to about 300 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam about 12 inches thick. The subsoil, from a depth of 12 to 54 inches, is moderately alkaline, brown clay loam. Moderately alkaline, reddish yellow clay loam extends to a depth of 77 inches.

This soil is well drained. Permeability is moderate, and available water capacity is high. Runoff is medium, and the hazard of erosion is moderate. The root zone is deep and is easily penetrated by plant roots.

This map unit is 70 to 95 percent Lewisville soils. Included with this soil in mapping are small areas of Krum, Bosque, and Frio soils. The more clayey Krum soils are in similar positions. The loamy Bosque and clayey Frio soils are at lower elevations on flood plains.

This soil is mainly used as cropland and pasture and is well suited to these uses. Grain sorghum and small grains are the main crops. Management objectives include terracing and contour farming to slow runoff and reduce erosion. Leaving crop residue on the soil helps to control erosion and improve soil tilth. Improved bermudagrass and kleingrass are the main pasture grasses. Fertilization, weed control, and controlled grazing are pasture management objectives. Pecan orchards are grown in some areas.

This soil is poorly suited to most urban uses and is well suited to recreational uses. The main limitations for urban uses are corrosivity to uncoated steel, shrinking and swelling as a result of changes in moisture, and low strength affecting streets and roads. These limitations can be overcome by good design and proper installation.

Areas of this map unit are preferred by quail, doves, songbirds, rabbits, and foxes because of the food and cover provided by grain and seed crops, grasses and legumes, and wild herbaceous plants.

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

MnB—Minwells fine sandy loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on terraces of the Leon River. The areas are oblong and range from 75 to 300 acres.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil extends to a depth of 18 inches and is reddish brown sandy clay loam that is about 10 percent siliceous pebbles. Red gravelly sandy clay that is about 30 percent siliceous pebbles extends to a depth of 52 inches. Red clay that is about 5 percent masses and concretions of calcium carbonate extends to a depth of 63 inches. The underlying material is reddish yellow gravelly sandy clay loam that is about 30 percent siliceous pebbles and 10 percent masses and concretions of calcium carbonate.

This soil is well drained. Available water capacity is medium, and permeability is slow. Surface runoff is medium. Erosion hazard is moderate.

This map unit is 65 to 80 percent Minwells soils. The remainder of the unit is made up of Nuff soils upslope, Slidell soils in drains and depressions, and soils that are similar to this Minwells soil but are less clayey in the subsoil. Also included are a few areas where slopes are more than 3 percent.

This soil is moderately suited to use as cropland. The principal crop is grain sorghum. Terraces, grassed waterways, and contour tillage are needed to help control erosion.

This soil is well suited to use as pasture. Kleingrass and coastal bermudagrass are the main pasture grasses. Proper management includes brush management and controlled grazing.

This Minwells soil is moderately suited to most urban uses. The main limiting factors are corrosivity to uncoated steel, moderate shrinking and swelling as a result of changes in moisture, and low strength for supporting heavy loads. This soil is well suited to most recreational uses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys.

Several of the woody plants, forbs, and grasses provide good cover, browse, and seeds for game birds and animals.

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

MuB—Minwells-Urban land complex, 1 to 3 percent slopes. The soils in this complex are deep and gently sloping. These soils are on terraces of the Leon River.

This complex is 40 to 80 percent Minwells soils, 20 to 60 percent Urban land, and up to 15 percent soils closely similar to the Minwells soil. Areas of the Minwells soil and Urban land are so intricately mixed that it was not practical to map them separately.

Typically, the surface layer is dark brown fine sandy loam to a depth of 5 inches. The subsoil extends to a depth of 44 inches and is red or dark red sandy clay and sandy clay loam that is about 10 percent siliceous pebbles. The layer below that, to a depth of 61 inches, is reddish brown gravelly sandy clay loam that is about 35 percent siliceous pebbles and about 5 percent calcium carbonate concretions. The underlying material to a depth of 80 inches is very gravelly sandy clay loam that is about 40 percent siliceous pebbles and 15 percent calcium carbonate concretions.

This soil is well drained. Permeability is slow, and available water capacity is medium. Surface runoff is medium.

The Urban land consists of areas covered by individual dwellings, apartments, and small businesses, as well as adjoining streets, driveways, parking lots, patios, and other structures that obscure or alter the soil to the extent that identification is not feasible.

The Minwells soil in this complex is moderately suited to most urban uses. The main limiting factors are corrosivity to uncoated steel, moderate shrinking and swelling with changes in moisture, and low strength for supporting heavy loads. This soil is well suited to recreational uses.

This complex was not assigned to a capability subclass or range site.

NuC—Nuff very stony silty clay loam, 2 to 6 percent slopes. This is a deep, gently sloping to sloping soil on the sides of low ridges and stream divides. Commonly, 3 to 25 percent of the surface is covered by limestone fragments, most of which are 6 to 24 inches across and 1/2 inch to 6 inches thick (fig. 8). Many of the rocks are tilted at a 30 to 50 degree angle. Most areas are irregular in shape and are as much as several thousand acres in size.

Typically, the surface layer is moderately alkaline, dark gray very stony silty clay loam to a depth of 11 inches. The layer below that, to a depth of 36 inches, is moderately alkaline brown silty clay loam in the upper part, grading to light olive brown silty clay loam that is about 30 percent, by volume, stones in the lower part. Interbedded layers of marly and shaly silty clay loam and silty clay are below a depth of 36 inches.

The Nuff soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is medium, and the hazard of erosion is moderate. The root zone is deep; however, in places penetration is restricted by stones in the subsoil.

This map unit is 75 to 95 percent Nuff soils. The remainder of this unit consists of areas of Cho soils upslope, Wise soils downslope, and Slidell soils in the drainageways.

The Nuff soil is mainly used as rangeland. The main limitation is stones on the surface, which can hinder the establishment of grasses.

This soil is not suited to cultivated crops and improved pasture because of the large stones on the surface. However, in some areas where the stones have been removed, small grains and hay are grown.

Areas of this map unit provide habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, cottontail rabbits, and jackrabbits.

This soil is poorly suited for most urban and recreational uses. Large stones and low strength are the main limitations. These limitations can be partly overcome by good design and careful installation.

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

OgB—Oglesby silty clay, 1 to 3 percent slopes. This is a shallow, gently sloping clayey soil on uplands. The areas are mainly oblong and range from 75 to 800 acres.

Typically, the surface layer is mildly alkaline, very dark grayish brown silty clay about 6 inches thick. The subsurface layer extends to a depth of 16 inches and is mildly alkaline, very dark grayish brown silty clay. Indurated limestone is below a depth of 16 inches. The upper part is fractured; the fractures are filled with soil material.

This soil is well drained. Permeability is slow, and available water capacity is very low. Surface runoff is slow to medium, resulting in a slight hazard of water erosion. The root zone is shallow. The rock severely limits root growth; however, plant roots can penetrate fractures in the rock.

This map unit is 65 to 75 percent Oglesby soils. The remainder consists of areas of Bolar soils upslope, Eckrant soils in similar positions, and a soil that is similar to Oglesby except for having a subhorizon that has an accumulation of clay.

The Oglesby soil is mainly used as rangeland. The main limitations are depth to rock and low available water capacity.

This soil is moderately suited to use as pasture. Coastal bermudagrass and kleingrass are the main pasture grasses. Depth to rock and low available water capacity are the major limitations. Pasture management

Figure 8.—Typical area of Nuff very stony silty clay loam, 2 to 6 percent slopes.

includes fertilization, weed control, and proper stocking rates.

This soil is poorly suited to use as cropland. The main limitations are depth to rock and low available water capacity.

This soil is poorly suited to most urban uses. Depth to rock, shrinking and swelling as a result of changes in moisture, and low strength for supporting roads are the main limitations. Most of these problems can be overcome by good design and careful installation. This soil is poorly suited to most recreational uses. Depth to rock and a clayey surface that is sticky when wet are the main limitations.

Areas of this map unit provide habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, cottontail rabbits, squirrels, and white-tailed deer.

This soil is in capability subclass IIIs and Shallow Clay range site.

PaC—Patilo fine sand, 1 to 5 percent slopes. This is a deep, gently sloping, sandy soil on ridgetops and side slopes. The areas are mainly oval and are about 100 acres.

Typically, the surface layer is pale brown, slightly acid fine sand about 5 inches thick. The subsurface layer is very pale brown, neutral fine sand that extends to a depth of 53 inches. The upper part of the subsoil is light gray, medium acid sandy clay loam that extends to a depth of 65 inches. The lower part of the subsoil is reddish yellow, neutral sandy clay loam that extends to a depth of 80 inches.

This soil is moderately well drained. There is no runoff because of the thick sand. Permeability is moderately slow, and available water capacity is low. This soil has a water table at a depth of 50 to 72 inches for short periods during seasons of heavy rainfall. Soil blowing is a hazard if the soil is cultivated. The deep root zone is easily penetrated by plant roots.

Patilo soils make up 55 to 80 percent of most mapped areas. Included with this soil in mapping are small areas of Cisco soils on lower slopes and soils that have less than 40 inches of sand over sandy clay loam. Also included are some areas where slopes are more than 5 percent.

The Patilo soil is moderately suited to use as pasture. The main grasses are common and improved bermudagrass, kleingrass, switchgrass, and weeping lovegrass. Grass seedlings are difficult to establish because of blowing sand and the lack of a firm seedbed. Fertilizer should be added at planned intervals throughout the growing season for sustained forage production.

This soil is poorly suited to most range species. The main limitations are low available water capacity and the thick sandy surface and subsurface layers.

This soil is moderately suited to use as cropland. The low available water capacity and thick sandy surface and subsurface layers are the main limitations. This soil is suited to peanuts, watermelons, and other truck crops. Leaving crop residue on the surface helps to maintain the content of organic matter and control soil blowing.

The Patilo soil is well suited to building site development. The main limitations are seepage, wetness as a result of the seasonal water table, sandiness, and corrosivity to steel and concrete.

This soil is poorly suited to recreational uses. The main limitation is the deep, loose sand that tends to blow if the soil is bare of vegetation and does not provide support for walking or driving.

Areas of this map unit are used by deer, songbirds, quail, and doves. A variety of smaller animals, such as rabbits, raccoon, and foxes, also use areas of this unit because of the availability of various herbs and plants.

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

PrB—Purves gravelly silty clay, 1 to 5 percent slopes. This is a shallow, gently sloping, clayey soil on ridges and side slopes. The areas are elongated and range from 5 to several hundred acres.

Typically, the surface layer is moderately alkaline, dark brown gravelly silty clay to a depth of 6 inches. Moderately alkaline, dark brown very gravelly silty clay that is about 45 percent limestone fragments extends to a depth of 14 inches. Limestone bedrock is below a depth of 14 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is very low. Surface runoff is slow to medium, and the hazard of erosion is moderate. The root zone is restricted; however, plant roots can penetrate the fractures in the bedrock.

This map unit is 80 to 95 percent Purves soil. The remainder consists of small areas of Bolar and Crawford soils and soils that are similar to the Purves soil except that they are more than 35 percent limestone fragments in the solum. The loamy Bolar soils are downslope from the Purves soil. Crawford soils are 20 to 40 inches deep and are upslope. The soils similar to the Purves soil are in similar positions.

This Purves soil is poorly suited to use as cropland. Depth to rock, surface stones, and low available water capacity are the main limitations.

This soil is moderately suited to use as pasture. Droughtiness limits production. Improved bermudagrass and kleingrass are commonly grown. Proper management includes fertilization, weed control, and controlled grazing.

This soil is poorly suited to most urban and recreational uses. Depth to rock and the clayey surface that is sticky when the soil is wet and that cracks when the soil is dry are the main limitations.

Areas of this map unit are used by quail and doves for food and cover.

This soil is in capability subclass IVe and Shallow range site.

ReF—Real-Rock outcrop complex, 12 to 40 percent slopes. This map unit consists of shallow, moderately steep to steep soils and areas of Rock outcrop on side slopes of uplands. The areas are generally long and narrow and are on hill slopes or bluffs overlooking rivers and streams. The areas range from 100 to 1,000 acres.

This map unit is about 65 to 75 percent Real soil, 10 to 25 percent Rock outcrop, and 10 to 25 percent similar soils. Areas of the soils and Rock outcrop are in such intricate patterns that it was not practical to map them separately.

Typically, the surface layer of the Real soil is moderately alkaline, dark brown gravelly clay loam about 5 inches thick. Moderately alkaline, dark brown very gravelly clay extends to a depth of 17 inches. Interbedded, weakly to strongly cemented limestone is below a depth of 17 inches.

The Real soil is well drained. Runoff is very rapid. Permeability is moderate, and available water capacity is very low. Erosion is a severe hazard.

Rock outcrop is generally in long and narrow horizontal bands 3 to 12 inches thick, although it is as much as 30 feet thick in some areas. These outcrops are mainly along edges of escarpments and abrupt slope breaks. Some areas include large boulders that have broken away from escarpments and fallen downslope.

Many areas have a layer of soil less than 4 inches thick overlying the Rock outcrop. Outcrops are generally strongly cemented limestone, although in many areas the rock is indurated.

Included with this complex in mapping are areas of Brackett, Cranfill, and Topsey soils. The Brackett soils are on side slopes in lower positions than the Real soil. The Cranfill and Topsey soils are at the base of steep slopes. Also included are areas of soils that are similar to the Real soil but are less than 35 percent rock fragments, and soils that are deeper than 20 inches.

Because of shallow rooting depth, slope, and Rock outcrop, this map unit is mainly used as rangeland and wildlife habitat. The Real soil is moderately suited to use as rangeland.

Areas of this map unit are used by deer and turkey. Cover for protection and browse for food is excellent.

The Real soil is poorly suited to most urban and recreational uses because of slope, severe hazard of erosion, depth to rock, and Rock outcrop. Recreational uses are mainly limited to picnic areas, paths, and trails.

This complex is in capability subclass VIIs. The Real soil is in the Steep Abode range site.

SeC—Seawillow clay loam, 3 to 5 percent slopes. This is a deep, gently sloping, loamy soil on stream terraces. The areas are elongated and range from 20 to 100 acres.

Typically, the surface layer is moderately alkaline, dark brown clay loam to a depth of 6 inches. From 6 to 80 inches, the soil grades from moderately alkaline, brown clay loam to reddish yellow clay loam.

This soil is well drained. Permeability is moderate, and available water capacity is high. Surface runoff is medium, resulting in a moderate hazard of water erosion. The root zone is deep and is easily penetrated by plant roots.

This map unit is 65 to 85 percent Seawillow soils. The remainder of the unit is made up of Doss and Real soils along the upper edges of the mapped areas. Lewisville soils are upslope on flatter surfaces.

This soil is used mainly as pasture and rangeland. It is well suited to use as pasture. Coastal bermudagrass and kleingrass are adapted pasture grasses. Pasture management includes fertilization, weed control, and controlled grazing.

This soil is moderately suited to use as cropland. The main limitation is steepness. Grain sorghum and oats are the main crops. The objectives of management are controlling erosion, improving soil tilth and fertility, and conserving soil moisture. Terraces, farming on the contour, and grassed waterways help reduce erosion. Leaving large amounts of crop residue on the ground helps improve tilth, control erosion, and conserve soil moisture.

This soil is moderately suited to most urban uses. The main limitations are shrinking and swelling of the soil with changes in moisture, low strength for supporting roads, and corrosivity to uncoated steel. These limitations can be overcome by good design and careful installation. This soil is well suited to most recreational uses.

Areas of this map unit provide habitat for bobwhite quail, mourning doves, meadowlarks, numerous songbirds, cottontail rabbits, squirrels, white-tailed deer, and turkey.

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

SlB—Slidell silty clay, 1 to 3 percent slopes. This is a deep, gently sloping soil in valley fill areas along drainageways. The areas are elongated or irregular in shape and range from 20 to 250 acres.

Typically, the surface layer is moderately alkaline, dark gray silty clay about 6 inches thick. The subsurface layer to a depth of 18 inches is dark gray silty clay. Moderately alkaline, gray and grayish brown silty clay extends to a depth of 66 inches. The underlying material to a depth of 80 inches is light gray clay mottled with yellow and brown.

This soil is well drained. Permeability is very slow, and available water capacity is high. Surface runoff is slow to medium. When dry, this soil has cracks as much as 1 inch wide and more than 20 inches deep. Water enters rapidly when the soil is dry and cracked and very slowly when the soil is moist. The hazard of erosion is moderate.

This map unit is 60 to 90 percent Slidell soils. Included with this soil in mapping are areas of Crawford, Denton, and Topsey soils. These soils are all upslope from the Slidell soil, each on a different geologic formation.

Much of this Slidell soil is used as cropland and is well suited to this use. Grain sorghum and small grains are the main crops. Corn, cotton, and forage sorghum are also grown. The main objectives of management are controlling erosion and maintaining tilth. Terracing and farming on the contour help to slow runoff and control erosion. Growing deep rooted legumes helps maintain tilth. Leaving crop residue on or near the surface helps to conserve moisture and slow runoff.

This soil is well suited to use as pastureland. Improved bermudagrass, kleingrass, johnsongrass, vetch, and sweetclover are commonly grown. Proper pasture management includes fertilization, weed control, and controlled grazing.

The Slidell soil is poorly suited to most urban and recreational uses. Shrinking and swelling as a result of changes in moisture and corrosivity to uncoated steel are the main limitations. This soil is poorly suited to septic tank absorption fields because of very slow permeability. These limitations can only be partly overcome by good design and careful installation. For recreational uses the main limitations are permeability and the clayey surface layer that cracks when the soil is dry and is sticky when the soil is wet.

Areas of this map unit are regularly inhabited by doves and quail. Deer occasionally use these areas for grazing; the lack of woody cover is a limitation.

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

TpC—Topsey-Pidcoke association, 2 to 8 percent slopes. This association consists of deep and shallow, loamy soils on undulating uplands. The areas are irregular in shape and range from 20 to several hundred acres.

Topsey soils make up 55 to 70 percent of the association, Pidcoke soils 25 to 35 percent, and other soils 5 to 20 percent. The Topsey soils are deep and are on side slopes in lower positions than the Pidcoke soils. The Pidcoke soils are underlain by indurated limestone at a depth of less than 20 inches and are on summits of knolls and low hills; they have slopes of less than 5 percent. These soils could have been mapped separately, but the long-term use is expected to be rangeland which can be managed as a combined unit.

Typically, the surface layer of the Topsey soil is dark brown clay loam about 7 inches thick. The subsoil, from a depth of 7 to 24 inches, is light yellowish brown silty clay loam; the upper 5 inches contains about 5 percent fossil shells. Interbedded clayey marl and shale extends to a depth of 80 inches. Reaction is moderately alkaline throughout.

The Topsey soil is well drained. Permeability is moderately slow, and available water capacity is medium. Runoff is medium, and the hazard of erosion is moderate. The root zone is deep and is easily penetrated by plant roots.

Typically, the surface layer of the Pidcoke soil is moderately alkaline, dark grayish brown clay loam about 8 inches thick. From a depth of 8 to 13 inches is moderately alkaline, grayish brown gravelly clay loam. Below that is indurated limestone containing many imbedded fossil shells.

The Pidcoke is well drained. Permeability is moderately slow, and available water capacity is very low. Runoff is medium, and the hazard of erosion is moderate. The root zone is shallow.

Included with these soils in mapping are small areas of Cho soils downslope, Cranfill soils on upper slopes above the Pidcoke soil, and Krum and Slidell soils in the drains.

These soils are used mainly as rangeland. The Topsey soil is moderately suited to use as cropland and pastureland; however, the Pidcoke soil is poorly suited. Slope and the high content of lime in the subsoil are the main limitations for the Topsey soil. Management objectives are controlling erosion, improving soil tilth, and conserving soil moisture. Terracing and farming on the contour help to slow runoff and control erosion. Grassed waterways are needed for terrace outlets. Growing closely spaced crops that produce a large amount of residue and leaving crop residue on the surface help to slow runoff, improve tilth, and conserve soil moisture.

Adapted pasture species for Topsey soils include improved bermudagrass, kleingrass, indiangrass, switchgrass, and improved bluestem (fig. 9). Proper management includes weed control, fertilization, and controlled grazing.

The Topsey soil is moderately suited to most urban uses, but the Pidcoke soil is poorly suited. Depth to rock is the main limitation for the Pidcoke soil. Shrinking and swelling as a result of changes in moisture, seepage, and corrosivity to uncoated steel are the main limitations for the Topsey soil. The Topsey soil is well suited to most recreational uses. The Pidcoke soil is poorly suited because of depth to rock.

Areas of this map unit are preferred by quail, dove, and rabbits because the ground cover and food are excellent.

The Topsey soil is in capability subclass IVe and Clay Loam range site. The Pidcoke soil is in capability subclass IVs and Shallow range site.

TuC—Topsey-Urban land complex, 3 to 8 percent slopes. The soils in this complex are deep and gently sloping to sloping. They are on uplands. The areas are oblong and range from 20 to several hundred acres in size. Slopes average about 4 percent.

This complex is about 40 to 65 percent Topsey soil, 20 to 40 percent Urban land, and up to 20 percent closely similar soils. Areas of the Topsey soil and Urban land are so intricately mixed that it was not practical to map them separately.

Typically, the surface layer is dark grayish brown clay loam about 7 inches thick. The subsoil to a depth of 22 inches is grayish brown clay loam that has some calcium carbonate concretions and is about 10 percent by volume shale fragments. The underlying material is stratified layers of marl and shale.

The Topsey soil is well drained. Permeability is moderately slow, and available water capacity is medium. Runoff is medium, and the hazard of erosion is severe. The root zone is deep and is easily penetrated by plant roots.

The Urban land part of the complex is covered by individual dwellings, small businesses, apartments and adjoining streets, driveways, sidewalks, patios, and other structures that alter the soil to the extent that classification is not practical.

Included with this complex in mapping are small areas of Pidcoke and Slidell soils.

The Topsey soil is moderately suited to most urban uses. Shrinking and swelling as a result of changes in moisture and corrosivity to uncoated steel and concrete are the main limitations. Good design and careful installation are needed to overcome these limitations.

Figure 9.—Beefmaster cattle grazing on kleingrass, in an area of Topsey-Pidcoke association, 2 to 8 percent slopes.

The Topsey soil is moderately suited to recreational uses.

This complex is not assigned to a capability subclass or range site.

WsC2—Wise clay loam, 3 to 5 percent slopes, eroded. This is a deep, gently sloping soil on uplands, mainly above drainageways, and on side slopes of ridges. Sheet erosion has left rills and shallow gullies in most areas. The rills and gullies run the length of the slope and are 50 to 200 feet apart. The areas are irregular in shape and range from 20 to about 400 acres.

Typically, the surface layer is brown clay loam about 6 inches thick. The next layer, to a depth of about 29 inches, is reddish yellow silty clay loam containing concretions of calcium carbonate. Below that to a depth of 80 inches is light brownish gray clayey marl interbedded with light gray loamy very fine sand.

This soil is well drained. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. The hazard of erosion is severe.

This map unit contains about 65 to 75 percent Wise soils and 10 to 20 percent soils that are similar to Wise except for having a darker surface or sandier texture. The remainder of this unit consists of areas of Cisco soils in similar positions, Doss soils downslope, and Krum soils in drains or depressions.

The Wise soil is moderately suited to use as pastureland. Improved bermudagrass, kleingrass, switchgrass, and weeping lovegrass are commonly grown. Proper management includes brush control and controlled grazing.

This soil is moderately suited to use as cropland. The main limitations are steepness and hazard of erosion. Management objectives include terracing and contour farming to slow runoff and reduce erosion. Leaving crop residue on the soil helps to control erosion and improve soil tilth.

The Wise soil is moderately suited to most urban uses. The main limitations are shrinking and swelling of the soil as a result of changes in moisture and low strength for supporting roads. These limitations can be overcome by good design and careful installation. The soil is well suited to most recreational uses. The main limitation is steepness.

Areas of this map unit provide habitat for quail, turkey, and white-tailed deer.

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

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The supply of high-quality farmland is limited. The U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops if treated and managed using acceptable farm methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, rangeland, or other purposes. They must either be used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and growing season and an acceptable level of acidity or alkalinity. This land has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not flooded during the growing season. Slope ranges mainly from 0 to 6 percent. For more detailed information regarding the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About twenty-seven percent of Coryell County meets the soil requirements for prime farmland. Areas of prime farmland are in valleys scattered throughout the county. Most of the areas are in map units 5, 6, 7, and 8 on the general soil map. Much of the acreage is currently used for crops; small grains, cotton, grain sorghum, and hay are most commonly grown. In Coryell County only a small acreage of prime farmland soils have been urbanized; however, some acreage is within the Fort Hood Military Reservation.

Detailed soil map units that make up prime farmland in Coryell County are listed in this section. The list does not constitute a recommendation for a particular land use. The extent of each map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." On some soils, appropriate measures have been applied to overcome a hazard or limitation, such as flooding or inadequate rainfall. Onsite investigation is necessary to determine whether the corrective measures are effective.

The following map units make up prime farmland in Coryell County, except for areas where the soils are urban or built-up land or are flooded more than once every 2 years during the growing season. Urban or built-up land is any contiguous unit of land 10 acres or more that is used for residences, industrial sites, commercial sites, construction sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, or shooting ranges.

BaB Bastsil fine sandy loam, 1 to 3 percent slopes
Bo Bosque clay loam, rarely flooded
Bs Bosque clay loam, occasionally flooded
CwB Crawford silty clay, 1 to 3 percent slopes
DeB Denton silty clay, 1 to 3 percent slopes
Fr Frio silty clay, occasionally flooded
KrB Krum silty clay, 1 to 3 percent slopes
LeB Lewisville clay loam, 1 to 3 percent slopes
MnB Minwells fine sandy loam, 1 to 3 percent slopes
SlB Slidell silty clay, 1 to 3 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

James O. Neighbors, conservation agronomist, Soil Conservation Service, assisted with the preparation of this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

According to the estimated resource data for Coryell County, in 1980 200,350 acres in the survey area was used for crops and pasture. Of this total, 43,350 acres was used for row crops; 97,000 acres for close-growing crops, mainly oats and wheat; and 60,000 acres for permanent pasture.

Soil erosion is the major problem on nearly all of the cropland where slopes are more than 2 percent. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Second, soil erosion on farmland results in sediment entering streams. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Management of residue helps control erosion. A good litter of crop residue left on the surface of the soil protects against packing rains, reduces crusting, decreases runoff, and reduces evaporation of soil moisture. It shades the soil and thus reduces the soil temperature. In addition, it adds organic matter to the soil, improves tilth, and reduces compaction by farm machinery. Crop residue should be protected from overgrazing and burning. Tillage equipment that keeps residue on the surface should be used. Minimum tillage of grain sorghum is effective in reducing erosion on sloping land and can be adapted to most of the soils that are presently being cropped.

Contour terraces reduce the length of the slope and thus reduce runoff and erosion. They are most practical on deep and moderately deep, clayey and loamy soils that have slopes of more than 1 percent.

Field crops suited to the soils and climate of Coryell County include some that are not commonly grown. Suited crops are cotton, grain sorghum, corn, and peanuts (fig. 10). Wheat, oats, and forage sorghum are the close-growing crops that are commonly grown.

Figure 10.—Grain sorghum in an area of Slidell silty clay, 1 to 3 percent slopes.

Kleingrass, King Ranch bluestem, and weeping lovegrass are suitable for producing grass seed.

Pasture is important in Coryell County because raising livestock is the main farm enterprise. For the past several years, the trend has been to convert land from other uses to pasture and hay. Land used for pasture and hay generally is planted to introduced grasses that will respond to good management. These grasses are mainly used to provide year-round grazing in combination with native range and supplement pastures.

Among the important grasses are coastal bermudagrass, kleingrass-75, weeping lovegrass, johnsongrass, indiangrass, Alamo switchgrass, King Ranch bluestem, and Old World bluestem. Coastal bermudagrass, kleingrass-75, and Alamo switchgrass are best suited to deep soils on bottom land areas. The first two, however, are adapted to most of the soils of the county if a good seedbed can be prepared. Weeping lovegrass provides good yields of forage on moderately coarse textured soils on uplands.

Good management practices for pasture include fertilization, rotation grazing to maintain proper grazing height, and weed and brush management. Good management practices for hay include fertilization and cutting forage at the correct height and at the proper stage of growth.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*19*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

James O. Neighbors, conservation agronomist, Soil Conservation Service, helped prepare this section.

Rangeland is land on which native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetative species are generally suitable for grazing, and the amount of vegetation is sufficient for grazing. Rangeland, or native grassland, receives no regular or frequent cultural treatment. The composition and production of the plant community is determined by soil, climate, topography, overstory canopy, and grazing management.

According to records of the local field office of the Soil Conservation Service, about 118,000 acres, or 18 percent of the survey area, is rangeland. The survey area is in the Grand Prairie vegetational area of Texas. It originally produced a wide variety of tall and mid growing grasses interspersed with an abundance of forbs. The area has now been invaded by oak, ash juniper, underbrush, and associated hardwood species.

The vegetative community has changed drastically during the past 50 years. Heavy grazing has deteriorated most of the grasslands, and much of the high quality vegetation has been grazed out. Now, tall grasses flourish in only a few places. A mixture of short to mid grasses and poor quality forbs has taken their place. However, remnants of the original plant species can still be found in protected areas, and in most cases, good grazing management makes it possible for these high quality plants to reestablish themselves.

Although most of the local ranches and livestock farms are cow-calf operations, some are stocker calf enterprises. Many ranches supplement their herds with stockers. This practice provides flexibility, so that the number of livestock to be cared for can be adjusted in periods of drought.

Livestock operations generally supplement the grazing of native grassland with the grazing of improved pastureland and cropland. Improved bermudagrass, kleingrass, and weeping lovegrass are commonly grown improved pasture grasses. Protein supplement, hay, and grazing of small grains are used during the winter.

Approximately 75 percent of the annual forage production takes place in April, May, and June, when spring rains and moderate temperatures are favorable for the growth of warm-season plants. A secondary growth period generally occurs in September and October, when fall rains and gradually cooling temperatures are common.

Droughts of varying length are common in the survey area. Each year, short midsummer droughts normally occur. Frequently, there are longer periods of drought that last for several months.

Range Sites and Condition Classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds, amounts, and proportions of forage make up a range site.

Climax vegetation on the range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there when the region was first settled. This plant community reproduces itself and changes very little as long as the environment remains unchanged. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. However, invaders have with little value for grazing.

Range condition is judged according to the standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation. The classes show the present condition of the native vegetation on a range site as compared to the native vegetation that could grow there. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

Table 6 shows, for each soil, the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production or *Potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

A primary objective of good range management is to keep range in excellent or good condition. If the range is well managed water is conserved, yields are improved, and the soils are protected. The main management concern is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, whereas actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and ability to recover.

Following years of prolonged overuse of rangeland, seed sources of the desirable vegetation will be eliminated. When this happens, the vegetation needs to be reestablished for management to be effective. Brush control, range seeding, fencing, development of water sites, or other mechanical treatment of water sites, or other mechanical treatment are methods used to revitalize the stands of native plants (fig. 11). Thereafter, management practices of deferred grazing, proper grazing use, and a planned grazing system are needed to maintain and improve the range.

Good management generally results in optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

There are 14 range sites in the survey area: Adobe, Blackland, Clay Loam, Deep Redland, Deep Sand, Loamy Bottomland, Low Stony Hills, Redland, Sandy Loam, Shallow, Shallow Clay, Steep Adobe, Stony Clay Loam, and Very Shallow.

Adobe range site. The Brackett soil in the Brackett-Topsey association, 3 to 8 percent slopes, eroded (map unit BtC2), the Cranfill soil (CrD), and the Real soil in the Doss-Real complex, 1 to 8 percent slopes (DrC), are in this site. The climax vegetation is mainly tall grasses with scattered clumps of oak. The vegetation is about 80 percent grasses, 10 percent woody plants, and 10 percent forbs.

Little bluestem makes up 40 percent of the grasses. Indiangrass, sideoats grama, and tall grama make up 20 percent. The rest is hairy dropseed, silver bluestem, rough tridens, and hairy grama. Woody plants include juniper, Texas oak, live oak, flameleaf sumac, and skunkbush sumac; forbs include wild alfalfa, bigtop dalea, white milkwort, trailing ratany, prairie-clover, and dotted gayfeather.

If the range site is subjected to prolonged overuse, indiangrass is grazed out. Little bluestem is stunted and has low producing vigor. Sideoats grama is short and appears in weak, unthrifty colonies. Eventually, if abuse is continued, the grasses thin out and bare patches of ground increase. When the range site is in poor condition, only such plants as queensdelight, threeawn, Texas grama, hairy tridens, and red grama continue to grow.

Blackland range site. The Slidell soil (map unit SlB) is in this site. The climax plant community is a tall grass prairie. The composition by weight is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

Little bluestem, indiangrass, and big bluestem make up about 75 percent of the climax vegetation. The rest is eastern gamagrass, switchgrass, Virginia wildrye, Florida paspalum, sideoats grama, silver bluestem, Texas wintergrass, Texas cupgrass, vine-mesquite, meadow dropseed, white tridens, and plains lovegrass; a wide variety of forbs that include Maximilian sunflower, Engelmann-daisy, blacksamson, penstemon, dotted gayfeather, sundrops, bundleflower, sensitivebrier, yellow neptunia, prairie-clover, snoutbean, wildbean, tickclover, scurfpean, western indigo, prairie senna, paintbrush, and gaura; and woody plants in scattered mottes that include live oak, elm, hackberry, bumelia, and coralberry.

When regression of the range site occurs as a result of heavy use, the tall grasses are grazed out. They are replaced by silver bluestem, Texas wintergrass, sideoats grama, and meadow dropseed. If heavy use continues, these plants also are grazed out and are replaced by mesquite, winged elm, honeylocust, osageorange, Texas

Figure 11.—This area of brush on Eckrant cobbly silty clay, 1 to 3 percent slopes, can be controlled by chaining.

grama, tumblegrass, and a host of annual grasses and forbs.

Clay Loam range site. The Bolar, Denton, Krum, Lewisville, Seawillow, and Wise soils (map units BgB, DeB, KrB, LeB, SeC, and WsC2) are in this site, as well as the Topsey soil in the Brackett-Topsey association, 2 to 8 percent slopes, eroded (BtC2), and the Topsey soil in the Topsey-Pidcoke association, 2 to 8 percent slopes (TpC). The climax plant community is a true prairie consisting mainly of tall grasses. The composition by weight is about 90 percent grass, 5 percent forbs, and 5 percent woody vegetation.

Little bluestem, switchgrass, big bluestem, and indiangrass make up about 70 percent of the vegetation. Other grasses are wildrye, sideoats grama, Texas wintergrass, vine-mesquite, Texas cupgrass, white tridens, meadow and tall dropseed, and silver bluestem. Forbs include Engelmann-daisy, Maxmilian sunflower, yellow neptunia, catclaw sensitivebrier, prairie-clover, scurfpea, gaura, heath aster, blue salvia, trailing ratany, blacksamson, golden dalea, bigtop dalea, wildbean, tickclover, dotted gayfeather, and bundleflower. Woody vegetation includes elm, hackberry, pecan, plum, and live oak.

When regression of the range site occurs as a result of heavy use, big bluestem is first grazed out, followed by indiangrass, switchgrass, and little bluestem. At the same time, sideoats grama, Texas wintergrass, and tall and meadow dropseed increase initially but decrease as regression continues. Eventually, if heavy use continues, the composition will consist mainly of buffalograss, Texas grama, tumblegrass, red threeawn, western ragweed, Baldwin ironweed, queensdelight, mesquite, sumac, and common honeylocust.

Deep Redland range site. The Crawford soil (map unit CwB) is in this site. The climax vegetation is mid and tall grasses. The composition by weight is 90 percent grass, 5 percent woody plants, and 5 percent forbs.

Indiangrass, big bluestem, and little bluestem make up 5 percent of the vegetation, and sideoats grama and Texas wintergrass make up about 20 percent. Other grasses are Texas cupgrass, cane bluestem, silver bluestem, buffalograss, Canada wildrye, vine-mesquite, Wright threeawn, tall dropseed, white tridens, meadow dropseed, and plains lovegrass. Woody plants include live oak, greenbrier, hackberry, sumac, Texas oak, and bush honeysuckle. Forbs include Maximilian sunflower, bushsunflower, Engelmann-daisy, dotted gayfeather, black samson, Mexican sagewort, pitchersage, halfshrub sundrop, bundleflower, prairie-clover, trailing wildbean, least snoutbean, tickclover, scurfpea, western indigo, knotweed, leafflower, heath aster, ruellia, gaura, and mallow.

When regression of the range site occurs as a result of heavy use, the tall grasses are first grazed out and are replaced by sideoats grama, Texas wintergrass, silver bluestem, and buffalograss. Further deterioration results in a stand mostly of buffalograss and Texas wintergrass. The main plants on a range site in poor condition are woody species, such as mesquite, persimmon, juniper, and lotebush; and forbs, such as horehound, eryngo, prairie coneflower, and western ragweed.

Deep Sand range site. The Desan and Patilo soils (map units DnB and PaC) are in this site. The climax plant community is a tall grass savannah. The composition by weight is about 80 percent grass, 15 percent woody plants, and 5 percent forbs.

Big bluestem, indiangrass, sand lovegrass, purpletop tridens, little bluestem, and switchgrass make up about 65 percent of the vegetation. Other grasses are fringleleaf paspalum, Scribner panicum, silver bluestem, and sand dropseed. Woody plants include post oak, wax myrtle, blackjack oak, greenbrier, ash, elm, hickory, and bumelia. Forbs include lespedeza, tickclover, wildbean, snoutbean, prairie senna, spiderwort, dayflower, snakecotton, and western ragweed.

When regression of the range site occurs as a result of heavy use, big bluestem is first grazed out, followed by indiangrass, switchgrass, and little bluestem. Low panicum and low paspalum invade along with greenbrier, berryvines, and other low growing woody shrubs. Other invading plants are bullnettle, red lovegrass, tumble lovegrass, red spangletop, sandbur, and queensdelight.

Loamy Bottomland range site. The Bosque and Frio soils (map units Bo, Bs, and Fr) are in this site. The climax plant community is mid and tall grasses, with a tree canopy of pecan, elm, hackberry, post oak, blackjack oak, live oak, cottonwood, and western soapberry shading about 25 percent of the ground. The vegetation is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, indiangrass, switchgrass, purpletop tridens, and wildrye make up most of the grasses. The rest is tall and meadow dropseed, vine-mesquite, sand lovegrass, Texas bluegrass, and beaked panicum. Woody plants include pecan, American elm, live oak, post oak, hackberry, cedar, elm, greenbrier, sumac, red ash, redbud, red mulberry, downy viburnum, western soapberry, coralberry, and grape. Forbs include Engelmann-daisy, Maximilian sunflower, trailing wildbean, lespedeza, gaura, dotted gayfeather, dalea, penstemon, and tickclover.

When regression of the range site occurs as a result of abuse by livestock, the tall grasses decrease in vigor and abundance. Mid grasses increase; however, they can also be grazed out if heavy use is prolonged. Woody plants dominate the range site that is in poor condition, and mesquite, persimmon, milkweed, tumblegrass, Texas grama, and common bermudagrass invade the area.

Low Stony Hill range site. The Eckrant soils (map unit EcB) and the Eckrant soil in Eckrant-Rock outcrop complex, 1 to 3 percent slopes (map unit ErB) are in this site. The climax vegetation of this site is a live oak savannah of less than 20 percent tree canopy. Live oak mottes are most abundant along water courses, where elm and hackberry trees also grow. The vegetation is 85 percent grasses, about 10 percent woody plants and 5 percent forbs.

Little bluestem, big bluestem and indiangrass make up about 55 percent by weight of the composition. Sideoats grama, silver bluestem, vine-mesquite, Texas wintergrass, and Canada and Virginia wildrye make up about 25 percent. Forbs include Maximilian sunflower, bushsunflower, Engelmann-daisy, penstemon, gayfeather, bundleflower, sensitivebrier, prairie clover, and western ragweed.

When regression of the range site occurs as a result of heavy grazing use by cattle, big bluestem, indiangrass, little bluestem, green sprangletop, Canada wildrye, and palatable forbs decrease. Sideoats grama, feather bluestem, Texas wintergrass may persist, as they are able to endure abusive use for considerable periods. Finally ash juniper, mesquite, Texas persimmon, prickly pear, broomweed, silverleaf nightshade, croton, hairy tridens, and Texas grama invade the range site.

Redland range site. The Evant soil (map unit EvB) is in this site. The climax plant community is mid and tall grasses with scattered mottes of live oak, elm, hackberry, and shinnery oak. The composition is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

Indiangrass, big bluestem, and little bluestem, make up 50 percent by weight of the composition, and sideoats grama, Texas wintergrass, hairy grama, silver bluestem, tall dropseed, vine-mesquite, white tridens, and buffalograss make up about 25 percent. Woody plants include live oak, elm, hackberry, greenbrier, elbowbrush, bumelia, shinnery oak, and post oak. Forbs include Engelmann-daisy, yellow neptunia, catclaw sensitivebrier, wildbean, dalea, prairie clover, dotted gayfeather, gaura, ruellia, black samson, bushsunflower, and Mexican sagewort.

When regression of the range site occurs as a result of heavy use, Texas wintergrass, tall dropseed, silver bluestem, and buffalograss increase, and the tall grasses are grazed out. If overgrazing continues, the tall grasses die out, and Texas grama, sand dropseed, tumblegrass, pricklypear cactus, and mesquite invade.

Sandy Loam range site. The Bastsil, Cisco, and Minwells soils (map units BaB, CoB2, MnB) are in this site. The climax plant community is a post oak-blackjack oak savannah of tall and mid grasses. The oak overstory shades about 20 percent of the ground. Vegetative composition is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, indiangrass, switchgrass, beaked panicum, purpletop tridens, sand lovegrass, Virginia wildrye, and Canada wildrye make up 70 percent of the grasses. The rest is tall dropseed, silver bluestem, Scribner panicum, fringeleaf paspalum, purple lovegrass, Carolina jointtail, sideoats grama, meadow dropseed, and sedges. Woody plants include post oak, blackjack oak, elm, greenbrier, plum, grape, hawthorn, American beautyberry, elbowbush, coralberry, Carolina snailseed, and berryvine. Forbs include Maximilian sunflower, Engelmann-daisy, tickclover, lespedeza, snoutbean, wildbean, catclaw sensitivebrier, yellow neptunia, blacksamson, gaura, and western indigo.

When regression of the range site occurs as a result of heavy use, big bluestem and sand lovegrass are first grazed out, followed by indiangrass, little bluestem, Canada and Virginia wildrye, beaked panicum, and Florida paspalum. As regression continues, tall dropseed, sideoats grama, and silver bluestem increase initially but decrease if heavy grazing is prolonged. Further deterioration results in an increase in the canopy cover of oak and low growing shrubs and vines. Common persimmon, sumac, winged elm, tumble windmillgrass, narrow leaf rushfoil, and western ragweed are also present when the range site is in poor condition.

Shallow range site. The Doss soils in the Doss-Real complex, 1 to 8 percent slopes (map unit DrC), Pidcoke soils in the Topsey-Pidcoke association, 2 to 8 percent slopes (map unit TpC) and the Purves soil (map unit PrB) are in this site. The climax plant community is a prairie of mid and tall grasses interspersed with an abundance of forbs. The composition by weight is about 90 percent grasses and 5 percent forbs and 5 percent woody plants.

Little bluestem makes up about 50 percent of the composition, and indiangrass and big bluestem make up 10 percent. Other grasses are mostly sideoats grama, tall dropseed, slim tridens, silver bluestem, Texas cupgrass, hairy grama, buffalograss, Texas wintergrass, and vine-mesquite. Forbs include Engelmann-daisy, scurfpea, prairie-clover, Maximilian sunflower, catclaw sensitivebrier, heath aster, golden dalea, penstemon, gaura, false gaura, snoutbean, and dotted gayfeather.

When regression of the range site occurs as a result of heavy use, big bluestem is replaced by indiangrass and switchgrass. As regression continues, little bluestem, sideoats grama, and tall dropseed increase initially but decrease with prolonged heavy use. Finally, mesquite, pricklypear, yucca, Texas grama, hairy tridens, tumblegrass, red threeawn, Hall panicum, curlycup gumweed, queensdelight, milkweed, nightshade, and western ragweed invade the range site.

Shallow Clay range site. The Oglesby soil (map unit OgB) is in this site. The climax vegetation of this site is a mixture of mid and short grasses with post oak, cedar, and elm occupying about a 20 percent canopy. Limestone fragments less than 3 inches to about 10 inches across range from none to a few on the surface to as much as 10 percent by volume in the upper 10 to 20 inches. The climax vegetation consists of about 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, and indiangrass make up about 65 percent by weight of the composition. Sideoats grama, Texas wintergrass, silver bluestem, buffalograss, and Texas cupgrass make up about 20 percent. Forbs include Maximilian sunflower, bush sunflower, Engelmann-daisy, gayfeather, bundle flower, prairie coneflower, and western ragweed.

If the site is continuously heavily grazed by cattle, sideoats grama and silver bluestem decrease in the plant community. Such plants as buffalograss, curly mesquite, and Texas wintergrass increase. If overgrazing is prolonged, threeawn, hairy tridens, Texas grama, small mesquite, prickly pear, and tasajillo invade the site.

Steep Adobe range site. The Real soil in the Real-Rock outcrop complex, 12 to 40 percent slopes (map unit ReF), is in this site. The climax vegetation is mainly tall grasses with scattered clumps of oak. The vegetation is about 75 percent grasses, about 15 percent woody plants, and 10 percent forbs.

Typically, about 40 percent of the composition is little bluestem, indiangrass, and big bluestem; 20 percent is sideoats grama, tall grama, and hairy grama; and 15 percent is hairy dropseed, silver bluestem, and rough tridens. About 15 percent of the vegetation is Texas oak, live oak, juniper, and sumac; and 10 percent is forbs, such as wild alfalfa, big dalea, white milkwort, trailing ratany, dotted gayfeather, and prairie-clover.

When regresion of the range site occurs as a result of heavy use, little bluestem, big bluestem, and indiangrass, as well as the more palatable grasses, are initially grazed out. Sideoats grama, hairy dropseed, silver bluestem, and hairy grama increase. Further deterioration from abuse results in an invasion of Texas grama, perennial threeawn, hairy tridens, red grama, and queensdelight. When the range site is in poor condition, the vegetation is dominantly an overstory of juniper and Texas oak.

Stony Clay Loam range site. The Nuff soil (map unit NuC) is in this site. The climax vegetation of this site is a live oak savannah of less than 10 percent canopy. Limestone fragments from 3 to 20 inches across and 1/2 to 1 inch thick cover about 20 percent of the soil surface. The vegetation is 90 percent grasses, about 5 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, and indiangrass make up about 70 percent by weight of the composition. Sideoats grama, tall dropseed, buffalograss, and Texas wintergrass make up about 20 percent. Forbs include Maximilian sunflower, Engelmann-daisy, gayfeather, bundleflower, western ragweed, eryngo, and basket flower.

When regression of the range site occurs as a result of heavy grazing by cattle, big bluestem, indiangrass, little bluestem, and palatable forbs decrease. Sideoats grama, Texas wintergrass, silver bluestem, and buffalograss are initial increasers; Texas wintergrass or buffalograss may persist as the mid grasses are grazed out as they can withstand abusive use for a considerable period. Ash juniper, mesquite, prickly pear, broomweed, croton, hairy grama, and Texas grama invade the range site.

Very Shallow range site. The Cho soil (map unit ChB) is in this site. The climax plant community is a prairie of mid and tall grasses interspersed with forbs. The composition by weight is about 85 percent grasses and 15 percent forbs.

Typically, sideoats grama makes up 50 percent of the vegetation; tall dropseed, silver bluestem, and slim and rough tridens make up about 15 percent; and Wright threeawn, hairy grama, buffalograss, Texas wintergrass, tall witchgrass, and little bluestem and indiangrass make up the rest. Forbs include Engelmann-daisy, yellow neptunia, plains blackfoot, dotted gayfeather, trailing ratany, scurfpea, Illinois bundleflower, and heath aster.

When regression of the range site occurs as a result of heavy use, little bluestem, indiangrass, and sideoats grama are first grazed out. Buffalograss, slim and rough tridens, silver bluestem, and Wright threeawn increase. If overgrazing continues, grama, red threeawn, tumblegrass, tumble windmillgrass, queensdelight, silver nightshade, and mealycup sage take over the area.

Pecan Orchards

James Van Story, county extension agent, Gatesville, Texas, prepared this section.

Coryell County has the potential to increase pecan production and thus increase agricultural income. The bottom lands of rivers, streams, and creeks with their deposits of alluvial soils offer a tremendous potential for pecan orchards. The existing native bottoms may hold the key to establishing improved orchards without the cost of planting grafted or budded trees. The existence of healthy native trees with good nut quality should be investigated before cutting and dozing take place. These high quality trees, though native, should be left in production if they can be managed.

Pecans perform best on deep, well drained soils. Soil oxygen is necessary for the absorption of nutrients and water by the tree root system. Pecans have a much more critical soil oxygen requirement than other trees or plants. For this reason internal drainage is essential. Pecans cannot be grown in soil that holds excess water, and wet, poorly drained areas must be avoided. The trees will have difficulty if there is not sufficient movement of water through the soil to allow roots to come in contact with air spaces.

Many soils in Coryell County are too shallow and lack the capacity to hold enough water to sustain pecan trees. A few are planted on shallow soils in yards and are watered regularly; however, regular watering is not feasible on large acreages.

Soils in Coryell County having the highest potential for pecan production include soil on bottom land and terraces. The bottom land soils include the Bosque clay loam, rarely flooded; the Bosque clay loam, occasionally flooded; and the Frio silty clay, occasionally flooded. The soils on the terraces include the Bastsil fine sandy loam, Krum silty clay, Minwells fine sandy loam, and Lewisville clay loam.

Pecan trees should not be fertilized the first year. After the first year, fertilize the trees with ammonium sulfate or ammonium nitrate in April, May, and June. A complete fertilizer is recommended every 3 to 4 years on upland soils or sandy soils.

Water is essential for good young tree growth and regular production of quality nuts on mature bearing trees. Drip irrigation, sprinkler irrigation, and flood irrigation can be used. On young trees, small amounts of water should be applied as growth begins each year in the spring. As growth continues, temperatures increase, and days become longer, the amount will have to be increased. The trees may need to be watered some in the winter months if a prolonged drought occurs. Mature bearing trees need 1 inch of water per week from April to October. The trees should not go over 3 weeks without water during this period.

Pecan scab and stem-end-blight are the major diseases affecting pecans in Coryell County. Pecan scab is a fungus disease which forms lesions on the leaves and shucks. Dark black, sunken spots on the shucks are a typical symptom. During the seasons of high relative humidity, Pecan scab is a very serious problem. Stem-end-blight is a fungus disease which is thought to enter the pecan nut at the water stage in late July. It is a very serious disease because it occurs in both wet and dry climates. Stem-end-blight is not identified until after damage occurs. The symptoms are black areas on the shuck, reduced percent kernel, and the shuck sticking to the nut.

Insect pests that affect Coryell County pecans are the pecan nut casebearer, pecan weevils, hickory shuckworms, and black aphids. The pecan nut casebearer occurs in late May to early June. The other pests usually occur later in the year in August and September.

Pecans cannot be grown successfully in Coryell County without foliar zinc sprays. Soil tests may show adequate levels of zinc present; however, the tree will not absorb the zinc from the soil. Zinc rosette appears as short stunted shoot growth. The shoots tend to grow in bunches. Older trees will have dead shoots throughout the top of the tree. Young trees should be sprayed every 2 weeks from April to August for growth to continue throughout the season. Bearing trees should be sprayed at bud break, prepollination, casebearer, and second generation casebearer to allow maximum shoot growth and leaf expansion.

Pecans are usually harvested after mid-November. If a major freeze or frost occurs before that date, the shucks can stick to the nuts. Pecans grown in town are frequently harvested by squirrels and blue jays. It is not uncommon for 25 pounds of nuts to be harvested by a single squirrel. Most commercial orchards are now harvested with tractor- or truck-mounted shakers. Nuts are then picked up with mechanical harvesters, cleaned in mechanical cleaners, and sacked and sold to wholesalers.

Recreation

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Frank Sprague, biologist, Soil Conservation Service, Temple, Texas, helped prepare this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and

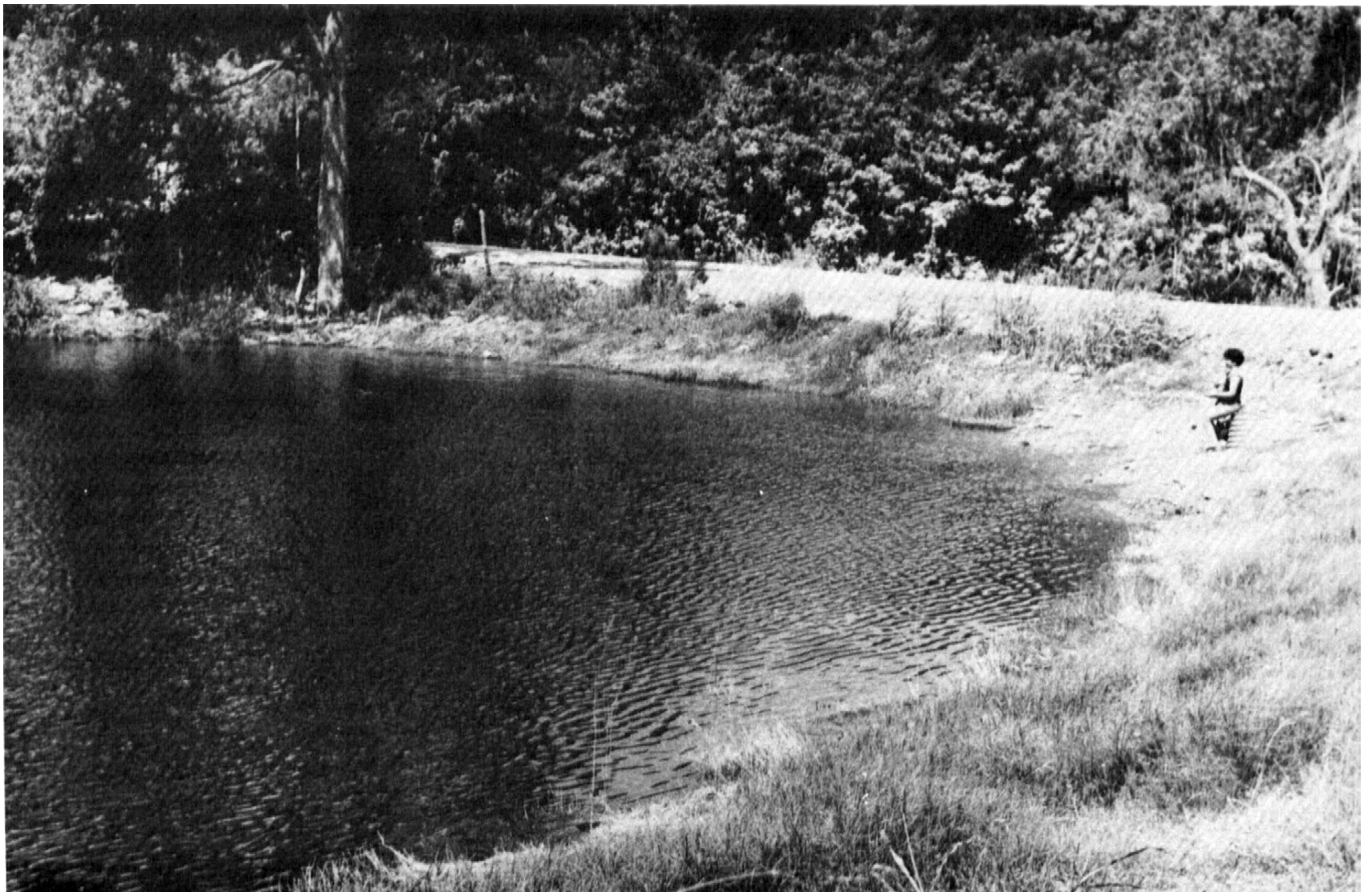


Figure 12.—Farm ponds provide opportunities for fishing, as well as water for livestock and wildlife.

abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

The major game species in Coryell County are white-tailed deer, mourning dove, bobwhite quail, turkey, squirrel, and waterfowl.

The leasing of hunting rights for deer, quail, and turkey is an important source of income for landowners. Furbearers such as fox, raccoon, and opossum are numerous throughout the county and are commercially trapped and hunted. Characteristic waterfowl include mallard, teal, pintail, American wigeon, lesser scaup, gadwall, and shoveler. Numerous songbirds, shore birds, and raptors are found in the various types of habitat in the county. Reptiles and amphibians are most common along the streams.

Many species of fish inhabit the streams, lakes, and ponds. Largemouth bass, channel catfish, crappie, and sunfish are the most prevalent sport fish (fig. 12). Cowhouse Creek and the Leon River provide public fishing in the upper reaches of Lake Belton.

The Fort Hood Military Reservation has a program to manage its fish and wildlife resources. Limited public hunting is provided, and fishing is available in the numerous lakes and ponds located on the reservation.

Wildlife habitat in the county is largely confined to rangeland, cropland, and pastureland. Therefore, the agricultural management of these lands largely determines their value as wildlife habitat. Improper grazing results in loss of valuable wildlife plants. Indiscriminate brush control can remove needed browse and cover plants. Good grazing management practices increase the quantity and quality of plants used by wildlife. Proper farming techniques such as conservation cropping systems provide food for wildlife as well as reducing erosion.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are lovegrass, kleingrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are little bluestem, sideoats grama, indiangrass, Englemann-daisy, and Maximilian sunflower.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are elbowbush, skunkbush, and sumac. Trees that benefit wildlife include oak, pecan, elm, hackberry, redbud, plum, Russian-olive, and autumn-olive.

The habitat for various kinds of wildlife is described in the following paragraphs.

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

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, bobwhite quail, turkey, squirrel, meadowlark, and mourning dove.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

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

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 16.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 16 and the results of chemical analysis in table 17. Information on clay mineralogy of several typical pedons is given in table 18. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by Texas A&M University, College Station, Texas, and by the National Soil Survey Laboratory, Lincoln, Nebraska.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*20*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).

Water retained—pressure extraction, percentage of oven-dry weight of less than 2 mm material; 1/3 or 1/10 (3/10) bar (4B1), 15 bars (4B2).

Moist bulk density—of less than 2 mm material, saran-coated clods (4A1).

Linear extensibility—change in clod dimension based on less than 2 mm material (4D).
Organic carbon—dichromate, ferric sulfate titration (6A1a).
Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (6O2), sodium (6P2), potassium (6Q2).
Cation-exchange capacity—ammonium acetate, pH 7.0 (5A6a).
Reaction (pH)—saturated paste (8C1b).
Reaction (pH)—calcium chloride (8C1e).
Carbonate as calcium carbonate—Warburg method (6E1f).
X-ray diffraction (7A21).
Differential thermal analysis (7A3).

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by Texas State Department of Highway and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (particle index)—T 100 (AASHTO), D 653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*21*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning dry or burnt, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciustolls (*Calci*, meaning calcic horizon, plus *Ustoll*, the suborder of the Mollisolls that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Calciustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, carbonatic, thermic, Typic Calciustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Denton series, which is a member of the fine-silty carbonatic, thermic Typic Calciustolls.

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*18*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*19*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bastsil Series

The Bastsil series consists of deep, well drained soils that formed in loamy alluvial sediments. These soils are nearly level to gently sloping and are on stream terraces. Slopes range from 1 to 3 percent.

Typical pedon of Bastsil fine sandy loam, 1 to 3 percent slopes; from the intersection of U.S. Highway 84 and Farm Road 2412 in Gatesville, about 9 miles northwest on Farm Road 2412 to county road, 1.8 miles northeast to Ater Cemetery, 10 feet east of road:

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; single grained; loose, very friable; many fine and very fine roots; slightly acid; clear smooth boundary.

E—8 to 15 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; loose, very friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.

Bt1—15 to 34 inches; red (2.5YR 4/8) clay loam, red (2.5YR 4/6) moist; moderate medium and coarse subangular blocky structure; extremely hard, friable; many thin patchy clay films on surface of peds and in pores; common very fine and fine roots and few coarse and medium roots; slightly acid; clear smooth boundary.

Bt2—34 to 50 inches; red (2.5YR 4/8) sandy clay loam, red (2.5YR 4/6) moist; moderate medium and coarse subangular blocky structure; extremely hard, friable; many thin patchy clay films on surface of peds and in pores; few fine and coarse roots; slightly acid; gradual smooth boundary.

B/E1—50 to 62 inches; red (2.5YR 5/8) sandy clay loam, red (2.5YR 5/6) moist; weak medium and coarse subangular blocky structure; extremely hard, friable; common thin patchy clay films on surface of peds and in pores; few fine roots; few siliceous pebbles; about 2 percent uncoated sand grains on surface of some peds; slightly acid; gradual smooth boundary.

B/E2—62 to 80 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; extremely hard, friable; few siliceous pebbles; about 4 percent uncoated sand grains on surface of some peds and in streaks; few very fine and fine roots; slightly acid.

The solum is 60 to more than 80 inches thick. Clay content of the control section ranges from 20 to 35 percent. Siliceous pebbles make up 0 to 15 percent. Most pedons have beds of gravel and sand below a depth of 80 inches.

The A horizon is brown or pale brown. It is medium acid to neutral.

The E horizon is light brown or pink. It is medium acid or slightly acid.

The Bt horizon is red, yellowish red, or strong brown. Some pedons have a few yellowish or reddish mottles. The Bt horizon is sandy clay loam or clay loam and is medium acid to neutral.

The matrix of the B/E horizon is in shades of red or brown. Texture is sandy clay loam, clay loam, or sandy loam. The E material consists of grayish uncoated sand grains on the surface of peds, in streaks, or in small pockets and makes up about 2 to 10 percent of the horizon, by volume. Reaction ranges from medium acid to neutral.

Bolar Series

The Bolar series consists of moderately deep, well drained soils that formed in interbedded limestone and marl. These soils are gently sloping and are on erosional uplands. Slopes range from 1 to 4 percent.

Typical pedon of Bolar gravelly clay loam, 1 to 4 percent slopes; from the intersection of Farm Road 182 and Farm Road 217 which is 1.0 mile north of Turnersville, 1.2 miles northeast on Farm Road 182 to another intersection with Farm Road 217, 1.2 miles east on Farm Road 217, 1.35 miles northeast on county road, 150 feet north of road in pasture:

A—0 to 9 inches; dark brown (7.5YR 4/2) gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure grading to moderate fine granular in the upper 3 inches; hard, friable, sticky and plastic; many very fine and fine roots and few medium roots; common fine and medium pores; few calcium carbonate concretions; about 20 percent by volume limestone fragments less than 3 inches in diameter; strongly effervescent; mildly alkaline; clear smooth boundary.

Bk1—9 to 19 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; common fine pores; common concretions, films, and threads of calcium carbonate; 25 percent by volume limestone fragments less than 3 inches in diameter; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—19 to 30 inches; very pale brown (10YR 7/4) gravelly loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common concretions and soft masses of calcium carbonate; 30 percent by volume limestone fragments less than 3 inches in diameter; violently effervescent; moderately alkaline; clear smooth boundary.

Bk3—30 to 38 inches; very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common concretions and soft masses of calcium carbonate; 10 percent by volume limestone fragments less than 3 inches in diameter; violently effervescent; moderately alkaline; gradual smooth boundary.

R—38 to 53 inches; limestone interbedded with soft marly earth.

The solum is 20 to 40 inches thick. Silicate clay content of the control section ranges from 20 to 35 percent. Calcium carbonate equivalent of the control section ranges from 40 to 70 percent. Fragments of limestone as much as 10 inches in diameter make up 3 to 35 percent by volume of the solum.

The A horizon is dark brown or dark grayish brown.

The Bk horizon is brown, dark brown, dark grayish brown, very pale brown, light yellowish brown, yellowish brown, brownish yellow, reddish yellow, or yellow. It is loam, clay loam, silty clay loam, or a gravelly counterpart.

The R layer is indurated limestone bedrock that is interbedded with marly soil material or chalky limestone at vertical intervals of 4 to 20 inches. Cracks or fractures are spaced about 6 to 30 inches apart. Fractures are tight, mainly less than 1/4 inch wide. The limestone has a hardness of 3 on Mohs' scale.

Bosque Series

The Bosque series consists of deep, well drained soils that formed in loamy, calcareous alluvium. These soils are along nearly level flood plains. Slopes range from 0 to 1 percent.

Typical pedon of Bosque clay loam, in an area of Bosque clay loam, occasionally flooded from the intersection of Farm Road 107 and Texas Highway 36 south of Gatesville, 2.9 miles south on Texas Highway 36 to intersection with East 24 Street at North Fort Hood, 2.3 miles east on East 24 Street to Longhorn Landing Strip, 0.2 mile south along east border of landing strip, 240 feet east in bottom land (100 feet west of Leon River):

A1—0 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure grading to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; common worm casts; common fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—9 to 23 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin discontinuous lenses of brownish fine sandy loam; common fine, very fine, and few medium roots; common worm casts; common fine and many very fine pores; few calcium carbonate films and threads; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak1—23 to 31 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; few worm casts; common films and threads of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak2—31 to 54 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common films and threads of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—54 to 80 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium and coarse subangular blocky; very hard, friable, slightly sticky and slightly plastic; few coarse roots; common films and threads of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to sand, gravel, or limestone ranges from 5 to about 30 feet. The clay content ranges from 20 to 35 percent. The calcium carbonate equivalent ranges from 15 to 40 percent. Some pedons have light colored discontinuous loamy or sandy strata less than 3 inches thick. Some pedons have limestone and siliceous pebbles or gravel that make up less than 15 percent by volume. The soil is mildly alkaline or moderately alkaline throughout.

The A horizon is brown, dark grayish brown, or grayish brown. The B horizon is brown, grayish brown, pale brown, or light yellowish brown. It is loam or clay loam. Some pedons have a buried B horizon below a depth of 40 inches that has clayey texture. The buried horizon is dark grayish brown or grayish brown.

Brackett Series

The Brackett series consists of deep, well drained, loamy soils on uplands. These soils formed in interbedded marl, limestone, and shale (fig. 13). Slopes range from 3 to 8 percent.

Typical pedon of Brackett gravelly loam, in an area of Brackett-Topsey association, 3 to 8 percent slopes, eroded; from the intersection of Texas Highway 36 and West Range Road about 3 miles southeast of Gatesville, 1.6 miles southwest on West Range Road, 2.1 miles southwest on Turnover Creek Road, and 75 feet northwest, in rangeland:

A—0 to 6 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; many very fine and fine roots; many very fine pores; few worm casts; 20 percent shell fragments as much as 1 inch across the longer axis; discontinuous stone line at lower boundary; few calcium carbonate masses; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—6 to 17 inches; pale yellow (2.5Y 8/4) loam, light yellowish brown (2.5Y 6/4) moist; weak medium subangular blocky structure; hard, friable; many very

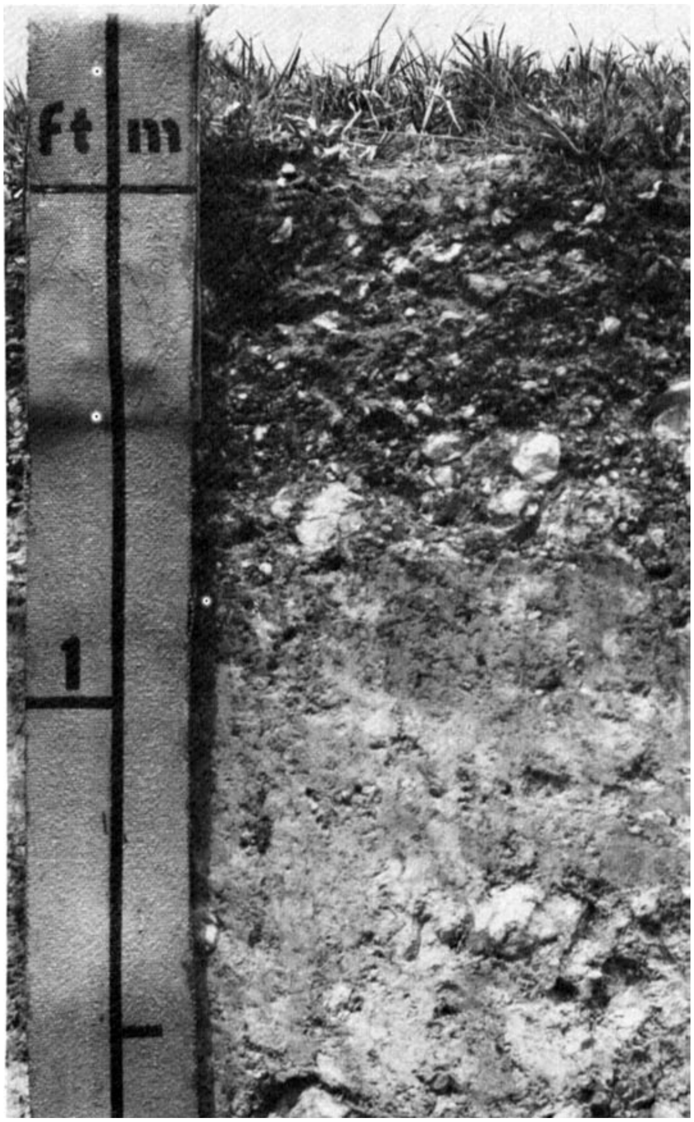


Figure 13.—Profile of Brackett gravelly loam. Note nodular limestone and shell fragments, and stone line at a depth of 6 inches.

fine roots; many very fine pores; few worm casts filled with darker material from the horizon above; few pockets of slightly indurated loamy marl that has strong fine angular blocky structure; discontinuous stone line at lower boundary; common calcium carbonate masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Ck—17 to 34 inches; white (2.5Y 8/2) loamy marl interbedded with shaly clay, pale yellow (2.5Y 7/4) moist; common fine faint yellowish brown and few fine faint white mottles; hard, friable; few very fine roots in fractures; many very fine pores; few pockets of soil material from the horizons above; many calcium carbonate masses; violently effervescent; moderately alkaline.

Depth to interbedded shale and marl ranges from 15 to 30 inches. Content of coarse fragments ranges from a few to about 30 percent. Silicate clay ranges from 18 to 30 percent in the control section. Calcium carbonate equivalent ranges from 40 to 80 percent throughout the pedon.

The A horizon is pale brown, brown, or grayish brown.

The B horizon is pale yellow, light yellowish brown, very pale brown, pale brown, light brownish gray, or yellowish brown. It is loam, clay loam, or gravelly loam.

The C horizon is white, pale yellow, very pale brown, or light yellowish brown. It is clayey marl or loamy marl interbedded with shale and limestone.

Cho Series

The Cho series consists of very shallow and shallow, well drained, loamy soils on uplands. These soils formed in calcareous, loamy sediment. Slopes range from 1 to 3 percent.

Typical pedon of Cho clay loam, 1 to 3 percent slopes; from the intersection of Farm Road 932 and U.S. Highway 84 in South Purmela, 0.5 mile northeast on Farm Road 932, 0.6 mile east on county road, and 800 feet north of county road, in rangeland:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; common very fine and fine pores; many calcium carbonate concretions; violently effervescent; moderately alkaline; clear smooth boundary.

A2—8 to 11 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; common very-fine and fine pores; about 45 percent caliche fragments; many calcium carbonate concretions; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkm—11 to 22 inches; white (10YR 8/2) indurated caliche, in plates 6 to 14 inches across and 1 to 2 inches thick; laminar in upper part; common pink (7.5YR 7/4) stains; few seams of dark loamy material between plates and in solution channels; few cemented shell fragments; clear wavy boundary.

Ck—22 to 59 inches; very pale brown (10YR 8/3) limy earth; massive; hard, friable; few pink (7.5YR 7/4) stains; few shells; about 60 to 70 percent, by volume, calcium carbonate; violently effervescent; moderately alkaline.

Thickness of the solum ranges from 7 to 20 inches and corresponds to the depth to the petrocalcic horizon.

The A horizon is dark grayish brown or brown. The A2 horizon is clay loam, gravelly clay loam, or very gravelly clay loam.

The Ck horizon has a laminar cap 1/2 to 1 inch thick. The Ck horizon is limy earth interbedded with caliche. It is 40 to 70 percent, by volume, calcium carbonate.

Cisco Series

The Cisco series consists of deep, well drained, loamy soils on uplands. These soils formed in sandy and loamy sediment. Slopes range from 1 to 5 percent.

Typical pedon of Cisco fine sandy loam, 1 to 5 percent slopes, eroded; from the intersection of Farm Road 116 and Farm Road 1783 south of Gatesville, 4.6 miles west on Farm Road 1783, 6.0 miles west on county road, and 30 feet south, in rangeland:

A—0 to 4 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; many fine roots; many fine pores; few worm casts; neutral; abrupt smooth boundary.

Bt1—4 to 23 inches; reddish brown (5YR 5/4) clay loam, reddish brown (10YR 4/4) moist; moderate medium and fine subangular blocky structure; hard, firm; common fine roots; many fine pores; common medium discontinuous dark reddish brown (5YR 3/3) clay films on vertical and horizontal faces of peds; few worm casts; neutral; clear smooth boundary.

Bt2—23 to 41 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium and fine subangular blocky structure; hard, firm; common very fine and fine roots; many very fine and fine pores; common thin discontinuous reddish brown (5YR 4/4) clay films; few thin yellow (10YR 7/6) skeletans; neutral; clear smooth boundary.

Bk1—41 to 58 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few very fine and fine roots; many very fine and fine pores; common films and threads of calcium carbonate; mildly alkaline; strongly effervescent; gradual smooth boundary.

Bk2—58 to 68 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 5/8) moist; weak fine subangular blocky structure; few remnant pieces of reddish yellow (7.5YR 7/6) shale; hard, friable; few very fine roots; many very fine pores; concentrations of calcium carbonate; mildly alkaline; strongly effervescent; clear smooth boundary.

C—68 to 80 inches; white (10YR 8/2) pack sand; single grained; loose, very friable; few bands of strong brown (7.5YR 5/8); intermittent pockets of shale that has rock structure; intermittent tonguing of clay into sand; neutral.

Solum thickness ranges from 40 to 70 inches. Clay content decreases with depth. Depth to secondary carbonates is 36 inches or more.

The A horizon is brown, dark brown, or reddish brown. It is slightly acid to mildly alkaline.

The Bt and Bk horizons are reddish brown, red, yellowish red, or reddish yellow. They are neutral to moderately alkaline. Clay content of the upper 20 inches of the Bt horizon ranges from 20 to 35 percent. The Bt horizon is clay loam or sandy clay loam. The Bk horizon is fine sandy loam or sandy clay loam.

Cranfill Series

The Cranfill series consists of deep, well drained, loamy soils on uplands. These soils formed in loamy, calcareous colluvial sediment containing many limestone fragments. Slopes range from 3 to 8 percent.

Typical pedon of Cranfill gravelly clay loam, 3 to 8 percent slopes; from the intersection of Farm Road 182 and Farm Road 217 which is 1 mile north of Turnersville, 6.2 miles northeast on Farm Road 182, and 1 mile northwest in native rangeland:

A—0 to 11 inches; grayish brown (10YR 5/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; hard, friable; many very fine and fine roots; common films, threads, and concretions of calcium carbonate; 25 percent, by volume, limestone fragments 1/4 inch to 3 inches in diameter; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk1—11 to 25 inches; very pale brown (10YR 7/4) gravelly clay loam, light yellowish brown (10YR 6/4) moist; moderate medium subangular blocky structure; hard, friable; common very fine and fine roots; many films, threads, and concretions of calcium carbonate; 30 percent, by volume, limestone fragments 1/4 inch to 2 inches in diameter; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk2—25 to 57 inches; light yellowish brown (10YR 6/4) gravelly clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; hard, friable; few fine roots; many films, threads, and concretions of calcium carbonate; 30 percent, by volume, limestone fragments 1/4 inch to 3 inches in diameter; violently effervescent; moderately alkaline; gradual smooth boundary.

Ck—57 to 74 inches; very pale brown (10YR 7/4) gravelly clay loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable; many soft masses, threads, and concretions of calcium carbonate; 15 percent, by volume, limestone fragments 1/4 inch to

2 inches in diameter; violently effervescent; moderately alkaline.

Solum thickness ranges from 40 to 70 inches. The calcium carbonate equivalent of the 10- to 40-inch control section ranges from 70 to 90 percent. The control section is 22 to 35 percent silicate clay.

The A horizon is grayish brown, brown, or light brownish gray. Coarse fragments, in the A horizon, range from 15 to 30 percent and are mainly limestone fragments from 1/4 inch to 3 inches in diameter.

The Bk horizon is light yellowish brown, yellowish brown, very pale brown, or pink. It is gravelly clay loam or gravelly loam. Coarse fragments of limestone make up 20 to 35 percent by volume.

Coarse fragments of limestone make up 15 to 30 percent, by volume, of the Ck horizon.

Crawford Series

The Crawford series consists of moderately deep, well drained, clayey soils on uplands. These soils formed in limestone. Slopes range from 1 to 3 percent.

Typical pedon of Crawford silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 107 in Fort Gates, 17.1 miles east on Farm Road 107, 2.2 miles north on county road, and 200 feet east, in cropland:

Ap—0 to 5 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; weak very fine blocky structure; very hard, firm; few fine quartz pebbles; few fragments of limestone; few concretions; neutral; abrupt smooth boundary.

A1—5 to 12 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium blocky structure parting to very fine blocky; extremely hard, very firm, very sticky and plastic; shiny ped faces; few fine quartz pebbles; few fragments of limestone; neutral; gradual irregular boundary.

A2—12 to 21 inches; dark brown (7/5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; parallelepipeds part to moderate medium blocky and weak very fine blocky structure; extremely hard, very firm, very sticky and plastic; few intersecting slickensides border parallelepipeds tilted 20 to 40 degrees from horizontal; shiny pressure faces; few fine quartz pebbles; few fragments of limestone; neutral; gradual wavy boundary.

A3—21 to 28 inches; dark reddish brown (5YR 3/2) silty clay, dark reddish brown (5YR 3/2) moist; crushed peds are dark reddish brown (5YR 3/3) moist; parallelepipeds part to moderate or strong medium blocky structure; extremely hard, very firm, very sticky and plastic; fine roots penetrate the peds; common distinct grooved slickensides border parallelepipeds about 1 1/2 inches across the long axis; shiny pressure faces; few quartz pebbles; few fragments of limestone; neutral; abrupt irregular boundary.

R—28 to 38 inches; fractured limestone; dark reddish brown clay in the fine crevices.

Thickness of the solum to indurated bedrock or limestone interbedded with clayey marl or shale is 20 to 40 inches. When dry, these soils have cracks ranging from 0.4 inch to 2.0 inches wide that extend from the surface to a depth of 20 inches or more. Clay content ranges from 40 to 60 percent. The soil is slightly acid to moderately alkaline and is mainly noncalcareous.

The Ap and A1 horizons are dark reddish brown, reddish brown, dark brown, brown, very dark brown, dark grayish brown, or very dark grayish brown. Less than half of the pedons have chroma of less than 1.5 in the Ap and A1 horizons.

The A2 and A3 horizons are dark reddish brown, reddish brown, dark brown, or brown. They are clay or silty clay. A few pedons have secondary lime directly above the limestone bedrock.

Denton Series

The Denton series consists of deep, well drained, clayey soils that formed in clayey material over weakly cemented to fractured indurated limestone and interbedded marl (fig. 14). These soils are nearly level to gently sloping and are on uplands. Slopes range from 1 to 3 percent.

Typical pedon of Denton silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 929 in Gatesville, 8.6 miles east and north on Farm Road 929 to intersection with county road, 0.3 mile east on Farm Road 929, 85 feet north in cultivated field:

Ap—0 to 6 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine and very fine granular structure; soft, very friable, sticky and plastic; few fine and medium roots; few fine pitted concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A—6 to 13 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine and very fine subangular blocky stucture; very hard, firm, sticky and plastic; few fine roots; many pressure faces; few small slickensides less than 1 inch across forming wedge-shaped peds; few fine pitted concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw—13 to 19 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate fine and very fine angular blocky structure; very hard,

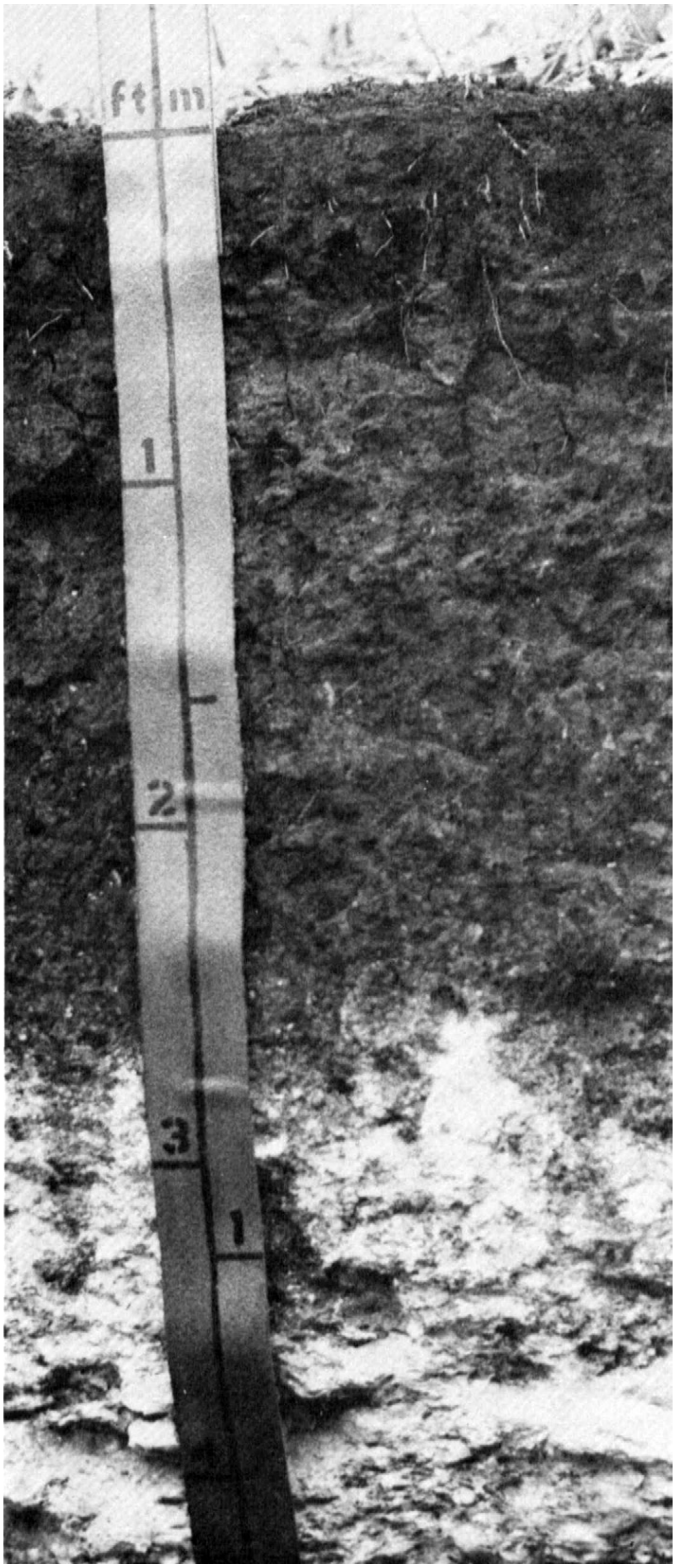


Figure 14.—Profile of Denton silty clay. Note limestone at a depth of about 45 inches.

firm, sticky and plastic; few fine roots; of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Bk—19 to 36 inches; reddish yellow (7.5YR 7.6) silty clay loam, reddish yellow (7.5YR 6/6) moist; common medium masses of strong brown (7.5YR 5/6); weak medium and fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine and medium concretions and soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear irregular boundary.

2Ck—36 to 52 inches; strong brown (7.5YR 5/6) marly soil material; massive; 5 percent masses of reddish yellow (7.5YR 6/6) Bk material; 10 percent, by volume, limestone fragments 1 inch to 8 inches across and 2 to 4 inches thick; fragments form a discontinuous line mainly in the upper part of the layer; about 25 percent coarse and very coarse soft masses and thin discontinuous strata of calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

2R—52 to 70 inches; indurated slightly weathered limestone bedrock interbedded with marl or chalky limestone at vertical intervals of 6 to about 12 inches; tight fractures 8 to 24 inches apart.

Thickness of the solum ranges from 22 to 40 inches, and depth to limestone bedrock ranges from 40 to 60 inches. Films, threads, or soft masses of calcium carbonate are within a depth of 15 to 28 inches.

The silicate clay content of the control section ranges from 25 to 35 percent. The calcium carbonate equivalent is 40 to 65 percent. The COLE in the upper 50 inches or to bedrock ranges from .02 to .1. However, the soil does not have a layer 20 inches or more thick that has COLE of .07 or more.

The A horizon is commonly less than 20 inches thick but ranges from 7 to 26 inches. It is brown, dark brown, or dark grayish brown. The total clay content ranges from 35 to 55 percent with 0 to 5 percent clay-size carbonates.

Some pedons do not have a Bw horizon. The Bw horizon, where present, is reddish brown, dark reddish brown, yellowish red, or dark yellowish brown. The texture is silty clay or silty clay loam.

The 2Bk horizon is reddish yellow, strong brown, pale brown, yellowish brown, or brown. It is silty clay loam, silt loam, or loam. Fragments of limestone ranging from pebble to cobble size make up 0 to about 15 percent by volume.

Some pedons do not have a 2Ck horizon. The 2Ck horizon, where present, is mainly in shades of brown or yellow. It is marly soil material, mainly of silty clay loam or silt loam texture.

Limestone pebbles or cobbles range from a few to about 35 percent by volume. Limestone fragments typically form a discontinuous lag line in the 2Bk or 2Ck horizon. Large soft masses and discontinuous strata of calcium range from about 5 to 35 percent by volume.

The 2R layer is indurated limestone bedrock that is interbedded with marly soil material or chalky limestone at vertical intervals of 4 to 20 inches. Cracks or fractures are spaced 6 to 30 inches apart. Fractures are tight, ranging from less than 1/4 of an inch to about 1 1/2 inches wide. In most pedons the bedrock cannot be excavated with conventional digging equipment such as a backhoe machine.

Desan Series

The Desan series consists of deep, somewhat excessively drained, sandy soils on stream terraces. These soils formed in sandy and loamy alluvium. Slopes range from 1 to 3 percent.

Typical pedon of Desan fine sand, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 931 in Flat, 3.3 miles northeast on Farm Road 931, 2.8 miles north on county road, and 4,300 feet northwest, in pasture:

Ap—0 to 8 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; weak medium granular structure; loose, very friable: many very fine and fine roots; many very fine pores; medium acid; abrupt smooth boundary.

E1—8 to 43 inches; reddish yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 5/6) moist; massive; loose, very friable; common very fine and fine roots; many very fine pores; medium acid; gradual smooth boundary.

E2—43 to 77 inches; reddish yellow (7.5YR 7/6) fine sand, strong brown (7.5YR 5/6) moist; few fine faint pink mottles; massive; loose, very friable; few very fine roots; many very fine pores; medium acid; clear smooth boundary.

Bt—77 to 90 inches; reddish yellow (7.5YR 6/8) fine sandy loam, strong brown (7.5YR 5/8) moist; weak medium subangular blocky structure; slightly hard, very friable; few very fine roots; many very fine pores; few thin patchy clay films and clay bridging sand grains; medium acid.

The combined thickness of the A and E horizons is 40 to 80 inches. Reaction ranges from slightly acid to medium acid.

The Ap horizon is brown or yellowish brown.

The E horizon is reddish yellow or light yellowish brown. It is fine sand, loamy fine sand, or sand.

The Bt horizon is reddish yellow or yellowish red. It is fine sandy loam or sandy clay loam. A BC horizon is present in some pedons. Where present, it is strong brown or yellowish brown.

Doss Series

The Doss series consists of shallow, well drained, loamy soils on concave and convex uplands. These soils formed in weakly cemented limestone interbedded with loamy, calcareous marl. Slopes range from 1 to 8 percent.

Typical pedon of Doss clay loam, in an area of Doss-Real complex, 1 to 8 percent slopes; from the intersection of U.S. Highway 84 and Farm Road 116 about 1 mile west of Gatesville, 17.3 miles southwest on Farm Road 116, 1.6 miles southeast on Antelope Road in Fort Hood Military Reservation, 200 feet west, in rangeland:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure: hard, friable; many very fine and fine roots; few concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—8 to 18 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; hard, friable; many very fine and fine roots; many very fine pores; about 14 percent limestone fragments by volume; common films, threads, and concretions of calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

Cr—18 to 22 inches; weakly cemented limestone interbedded with loamy, calcareous marl; few fine roots in fractures and between limestone strata; the limestone has a hardness of about 2.5 on Mohs' scale.

The solum is 11 to 20 inches thick. The total clay content ranges from 27 to 40 percent in the solum. Silicate clay ranges from 25 to 35 percent. Limestone fragments, gravel and cobble size, range from a few to 15 percent by volume. Calcium carbonate equivalent ranges from 40 to 60 percent. Reaction is mildly alkaline or moderately alkaline.

The A horizon is dark brown, very dark grayish brown, or dark grayish brown.

The B horizon is brown, very pale brown, or light yellowish brown. It is clay loam or silty clay loam. Some pedons do not have a B horizon.

The Cr horizon is weakly cemented limestone interbedded with loamy, calcareous marl. The loamy marl is dark brown, light gray, yellowish brown, light yellowish brown, or yellow. The limestone has a hardness of less than 3 on Mohs' scale.

Eckrant Series

The Eckrant series consists of very shallow and shallow, well drained, clayey soils on uplands. These soils formed in residuum of limestone. Slopes range from 1 to 3 percent.

Typical pedon of Eckrant cobbly silty clay, in an area of Eckrant-Rock outcrop complex, 1 to 3 percent slopes; from the intersection of Farm Road 1996 and Farm Road 107 about 3.2 miles south of Oglesby, 1.75 miles west on Farm Road 107 and 1,000 feet south, in rangeland:

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) cobbly silty clay, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many fine and medium roots; few fine pores; few worm casts; about 20 percent limestone pebbles and 15 percent cobbles; mildly alkaline; clear wavy boundary.

A2—5 to 12 inches; very dark grayish brown (10YR 3/2) very cobbly silty clay, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; common very fine pores; about 20 percent limestone pebbles and 35 percent cobbles; few calcium carbonate pendants under some of the cobbles; mildly alkaline; abrupt wavy boundary.

R—12 to 13 inches; hard, massive limestone with a thin cap of softer limestone.

Thickness of the solum and depth to limestone bedrock range from 6 to 15 inches (fig. 15). Clay content ranges from 40 to 55 percent. Coarse fragments of pebbles, cobbles, and stones make up 35 to 70 percent of the pedon; the amount increases with depth. The soil is mildly alkaline or moderately alkaline.

The A horizon is very dark grayish brown, dark grayish brown, or dark brown. Secondary calcium carbonate coats some of the limestone along fractures.

In some pedons, the upper 1/2 to 1 inch of the bedrock is softer than that below. Some pedons have soft limy material interbedded with the limestone.

Figure 15.—Profile of Eckrant cobbly silty clay.

Evant Series

The Evant series consists of shallow, well drained, clayey soils that formed in clayey marine sediment. These soils are on gently sloping uplands. Surfaces are plane to convex, and slopes range from 1 to 3 percent.

Typical pedon of Evant silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 184, near Coldsprings, 1.5 miles south on Farm Road 184, 1.0 mile south on East Range Road in Fort Hood, and 300 feet east, in rangeland:

A1—0 to 3 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm, slightly sticky; many fine roots; about 5 percent by volume chert pebbles and cobbles 1/4 inch to 6 inches across; neutral; clear smooth boundary.

A2—3 to 8 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; moderate very fine subangular blocky structure; very hard, firm, sticky and plastic; many fine and few medium and coarse roots; few pressure faces; about 11 percent by volume chert pebbles 1/2 inch to 2 inches across; slightly acid; clear smooth boundary.

Bt1—8 to 15 inches; dark red (2.5YR 3/6) clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine and few medium and coarse roots; few filled cracks; few pressure faces and small slickensides; few chert pebbles 1/8 to 1/2 inch across; medium acid; clear smooth boundary.

Bt2—15 to 17 inches; dark red (2.5YR 3/6) clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; extremely hard, very firm, sticky and plastic; common fine, few medium and coarse roots; few filled cracks; common pressure faces and a few slickensides as much as 3 inches across; few chert pebbles 1/8 to 1/2 inch across; neutral; clear smooth boundary.

Bk—17 to 19 inches; dark reddish brown (2.5YR 3/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; common very fine and fine and few medium roots; many concretions of calcium carbonate; about 13 percent by volume chert pebbles 1/8 to 1/2 inch across; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Bkm—19 to 27 inches; pinkish white (7.5YR 8/2) strongly cemented material plugged with carbonates; brownish and yellowish seams 1/8 to 1/4 inch thick make up about 30 percent by volume below an indurated laminar cap 1/4 to 1/2 inch thick; roots matted on cap, few roots along fractures; fractures at intervals of 4 to 18 inches.

Cr—27 to 50 inches; white interbedded weakly and strongly cemented layers of chalky limestone; hardness of less than 3 on Mohs' scale.

Thickness of the solum and depth to the petrocalcic horizon range from 14 to 20 inches. Pebbles and cobbles of chert and limestone make up 0 to 20 percent by volume. Typically, pebbles and cobbles range from a few to less than 15 percent.

The A horizon is dark reddish brown, reddish brown, brown, dark brown, or dark yellowish brown. Reaction is slightly acid or neutral.

The B horizon has colors of reddish brown, dark reddish brown, red, dark red, and brown. Clay content ranges from 60 to 80 percent. The Bt horizon is medium acid to neutral. The Bk horizon is mildly alkaline or moderately alkaline.

The Bkm horizon has colors in shades of white or pink with thin horizontal seams of yellow or brown. It is plugged with carbonates and is weakly to strongly cemented. This horizon has an indurated laminar cap 1/4 to 1 inch thick. The cap is thinnest in the steepest areas; some pedons do not have a cap. Roots enter this horizon only along fractures and in some of the softer horizontal seams.

The Cr horizon is weakly or strongly cemented chalky limestone. It is massive or platy. In some pedons it is strongly cemented and platy in the upper part and weakly cemented and massive below. The limestone can be chipped or dug with a spade when moist.

Frio Series

The Frio series consists of deep, well drained, clayey soils on flood plains. These soils formed in loamy and clayey calcareous alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Frio silty clay, occasionally flooded; from the intersection of Texas Highway 36 and Texas Highway 236 in The Grove 18 miles southeast of Gatesville, 5.2 miles northwest on Texas Highway 236, and 100 feet west in wooded area 0.28 mile northwest of the north end of the Leon River bridge in Mother Neff State Park:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; hard, firm, sticky and plastic; many and medium roots and few coarse roots; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—8 to 22 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; many fine, medium, and few coarse roots; few fine shell fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

A3—22 to 29 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, sticky and plastic; common fine and medium and few coarse roots; common fine films and threads of calcium carbonate; few fine shell fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

A4—29 to 40 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; common fine and medium and few coarse roots; common fine films and threads of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk1—40 to 80 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure parting to weak coarse blocky; hard, firm, sticky and plastic; few fine, medium, and coarse roots; many fine films and threads and a few soft masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth of sand, gravel, or limestone ranges from 6 to about 30 feet. The clay content ranges from 30 to 50 percent; the control section averages 35 to 42 percent clay. The calcium carbonate equivalent ranges from 15 to 40 percent. The COLE ranges from about .04 to .09 in the upper 50 inches; however, the soil does not have a layer 20 inches or more thick with COLE of .07 or more. Some pedons have limestone and chert pebbles or cobbles that make up less than 15 percent by volume.

The A horizon is dark brown, dark grayish brown, or very dark grayish brown. It is 20 to 60 inches thick. Some pedons have light colored discontinuous loamy strata less than 3 inches thick.

Most pedons have a B horizon that has higher value or chroma than the A horizon. The B horizon is below a depth of 22 inches and is typically below the control section. However, some pedons have a buried A horizon below this depth.

Krum Series

The Krum series consists of deep, well drained, clayey soils on low terraces and in filled valleys. These soils formed in calcareous, clayey, old alluvial sediment. Slopes range from 1 to 3 percent.

Typical pedon of Krum silty clay, 1 to 3 percent slopes; from the intersection of Farm Road 116 and Farm Road 1783 southwest of Gatesville, 4.6 miles west on Farm Road 1783, 3.8 miles west on county road, and about 3,000 feet south, in pasture:

Ap—0 to 5 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; many fine and medium roots; few very fine pores; few concretions of calcium carbonate (about 1 percent by volume); strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—5 to 25 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common fine roots; common very fine pores; common concretions of calcium carbonate (about 2 percent by volume); strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—25 to 57 inches; grayish (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine pores; common films, threads, and concretions of calcium carbonate (about 5 percent by volume); strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—57 to 80 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; common films, threads, and concretions of calcium carbonate (about 8 percent by volume); violently effervescent; moderately alkaline.

The solum is 48 to more than 80 inches thick. The soil, when dry, has cracks 0.4 inch to 1.2 inches wide that extend from the surface to a depth of 30 to 50 inches. The 10- to 40-inch control section is silty clay or clay. Clay content is 40 to 60 percent.

The A horizon is very dark grayish brown, dark grayish brown, dark gray, or very dark gray. Thickness of the horizons that have value and chroma of less than 3.5 when the soil is moist ranges from 14 to 36 inches.

The B horizon is very dark grayish brown, dark grayish brown, grayish brown, brown, or pale brown. The content of calcium carbonate ranges from 5 percent to about 20 percent by volume.

The C horizon, where present, is light yellowish brown, brownish yellow, light brown, or reddish yellow. The content of calcium carbonate ranges from 2 to 20 percent by volume. Texture is silty clay loam, silty clay, or clay.

The Krum soils described in Coryell County are a taxadjunct to the Krum series, because of the presence of a calcic horizon within a depth of 40 inches. This difference does not adversely affect use and management of the soils.

Lewisville Series

The Lewisville series consists of deep, well drained, loamy soils on terraces along major streams. These soils formed in calcareous, old alluvial sediment. Slopes range from 1 to 3 percent.

Typical pedon of Lewisville clay loam, 1 to 3 percent slopes; from the intersection of Farm Road 116 and Farm Road 1783 southwest of Gatesville, 4.6 miles west on Farm Road 1783, 3.6 miles west on county road, and 75 feet north in pasture along Cowhouse Creek:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common fine calcium carbonate concretions; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—5 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; common very fine pores; common fine calcium carbonate concretions; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—12 to 27 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; few very dark grayish brown (10YR 3/2) coatings on ped faces; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine root channels filled with dark grayish brown (10YR 4/2) material; many fine pores; common fine calcium carbonate films, threads, and concretions; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—27 to 54 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few faint root channels filled with dark grayish brown (10YR 4/2) material; many very fine pores; common fine calcium carbonate films, threads, and concretions; violently effervescent; moderately alkaline; clear smooth boundary.

Bk3—54 to 77 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine root channels filled with dark grayish brown (10YR 4/2) material; many very fine pores; few medium calcium carbonate concretions; common fine calcium carbonate films and threads; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The mollic epipedon is 10 to 19 inches thick. Depth to the calcic horizon ranges from 10 to 20 inches. Silicate clay content ranges from 27 to 35 percent. Calcium carbonate equivalent in the 10- to 40-inch section ranges from 20 to 40 percent.

The A horizon is dark grayish brown or brown. Siliceous pebbles make up 0 to about 3 percent by volume.

The Bk1 horizon is brown, yellowish brown, grayish brown, or pale brown. The Bk2 horizon is brown, light brown, light yellowish brown, or grayish brown. Visible carbonates range from 3 to 10 percent. The Bk3 horizon is pale brown, light brown, or reddish yellow. Visible carbonates range from 3 to 10 percent.

Minwells Series

The Minwells series consists of deep, well drained, loamy soils on terraces. These soils formed in clayey and loamy sediment stratified with gravelly sandy clay loam and sand in ancient deposits along the Leon River. Slopes range from 1 to 3 percent.

Typical pedon of Minwells fine sandy loam, 1 to 3 percent slopes; from the intersection of Farm Road 930 and Farm Road 2412 in Levita, 1.0 mile east on Farm Road 2412, 1.4 miles north and 0.9 mile west on county roads, and 75 feet south, in pasture:

Ap—0 to 6 inches; dark brown (10YR 4/3) fine sandy loam; dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, nonplastic; many very fine and fine roots; many very fine pores; few siliceous pebbles as much as 1/8 inch across; neutral; abrupt smooth boundary.

Bt1—6 to 18 inches; reddish brown (2.5YR 5/4) gravelly sandy clay loam, reddish brown (2.5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; many very fine pores; many thin continuous dark reddish brown (2.5YR 3/4) clay films; about 10 percent siliceous pebbles as much as 1/4 inch across; neutral; clear smooth boundary.

Bt2—18 to 52 inches; red (2.5YR 5/6) gravelly sandy clay, red (2.5YR 4/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine pores; many thin discontinuous reddish brown (2.5YR 4/4) clay films; about 30 percent siliceous pebbles as much as 1/4 inch across; neutral; clear smooth boundary.

Btk—52 to 63 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; common fine distinct strong brown mottles; weak fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine pores; common thin discontinuous reddish brown (2.5YR 4/4) clay films; about 5 percent masses and concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

BCk—63 to 80 inches; reddish yellow (5YR 6/6) gravelly sandy clay loam, yellowish red (5YR 5/6) moist; massive, hard, friable; estimated 30 percent siliceous pebbles as much as 1 inch in diameter; about 10 percent by volume masses and concretions of calcium carbonate; strongly effervescent; moderately alkaline.

The solum is 40 to about 80 inches thick. Depth to beds of gravel ranges from 40 to about 70 inches. Depth to calcium carbonate accumulation ranges from 40 to 65 inches.

The A horizon is dark brown or brown. It is neutral or mildly alkaline. Siliceous pebbles make up 0 to 10 percent by volume.

The Bt horizon is reddish brown, red, or yellowish red. It is clay, sandy clay, or sandy clay loam. Reaction is neutral to moderately alkaline. Clay content of the upper 20 inches ranges from 35 to 45 percent.

The BCk horizon is yellowish red or reddish yellow. It is gravelly sandy clay loam or very gravelly sandy clay loam. Siliceous pebbles make up 20 to 60 percent by volume. Reaction is mildly alkaline to moderately alkaline.

Nuff Series

The Nuff series consists of deep, well drained, loamy, very stony soils that formed in interbedded marl, limestone, and shaly silty clay loam. Slopes range from 2 to 6 percent.

Typical pedon of Nuff very stony silty clay loam, 2 to 6 percent slopes; from the intersection of U.S. Highway 84 and FM 116, 3.1 miles southwest on FM 116, 1.7 miles east on county road, 2.2 miles north on county road, and 300 feet west, in rangeland:

A1—0 to 5 inches; dark gray (10YR 4/1) very stony silty clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure parting to weak fine granular; very hard, friable, sticky and plastic; many very fine and few medium roots; common worm casts; few fine concretions of calcium carbonate; limestone fragments 3 to 20 inches across and 1/2 inch thick cover about 20 percent of surface and make up 5 percent by volume of layer; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—5 to 11 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; many very fine and fine roots; common worm casts; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—11 to 21 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; common very fine and fine roots; common worm casts; common fine concretions of calcium carbonate; few cracks filled with soil from horizons above; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—21 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; common fine and medium concretions and soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk3—30 to 36 inches; light olive brown (2.5YR 5/4) very stony silty clay loam, olive brown (2.5Y 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; common fine and medium concretions and soft masses of calcium carbonate; about 30 percent by volume limestone fragments 4 to 18 inches across and 1/2 to 3/4 inch thick; strongly effervescent; moderately alkaline; gradual wavy boundary.

CBk—36 to 58 inches; light gray (2.5Y 7/2), yellow (2.5Y 8/6), and yellow (10YR 7/8) interbedded layers of marly and shaly silty clay loam, light brownish gray (2.5Y 6/2), yellow (2.5Y 7/6), and brownish yellow (10YR 6/8) moist; massive; few fine roots; few fossil shells 1/2 inch to 1 1/4 inches across; strongly effervescent; moderately alkaline; gradual wavy boundary.

Ck—58 to 80 inches; pale yellow (5Y 7/3) and yellow (10YR 7/8) interbedded compact layers of shaly silty clay, pale olive (5Y 6/3) and brownish yellow (10YR 6/8) moist; massive; few fine roots; strongly effervescent; moderately alkaline.

The solum is 20 to 40 inches thick. Limestone pebbles and fragments as much as 48 inches across and 1/2 inch to 4 inches thick cover 3 to 30 percent of the surface. Most of the fragments are 6 to 24 inches across and 1/2 inch to 2 inches thick. Some fragments are tilted at an angle of 30 to 50 degrees. Calcium carbonate concretions are typically throughout the soil, and films, threads, or soft masses of calcium carbonate are within a depth of 15 to 24 inches.

The A horizon is dark gray, very dark gray, dark grayish brown, or very dark grayish brown. Pebbles, cobbles, and stone-sized limestone fragments range from 2 to 40 percent by volume; stones and cobbles typically make up 3 to 25 percent.

The B horizon is brown, grayish brown, light olive brown, dark brown, or very dark grayish brown. Yellowish or brownish mottles range from none to few. The B horizon is silty clay loam, silt loam, or a stony counterpart. Limestone fragments make up 5 to 35 percent by volume of some layers in this horizon. The stony layers are thin and discontinuous. Some pedons do not have these stony layers.

The C horizon is yellowish, grayish, or brownish. It is interbedded marly and shaly silt loam, silty clay loam, or silty clay. Some pedons have limestone layers 2 to 4 inches thick at vertical intervals of 2 to 6 feet.

Oglesby Series

The Oglesby series consists of shallow, well drained, clayey soils. These soils formed in residuum of weathered limestone and marine sediment over limestone bedrock. Slopes are dominantly less than 3 percent, although they range to 5 percent.

Typical pedon of Oglesby silty clay, 1 to 3 percent slopes; from the intersection of Farm Road 182 and Farm Road 217 about 1.0 mile north of Turnersville, 4.9 miles east on Farm Road 182, 1.1 miles southeast on county road, 200 feet west in rangeland:

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; weak medium subangular blocky and granular structure; hard, firm, sticky and plastic; many very fine and fine and few medium roots; common fine pores; mildly alkaline; gradual smooth boundary.

A2—6 to 16 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; moderate medium angular and subangular blocky structure; hard, firm, sticky and plastic; common fine and few medium roots; common pressure faces and few small slickensides; about 5 percent by volume limestone fragments 2 to 6 inches across; mildly alkaline; abrupt wavy boundary.

R—16 to 24 inches; indurated limestone that has a hardness of 3 or more on Mohs' scale; upper part has coarse fractures filled with soil material; lower part has tight fractures.

The solum is 10 to 20 inches thick. The average clay content is 40 to 50 percent. Limestone fragments less than 3 inches to about 10 inches across range from none to a few on the surface and make up as much as 10 percent by volume of the solum. Some pedons have a few chert fragments of similar size. The soil is mildly alkaline or moderately alkaline and noncalcareous.

The A horizon is dark brown, dark grayish brown, very dark grayish brown, very dark brown, or dark brown.

The limestone bedrock generally cannot be excavated using a backhoe machine.

Patilo Series

The Patilo series consists of deep, moderately well drained, sandy soils on uplands. These soils formed in thick sandy beds that appear to have been reworked somewhat by wind. Slopes range from 1 to 5 percent.

Typical pedon of Patilo fine sand, 1 to 5 percent slopes; from the intersection of Farm Road 217 and Texas Highway 36 in Jonesboro, about 2 miles southeast on Texas Highway 36, 4.0 miles south and west on county road, and 450 feet north, in rangeland:

A—0 to 5 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; weak fine subangular blocky structure; hard, very friable; many fine and medium roots; many fine pores; slightly acid; clear smooth boundary.

E—5 to 53 inches; very pale brown (10YR 8/4) fine sand, very pale brown (10YR 7/4) moist; single grained; hard, very friable; common fine and medium roots; many fine pores; neutral; clear smooth boundary.

Bt1—53 to 65 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; many medium distinct reddish yellow (7.5YR 6/8) and a few fine prominent red mottles; weak fine subangular blocky structure; hard, firm, slightly sticky; few fine and medium roots; common very fine pores; few thin patchy clay films; medium acid; gradual smooth boundary.

Bt2—65 to 80 inches; reddish yellow (7.5YR 7/8) sandy clay loam, reddish yellow (7.5YR 6/8) moist; common medium distinct pale brown (10YR 6/3) and few fine distinct light brownish gray mottles; weak medium subangular blocky structure; hard, firm, slightly sticky; few fine and medium roots; common very fine pores; few thin patchy clay films; few thin brown skeletans; common black concretions; neutral.

The A and E horizons combined are 40 to 80 inches thick. They are slightly acid or neutral. The A horizon is brown or pale brown. The E horizon is very pale brown or pink.

The Bt horizon is strongly acid to slightly acid. It is light gray, yellowish brown, or reddish yellow and has varying amounts of red, yellow, brown, and gray mottles of various sizes.

Pidcoke Series

The Pidcoke series consists of shallow, well drained, loamy soils that formed in marly marine sediment over indurated limestone containing many fossil shells. Slopes range from 2 to 5 percent.

Typical pedon of Pidcoke clay loam, in an area of Topsey-Pidcoke association, 2 to 8 percent slopes; from the intersection of Texas Highway 36 and Farm Road 2955 about 11 miles north of Gatesville, 0.4 mile northwest on Texas Highway 36, 0.6 mile south on County Road, 75 feet northwest in rangeland:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky and granular structure; hard, friable; common very fine and fine roots; common fine concretions of calcium carbonate; about 5 percent by volume fossil shells 1/8 inch to 1 1/2 inches across; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—8 to 13 inches; grayish brown (10YR 5/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable; common very fine and fine roots; common fine concretions and few films and threads of calcium carbonate; about 25 percent by volume fossil shells 1/8 inch to 1 1/2 inches across; strongly effervescent; moderately alkaline; abrupt smooth boundary.

R—13 to 30 inches; indurated limestone containing many imbedded fossil shells; massive and unfractured; hardness of about 4 on Mohs' scale.

The solum is 10 to 20 inches thick. Texture is clay loam, silty clay loam, or a gravelly counterpart. Silicate clay ranges from 20 to 35 percent. The calcium carbonate equivalent ranges from 40 to 60 percent. Fossil shells, mainly Texigryphaea (oyster), 1/8 inch to 3 inches across range from a few to 25 percent by volume in the control section. The soil is moderately alkaline and calcareous throughout.

The A horizon is dark grayish brown, very dark grayish brown, or dark brown. It is 7 to 16 inches thick. Fossil shells range from a few to about 15 percent by volume.

The B horizon is dark grayish brown, grayish brown, or dark brown. It is 0 to 8 inches thick. Fossil shells range from 5 to 35 percent by volume.

The R layer is indurated limestone. The limestone is cemented beds of oyster shells. The beds are 2 to 20 feet thick and have thin marl or shale seams at vertical intervals of about 1 to 3 feet.

Purves Series

The Purves series consist of shallow, well drained, clayey soils on uplands. These soils formed in limestone. Slopes range from 1 to 5 percent; they are dominantly 3 percent.

Typical pedon of Purves gravelly silty clay, 1 to 5 percent slopes; from the intersection of U.S. Highway 84 and Farm Road 185 about 12 miles east of Gatesville, 0.8 mile north on Farm Road 185, 1.5 mile east on county road, 0.6 mile north in cultivated field:

Ap—0 to 6 inches; dark brown (7.5YR 4/2) gravelly silty clay, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable, sticky and plastic; many fine roots; few very fine pores; few calcium carbonate concretions; about 15 percent by volume limestone fragments mainly less than 1 inch in diameter on the surface and in the soil; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak—6 to 14 inches; dark brown (7.5YR 4/2) very gravelly silty clay, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; few fine pores; common calcium carbonate concretions and films and threads; 45 percent limestone fragments as much as 3 inches across; strongly effervescent; moderately alkaline; abrupt smooth boundary.

R—14 to 16 inches; fractured limestone bedrock.

The solum is 9 to 19 inches thick. Limestone fragments ranging from 0.5 inch to 5 inches on the long axis make up as much as 35 percent by volume. The clay content ranges from 35 to 50 percent.

The horizons are brown, dark grayish brown, or dark brown.

The R layer is indurated, fractured limestone that has hardness of more than 3 on Mohs' scale. In some places the limestone is interbedded with marl.

Real Series

The Real series consists of shallow, well drained, loamy soils on uplands. These soils formed in weakly and strongly cemented limestone interbedded with loamy, calcareous marl. Slopes range from 1 to 30 percent.

Typical pedon of Real gravelly clay loam, in an area of Doss-Real complex, 1 to 8 percent slopes; from intersection of U.S. Highway 84 and Farm Road 116 about 1 mile west of Gatesville, 17.3 miles southwest on Farm Road 116, 1.6 miles southeast on Antelope Road in Fort Hood Military Reservation, 250 feet west in rangeland:

A—0 to 8 inches; dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; few concretions of calcium carbonate; many fine pores; 41 percent calcium carbonate equivalent; about 15 percent fragments of limestone 1/4 inch to 2 inches in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak—8 to 15 inches; dark brown (10YR 4/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; common concretions of calcium carbonate; many fine pores; 49 percent calcium carbonate equivalent; about 40 percent fragments of limestone 1/4 inch to 3 inches in diameter; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Crk—15 to 21 inches; weakly and strongly cemented limestone interbedded with loamy, calcareous marl; few fine roots in fractures.

Thickness of the solum and depth to weakly and strongly cemented limestone range from 9 to 20 inches. The calcium carbonate equivalent ranges from 40 to 65 percent. Silicate clay content ranges from 22 to 35 percent.

The A horizon is dark brown, dark grayish brown, or brown. The Ak horizon is very gravelly loam or very gravelly clay loam. Limestone fragments make up 15 to 40 percent of the A horizon and 40 to 80 percent of the Ak horizon. The fragments are generally less than 3 inches in diameter.

The Crk layer is weakly and strongly cemented limestone interbedded with loamy marl. The limestone has a hardness of less than 3 on Mohs' scale.

Seawillow Series

Seawillow series consists of deep, well drained, loamy soils on stream terraces. These soils formed in loamy, calcareous sediment. Slopes range from 3 to 5 percent.

Typical pedon of Seawillow clay loam, 3 to 5 percent slopes; from the intersection of Farm Road 116 and Farm Road 1783 south of Gatesville, 4.6 miles west on Farm Road 1783, 3.9 miles west on county road, 1.2

miles north on pasture road, and 900 feet northeast, in bermudagrass pasture:

Ap—0 to 6 inches; dark brown (7.5YR 4/4) clay loam; dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; many very fine and fine pores; few concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—6 to 11 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable; common very fine and fine roots; common very fine and fine pores; about 10 percent concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—11 to 21 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; moderate very fine subangular blocky structure; hard, friable; few very fine roots; common very fine pores; about 8 percent concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk3—21 to 45 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; moderate fine subangular blocky structure; hard, friable; few very fine roots; common very fine pores; about 25 percent concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

BCk—45 to 80 inches; reddish yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; weak fine subangular blocky structure; hard, friable; few very fine pores; about 25 percent concretions of calcium carbonate increasing to more than 25 percent below 65 inches; strongly effervescent; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches. Gravel layers are common below a depth of 60 inches. Coarse fragments of limestone pebbles or siliceous pebbles make up 0 to 14 percent. Calcium carbonate equivalent ranges from 40 to 70 percent. Silicate clay ranges from 18 to 35 percent.

The A horizon is 5 to 15 inches thick.

The Bk horizon is brown, reddish brown, light brown, reddish yellow, or pink. It is loam, silty clay loam, or clay loam. Calcium carbonate content increases with depth.

The BCk horizon is reddish yellow. In many places it has stratified layers of gravel. Thick layers of gravel are common at greater depths.

Slidell Series

The Slidell series consists of deep, well drained, clayey soils on uplands. These soils formed in clayey marine sediment. Slopes range from 1 to 3 percent.

Typical pedon of Slidell silty clay, 1 to 3 percent slopes; from the intersection of U.S. Highway 84 and Farm Road 932, 0.6 mile east on county road, and 100 feet north of road, in rangeland, in the center of a microdepression:

A1—0 to 6 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate fine granular structure; very hard, very firm, sticky and plastic; many fine and very fine roots; many very fine pores; few calcium carbonate concretions; strongly effervescent; moderately alkaline; clear wavy boundary.

A2—6 to 18 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; many fine and very fine roots; common very fine pores; common slickensides and shiny pressure faces; few calcium carbonate concretions; strongly effervescent; moderately alkaline; clear wavy boundary.

AC1—18 to 35 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; many very fine roots; common very fine pores; many slicknesides, some of which intersect many cracks as much as 1/2 inch wide filled with darker material from horizon above; common calcium carbonate concretions; strongly effervescent; moderately alkaline; clear wavy boundary.

AC2—35 to 66 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few very fine pores; many slickensides; many cracks as much as 1/4 inch wide filled with very dark gray (10YR 3/1) material; few black concretions; many calcium carbonate concretions; violently effervescent; moderately alkaline; clear wavy boundary.

C—66 to 80 inches; light gray (10YR 7/1) silty clay, gray (10YR 6/1) moist; many fine faint yellowish brown and common fine faint brownish yellow mottles; massive; very hard, very firm, sticky and plastic; few very fine roots; few very fine pores; few black concretions; common calcium carbonate concretions as much as 1/8 inch across; violently effervescent; moderately alkaline.

The solum is 60 to more than 80 inches thick. When dry, cracks as much as 1 inch wide extend to a depth of more than 20 inches. Thickness of the A horizon and depth to subhorizon where the matrix has chroma of more than 1.5 range from 20 to 50 inches in more than 60 percent of the pedons. In less than 40 percent of the pedons, the matrix has chroma of 2 or more within a depth of 8 to 20 inches. Cycles of microdepressions and microknolls are repeated every 10 to 20 feet. In native areas, microknolls are 6 to 8 inches higher than microdepressions.

The A horizon is dark gray or very dark gray. It is generally calcareous, although it is noncalcareous in some pedons in the center of some microdepressions.

The AC horizon is gray, grayish brown, or very dark grayish brown. Mottles of yellowish brown, dark yellowish brown, or light olive brown range from none to common.

The C horizon is light gray, light brownish gray, very pale brown, or grayish brown. Some pedons have mottles in shades of yellow, brown, or grayish brown. Some pedons have marly clay below a depth of 70 inches.

Topsey Series

The Topsey series consists of deep, well drained, loamy soils on uplands (fig. 16). These soils formed in calcareous sediment. Slopes range from 3 to 8 percent.

Typical pedon of Topsey clay loam, in an area of Brackett-Topsey association, 3 to 8 percent slopes, eroded; from the intersection of Texas Highway 36 and West Range Road about 3 miles southeast of Gatesville, 1.6 miles southwest on West Range Road, 1.8 miles southwest on Old Georgetown Road, and 950 feet north-northeast, in rangeland:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular and subangular blocky structure; slightly hard, friable; common very fine and fine and few medium roots; common fine pores; few worm casts; violently effervescent; moderately alkaline; clear smooth boundary.

Bw1—8 to 14 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate very fine granular and subangular blocky structure; hard, friable; common fine and few medium roots; common fine pores; dark stains on some ped surfaces; few very fine concretions and soft masses of calcium carbonate; about 2 percent fossil shells 1/10 inch to 1 1/2 inches across; violently effervescent; moderately alkaline; clear smooth boundary.

Bw2—14 to 19 inches; light yellowish brown (2.5Y 6/4) gravelly loam, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure; hard, friable; common fine and few medium roots; common fine pores; few very fine concretions, threads, and soft masses of calcium carbonate; about 30 percent fossil shells 1/10 inch to 1 1/2 inches across; few grayish shale fragments; violently effervescent; moderately alkaline; clear smooth boundary.

BCk—19 to 28 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine faint yellowish brown and pale yellow mottles; weak medium and coarse subangular blocky structure parting to moderate very fine subangular blocky; hard, friable; few fine roots; common fine pores; common fine and medium and few coarse soft masses of calcium carbonate; about 3 to 5 percent fossil shells 1/10 inch to 1 1/2 inches across; few

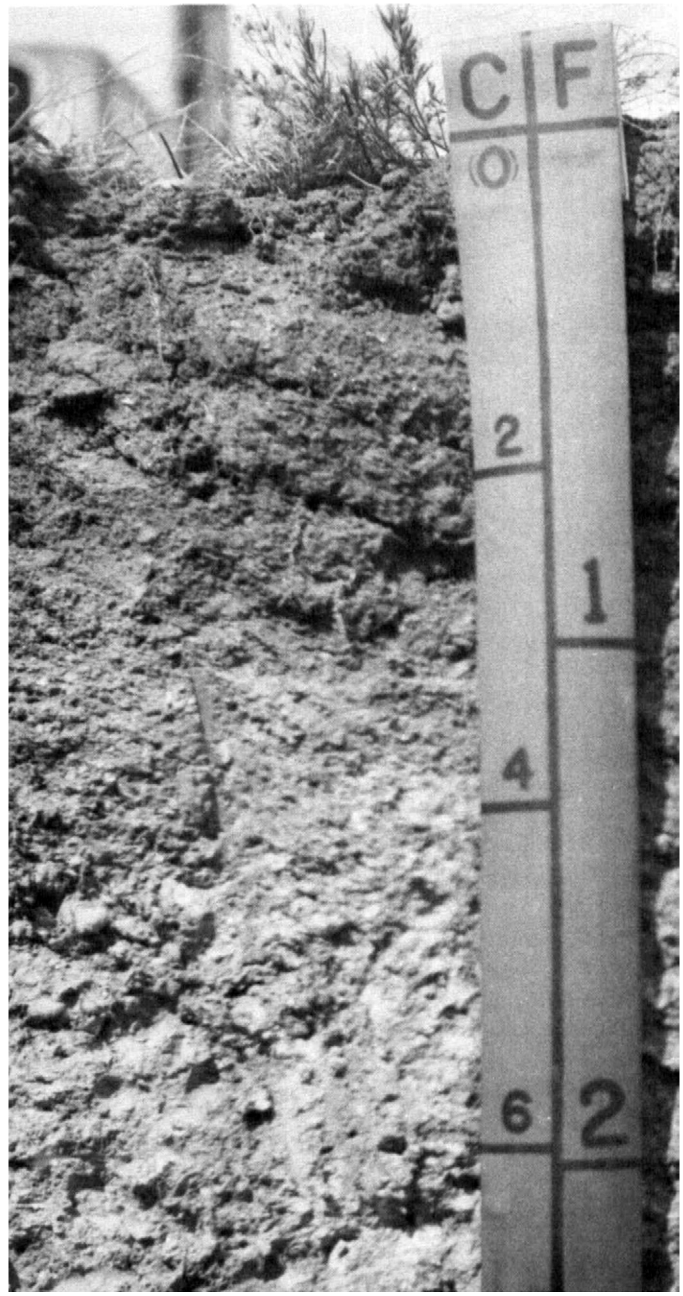


Figure 16.—Profile of Topsey clay loam. Multiply the figures on the left by 10 to obtain the depth in centimeters.

thin grayish shale fragments; violently effervescent; moderately alkaline; gradual smooth boundary.

2C—28 to 67 inches; pale yellow (2.5Y 7/4) marly and shaly silty clay loam, light yellowish brown (2.5Y 6/4) moist interbedded with yellowish brown (10YR 5/8) and light gray (10YR 7/2) thin discontinuous shaly strata; massive; very hard, firm; few fine roots; few fine and medium soft masses of calcium carbonate; about 2 percent fossil shells 1/10 inch to 1 1/2 inches across; violently effervescent; moderately alkaline.

Solum thickness ranges from 20 to 40 inches. The texture of the soil is silt loam, loam, clay loam, silty clay, or silty clay loam or a gravelly counterpart. The content of sand coarser than very fine sand is more than 15 percent. Total carbonates in the control section range from 40 to 80 percent. Coarse shell fragments range from 0 to 20 percent.

The A horizon is dark grayish brown, very dark grayish brown, or dark brown. It is 7 to 12 inches thick.

The B horizon is brown, grayish brown, yellowish brown, pale brown, light yellowish brown, very pale brown, light olive brown, or pale yellow. The Bw1 horizon is 5 to 16 inches thick. The Bw2 horizon is 0 to 10 inches thick. The BCk horizon is 6 to 12 inches thick.

The C horizon is light brownish gray, light yellowish brown, light gray, yellow, light olive brown, olive yellow, or pale yellow. Some pedons have few to many mottles in these colors.

Wise Series

The Wise series consists of deep, well drained, loamy soils on uplands. These soils formed in interbedded calcareous clayey marl and sand. Slopes range from 3 to 5 percent.

Typical pedon of Wise clay loam, 3 to 5 percent slopes, eroded; from the intersection of U.S. Highway 84 and Farm Road 116 west of Gatesville, 11 miles south of Farm Road 116, 0.8 miles east on military road, 200 feet north in rangeland:

A—0 to 6 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, friable, slightly sticky; many very fine and fine roots; many very fine pores; about 5 percent gravel by volume; common concretions of calcium carbonate; strongly effervescent; mildly alkaline; clear smooth boundary.

Bw—6 to 21 inches; reddish yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; hard, friable, slightly sticky; few very fine roots; common very fine pores; few films and threads of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—21 to 29 inches; reddish yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) moist; weak fine and medium subangular blocky structure; very hard, firm, slightly sticky; few very fine roots; common films, threads, and concretions of calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

C—29 to 80 inches; stratified layers of light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6) clayey marl interbedded with light gray (10YR 7/2) loamy very fine sand; few fine distinct yellow (10YR 7/8) mottles in sandy material; clay has common pockets of calcium carbonate; moderately alkaline; sand is noncalcareous.

The solum is 20 to 40 inches thick.

The thickness of the A horizon ranges from 5 to 9 inches. The A horizon is dark brown, dark grayish brown, or brown.

The B horizon is brown, pale brown, yellowish brown, pale yellow, reddish yellow, or brownish yellow and in many places has brownish yellow (10YR 6/8) or light gray sand lenses. Few fine prominent dark yellowish brown or faint light olive brown mottles are in some pedons. Texture is loam, silty clay loam, or clay loam.

The C horizon is interbedded loamy or clayey marl and sand. Pockets of carbonates are in many pedons. The C horizon is light brownish gray, light gray, gray, brownish yellow, yellow, very pale brown, or brown and in many pedons has mottles of these colors or light olive brown or dark yellowish brown.

Formation of the Soils

Factors of Soil Formation

Soil is a natural, three-dimensional body on the earth's surface that supports plants and has properties. Properties of the soil result from the integrated effect of climate and living matter acting on parent material, as conditioned by relief over periods of time.

The interaction of five main factors results in differences among the soils. These factors are the physical and chemical composition of the parent material, the climate during and after the accumulation of the parent material, the kind of plants and organisms living in the soils, the relief of the land and its effect on runoff, and the length of time it took the soils to form.

The effect of a factor can differ from place to place, but it is the interaction of all the factors that determines the kind of soil that forms. In the following paragraphs the factors of soil formation are discussed as they relate to the soils in the survey area.

Climate

The survey area has a subhumid, temperate, continental climate. The subhumid climate has promoted moderately rapid soil development. Climate is uniform throughout the survey area, although its effect has been modified locally by relief and runoff.

Living Organisms

Plants, insects, micro-organisms, earthworms, and other living organisms have contributed to the development of the soils. Gains in organic matter and nitrogen content of the soil, gains or losses in plant nutrients, and changes in structure and porosity are caused by plant and animal life.

Vegetation, dominantly grassland prairie, has greatly affected soil formation in the county. Soils that formed under grassland prairie are generally high in organic matter content and dark in color.

Topography

Topography, or relief, affects soil formation through its influence on drainage, runoff, erosion, plant cover, and soil temperature. Topographically, the county consists of a dissected limestone plain underlain by hard limestone on the higher ridges and softer limestone and marly clay on the rolling hills and plateaus. The plain is undulating; the steeper slopes are along the Leon River and Cowhouse Creek.

Time

A great length of time is required for the formation of soils with distinct horizons. The differences in the length of time that the parent material has been in place are commonly reflected in the degree of development of soil horizons. Young soils have very little horizon development, and old soils have well expressed horizons.

Bosque and Frio soils are young soils. They are on bottom lands that are flooded, and sediment is continuously being added. These soils have little horizon development.

An advanced stage of development is evident in the Cisco soils. These soils have developed a distinct surface layer and subsoil that bear little resemblance to the original parent material.

Parent Material

Parent material is the unconsolidated soil mass from which the soils were formed. It determines the limits of the chemical and mineralogical composition of the soil. For more information, see the following section on geology.

Geology

Dr. David L. Amsbury, geologist, National Aeronautic and Space Administration, Seabrook, Texas, prepared this section.

Much of the parent material of the soils in Coryell County is calcareous clay and clayey limestone. Layers of pure limestone, clay, and sand are also important sources. Broad areas of soils have been formed on beds of fossil oyster shells, which are similar to limestone gravel in their effect on soil processes. The type of parent material determines relative resistance to erosion, and thus topographic position; it also affects the chemical composition and physical texture of the soil. Steep slopes and relatively pure limestones produce thin, stony soils, whereas gentle slopes and clayey units tend to have deep, heavy soils. Sand and oyster shell beds tend to have gentle slopes; however, the soils are generally poor because of high internal drainage and low nutrient value.

The general soil map corresponds well to the Waco and Brownwood geological maps of the county published by the Texas Bureau of Economic Geology (*5*). Similar patterns are shown on the smaller scale Geological Map of Texas and on the Land Resource Map, also published by the Bureau of Economic Geology (*10, 11*).

Most of the geologic units in Coryell County are of Lower Cretaceous age (*1*). By physical and fossil correlations to rocks in which radioactive minerals are present, these units are considered to have formed during a period of about 10 million years, centered at about 90 million years ago. Much of the younger alluvial material along the Leon River, Cowhouse Creek, and Coryell Creek formed after the last major ice age, during the past 10 to 12 thousand years. The present landscape of the county was determined during the ice age, in the Pleistocene epoch, generally before the last glacial period, the Wisconsin Stage.

Recent Epoch

Flood plains of the major streams mark the youngest mappable geological units in the county. The alluvial deposits of these streams are similar to the deep clays and colluvial material that mantle the gently rolling hillsides along the stream valleys. In vertical stream banks and excavations, evidence of water transport can be seen in the alluvial material: relict stream bottom sand bars and gravel lenses; crossbedding; a general upward decrease in gravel content and grain size; and a mixture of materials derived from many older units upstream. Similar alluvial deposits in many parts of Central Texas contain scattered bones and teeth of mammoths, extinct bison, and other prehistoric animals and a few ancient Indian spearpoints. Bosque and Frio soils formed in the recent alluvium of major streams. Lewisville and Krum soils formed in older alluvial sediment of minor streams.

Pleistocene Epoch

The Leon River is clearly an underfit stream. The modern river flows in a small, tightly meandering channel in contrast to the wide valley above. The older valley was cut in hard limestone at many places, into broad, sweeping meander loops. Examples of these meander loops can be found above and below Jonesboro and below Leon Junction. The loops have a radius of curvature 8 to 10 times that of the modern Leon River, indicating a maximum flood flow also about 8 to 10 times larger.

The modern stream carries mostly dark clay and silt, with some locally derived limestone gravel. Above the flood plain, the terraces consist largely of reddish sand that has abundant gravel obviously brought in from outside the county and from outside the present drainage basin of the Leon River. Raymond L. Lewand, Jr., a student at Baylor University, decided that the most reasonable explanation for these characteristics is that the Leon River Valley once contained the Brazos River, until headward erosion by a tributary stream in north-central Stephens County diverted the Brazos River into its present course (*12*). This diversion apparently happened late in the Pleistocene.

The Minwell soils developed on the older, coarse alluvial deposits. Bastsil and Desan soils are on younger terraces above the modern flood plains of the Leon River.

Cretaceous Period

The rocks of the Lower Cretaceous age formed near the shore of a shallow sea that extended from the ancient Gulf of Mexico through the East Texas Basin into Coryell County. The original flat-lying layers of sediment have been tilted about 20 feet per mile to the eastward. In Coryell County the Leon River has an average slope of 6.25 feet per mile and Cowhouse Creek about 10 feet per mile. Because the rock layers are tilted eastward more than the stream bottoms, the stream valleys cut into the younger rocks to the east and into the older ones to the west. The rock layers are described in the following paragraphs, from youngest to oldest, as they would be encountered in traveling westward across the county.

Georgetown Formation. Nodular limestone, marl, and calcareous shale of the Georgetown Formation underlie a northwest-southwest trending belt of rolling uplands and former prairie along the eastern edge of the county. This belt runs from the county line northwest of Turnersville, through Whitehall, Coryell City, Osage, and Oglesby to the Whitson Community. A smaller patch is near The Grove. The Georgetown Formation is about 100 feet thick in Coryell County. Outcrops of bedrock are limited to a few borrow ditches.

The upper member of the Georgetown Formation is termed the Main Street Limestone. It is white, nodular to flaggy, and fine grained; it tends to be more resistant to weathering than other portions of the formation. The Main Street Limestone is underlain by two other members of the Georgetown Formation, the Weno Limestone and Paw Paw Shale, which are somewhat more clayey and less resistant to erosion. In Coryell County, these members extend from Osage to Whitson on the the crest of a gentle ridge. The outcrop coincides with the Crawford-Purves-Slidell map unit.

The lower one-half to two-thirds of the Georgetown Formation is Denton Clay, Fort Worth Limestone, and Duck Creek Limestone. These members consist of soft, nodular, generally clayey limestone layers interbedded with calcareous clays. Oyster shells and the internal molds of clams and snails are abundant in some beds. The units of the Georgetown Formation weather to gently rolling hills. One prominent outcrop, probably lower Fort Worth and upper Duck Creek, is evident in ditches along FM 215 east of Whitehall.

The underlying Kiamichi Clay is mapped with the Georgetown Formation in Coryell County, because it is less than 20 feet thick. Where it is more than a few feet thick, it tends to weather to a narrow "racetrack" prairie located between the juniper-covered Edwards Limestone below and the brushy ledges of Duck Creek Limestone above.

The lower units of the Georgetown Formation are the parent material for the Denton and Bolar soils in the eastern part of the county.

Edwards Limestone. Thick beds of Edwards Limestone support the long ridges that extend from the northwest to the southeast across the county. Studies by many geologists during the past century show that the rocks distinctive to this formation formed from the calcareous skeletons of thick-shelled, reef- and bank-building clams called rudistids (*15*). Between mounds of shell debris, thin beds of fine-grained but nonclayey limestone were laid down. These thinner beds locally contain abundant nodules of chert. Growth of the reefy complex began along a belt trending WNW-ESE that coincides with the Owl Creek Mountains and other hills that extend west to Baggett Mountain and northwest to King. To the northeast of the belt, the generally clayey lime muds of the Comanche Peak Limestone formed; to the southwest, lagoonal and tidal-flat dolomite formed. Both of these materials are much less resistant to weathering than the Edwards Limestone.

The Edwards Limestone forms brush-covered ledges and cliffs (fig. 17). It is widely quarried for road metal material. Extensive cutting is required for major highway construction. The formation is about 60 feet thick in the southern part of the county, about 130 feet thick in the interfluve between Cowhouse Creek and the Leon River, and thins to 30 feet in the northern part of the county. Edwards Limestone underlies the Eckrant soils in the Eckrant-Rock outcrop unit.

Comanche Peak Limestone. The Comanche Peak Limestone is on steep slopes under ledges of the Edwards Limestone. It is white, nodular, fairly soft limestone interbedded with marl and calcareous clay (*4*). Thin, resistant beds of oyster shells are prominent in some road cuts and road-metal quarries. Internal molds of clams, snails, and ammonites and shells of exogyrate oysters, grypheate oysters, and echinoids are extremely abundant in some beds (*13*).

In the southern part of the county the upper Comanche Peak Limestone grades rapidly into the Edwards Limestone. To the north, various layers grade gradually into thick clayey material mapped as Walnut Clay. Thickness of the Comanche Peak Limestone is about 60 feet throughout most of the county.

Slopes on the Comanche Peak tend to be thickly mantled by colluvium. If the Edwards Limestone did not protect it, the Comanche Peak Limestone probably would form gently rounded hills like those on the Georgetown Formation. Real soils in the Eckrant-Real-Rock Outcrop unit are underlain by Comanche Peak Limestone.

Walnut Clay. Shale, oyster-shell beds, nodular limestone, and flaggy limestone of the Walnut Clay underlie the largest area of the county. The upper part of the Walnut Clay is interbedded with and grades southward into the Comanche Peak Limestone. The lower part gradually overlaps Paluxy Sand from south to north. In Coryell County the Walnut Clay is 100 to 150 feet thick. It weathers to broad, rolling slopes along the sides of major valleys.

The upper Walnut Clay is a clay shale that underlies the Comanche Peak Limestone, weathering to gentle slopes away from the major ridges. This shale is calcareous and contains dark brown, locally rippled flagstones formed of oysters and other shells (*9*). Some beds of white, nodular, fossiliferous limestone and marl can be seen in borrow pits and in excavations for ponds. Upper Walnut Clay underlies the Slidell-Topsey-Brackett map unit.

A prominent bed of gryphaeate oyster shells, as much as 20 feet thick, forms broad, low hills about halfway between the major ridges and the valley bottoms. Texas Highway 36 cuts through several of these projecting knobs northwest of Gatesville. Below the thick oyster bed, deep road cuts and gullies expose layers of white marl and limestone that has an abundance of internal molds of clams, snails, and ammonites. The combination of a thick oyster bed and fossiliferous marl forms the most noticeable marker of the Lower Cretaceous in north-central Texas. This combination has been traced from Whitestone, northwest of Austin, to a point west of Fort Worth. In Coryell County the oyster bed weathers to Topsey and Pidcoke soils of the Slidell-Topsey-Brackett map unit.

A second shale unit, thinner than the upper Walnut Clay, overlies hard, flaggy limestone and relatively resistant nodular limestone. These limestones are abundantly fossiliferous, mostly containing gryphaeate and exogyrate oyster shells. The lower Walnut Clay limestones are particularly prominent in the western part of the county, for example, near South Purmela and Topsey. Soils of the Nuff-Cho map unit are underlain by lower Walnut Clay.

Paluxy Sand. Paluxy Sand separates the lower Walnut Clay limestone from similar limestone of the Glen Rose Formation. It is about 30 feet thick in the central part of the county, thinning to the east, west, and south. The southern edge of Paluxy deposition is exposed along House Creek near the Bell County line.

The uncemented sand is very fine grained, grading to coarse silt. It is rarely fossiliferous, although it is directly overlain by fossiliferous thin shales and nodular limestone. Shales interbedded with the sand are finely laminated and pale green or light to medium gray. Detailed study suggests that the sand was swept southward by marine currents and spread onto a hard

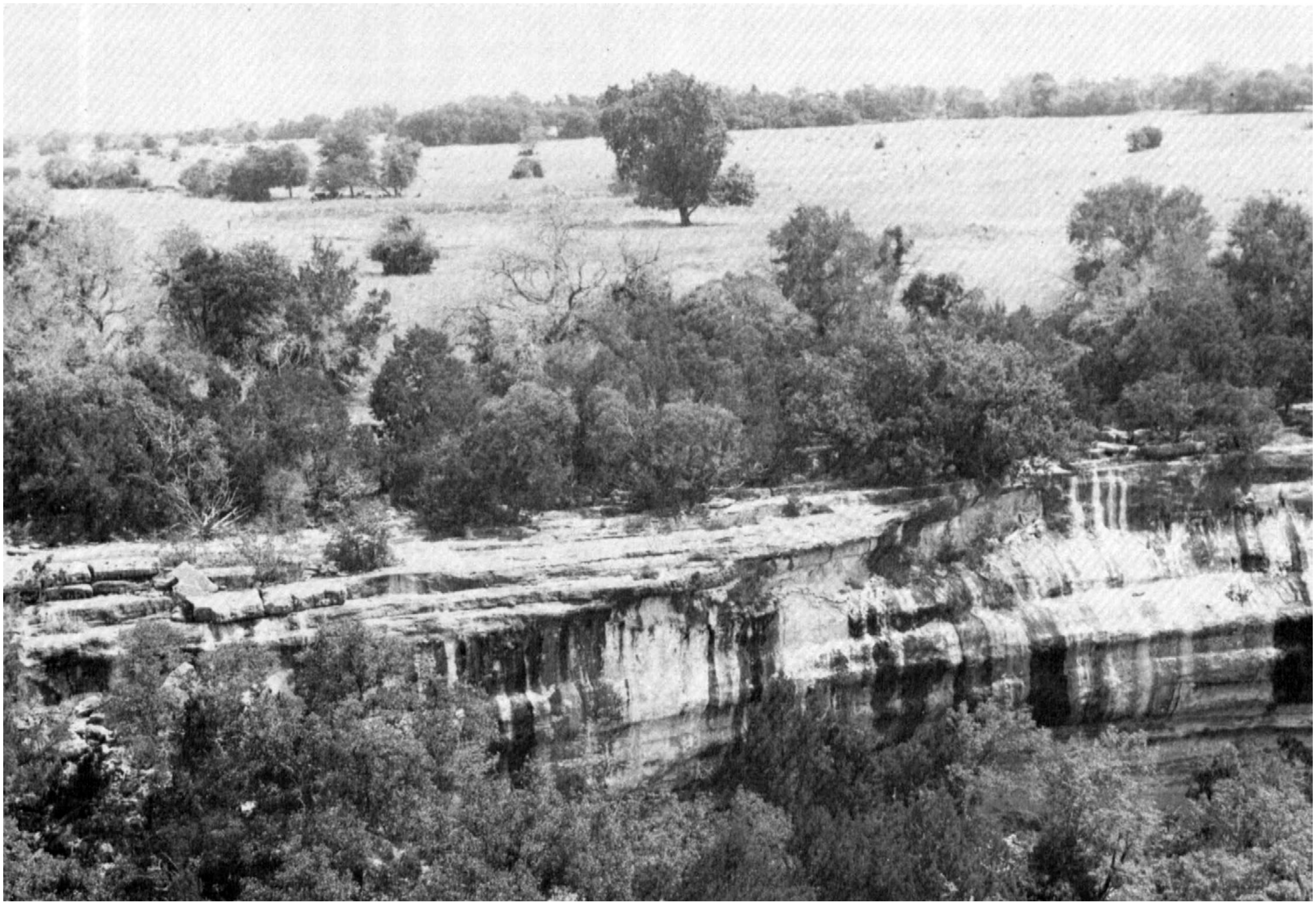


Figure 17.—An exposure of Edwards Limestone. The brush-covered area in the foreground is Real-Rock outcrop complex, 12 to 40 percent slopes. Eckrant-Rock outcrop complex, 1 to 3 percent slopes, is in the background.

rock floor developed on the Glen Rose Formation (*16*). Conditions changed abruptly, and the broad sand body was covered with muddy, fossil-bearing limestone of the Walnut Clay.

Paluxy Sand is the parent material for Cisco and Wise soils of the Nuff-Cho map unit.

Glen Rose Formation. The limestone and marl of the Glen Rose Formation are the oldest rocks exposed in Coryell County. The limestone is thin to medium bedded, and flaggy or nodular. It is similar to the lower Walnut Clay limestone but tends to be grayish rather than brownish, more resistant to weathering, and does not have the gryphaeate oysters so common in the Walnut Clay. Rock specimens of the flaggy beds, cut and polished at right angles to bedding, show that the Glen Rose limestone tends to have a much higher percentage of rounded shell fragments and other grains indicating abrasion than the Walnut Clay limestone (*6*). Individual beds extend a few hundred yards to perhaps a few miles. Deposition took place on a complex of tidal flats and lagoons swept by storms and wind tides. Relief was extremely low. Cementation of the carbonate sediment into limestone probably was very rapid.

The Glen Rose Formation is about 300 feet thick in Coryell County; maximum exposure is about 200 feet, near Pidcoke. Doss and Real soils of the Doss-Real-Krum unit formed on Glen Rose limestone and marl.

Older Rocks. The Glen Rose Formation is underlain by sand, gravel, and red clay which formed in an old valley system before the sea flooded the county. These sandy materials, Trinity Sand, constitute an important ground-water resource. The top of these sands lies deeper below the general land surface toward the east, partly because of the eastward dip of all the Cretaceous rocks and partly because the sea gradually replaced alluvial environments westward as the sediments were deposited. The old valley system varies several hundred feet in relief, which makes prediction of water production at a specified place difficult.

The hills and valley floors of the buried system formed in limestone and shale of Pennsylvanian age. Hydrocarbon accumulations are possible within these older rocks, but none has been found in the county during some 80 years of sporadic exploration.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Cement rock. Shaly limestone used in the manufacture of cement.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at Gatesville, Tx]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	58.8	33.2	46.0	84	10	111	1.80	.33	2.94	3	.6
February---	63.1	37.3	50.2	86	16	126	2.51	.95	3.80	5	.8
March------	71.2	44.7	58.0	91	23	286	1.92	.51	3.03	3	.0
April------	79.0	54.1	66.6	94	32	498	3.32	1.51	4.87	5	.0
May--------	84.8	61.5	73.2	97	42	719	4.58	2.29	6.57	6	.0
June-------	92.4	68.6	80.5	102	54	915	3.08	.87	4.86	4	.0
July-------	97.2	71.8	84.5	108	62	1,070	2.01	.16	3.36	3	.0
August-----	97.2	71.1	84.2	107	60	1,060	2.19	.48	3.53	4	.0
September--	90.2	66.2	78.2	103	47	846	3.66	1.47	5.50	5	.0
October----	81.3	55.0	68.2	96	35	564	3.24	.89	5.15	4	.0
November---	69.1	43.3	56.2	88	21	228	2.30	.84	3.55	4	.2
December---	62.3	36.5	49.4	81	16	112	1.90	.70	2.91	3	.0
Yearly:											
Average--	78.9	53.6	66.3	---	---	---	---	---	---	---	---
Extreme--	---	---	---	108	8	---	---	---	---	---	---
Total----	---	---	---	---	---	6,535	32.51	25.03	40.31	49	1.6

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at Gatesville, Tx]

Probability	Temperature		
	24°F or lower	28°F or lower	32°F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 17	March 27	April 11
2 years in 10 later than--	March 9	March 20	April 5
5 years in 10 later than--	February 20	March 6	March 25
First freezing temperature in fall:			
1 year in 10 earlier than--	November 19	November 6	October 23
2 years in 10 earlier than--	November 26	November 13	October 30
5 years in 10 earlier than--	December 9	November 27	November 14

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at Gatesville, Tx]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24°F	Higher than 28°F	Higher than 32°F
	Days	Days	Days
9 years in 10	261	237	211
8 years in 10	272	246	218
5 years in 10	291	264	232
2 years in 10	312	283	247
1 year in 10	325	295	256

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
BaB	Bastsil fine sandy loam, 1 to 3 percent slopes	4,540	0.7
BgB	Bolar gravelly clay loam, 1 to 4 percent slopes	33,400	4.9
Bo	Bosque clay loam, rarely flooded	3,140	0.5
Bs	Bosque clay loam, occasionally flooded	19,900	3.0
BtC2	Brackett-Topsey association, 3 to 8 percent slopes, eroded	27,000	4.0
ChB	Cho clay loam, 1 to 3 percent slopes	24,400	3.6
CoB2	Cisco fine sandy loam, 1 to 5 percent slopes, eroded	20,000	3.0
CrD	Cranfill gravelly clay loam, 3 to 8 percent slopes	500	0.1
CwB	Crawford silty clay, 1 to 3 percent slopes	9,600	1.4
DeB	Denton silty clay, 1 to 3 percent slopes	38,000	5.6
DnB	Desan fine sand, 1 to 3 percent slopes	400	0.1
DrC	Doss-Real complex, 1 to 8 percent	107,800	15.9
EcB	Eckrant cobbly silty clay, 1 to 3 percent slopes	33,200	4.9
ErB	Eckrant-Rock outcrop complex, 1 to 3 percent slopes	39,900	5.9
EuB	Eckrant-Urban land complex, 1 to 3 percent slopes	1,000	0.2
EvB	Evant silty clay, 1 to 3 percent slopes	12,700	1.9
Fr	Frio silty clay, occasionally flooded	10,900	1.6
KrB	Krum silty clay, 1 to 3 percent slopes	20,500	3.0
LeB	Lewisville clay loam, 1 to 3 percent slopes	14,900	2.2
MnB	Minwells fine sandy loam, 1 to 3 percent slopes	1,900	0.3
MuB	Minwells-Urban land complex, 1 to 3 percent slopes	2,000	0.3
NuC	Nuff very stony silty clay loam, 2 to 6 percent slopes	72,500	10.7
OgB	Oglesby silty clay, 1 to 3 percent slopes	5,700	0.8
PaC	Patilo fine sand, 1 to 5 percent slopes	269	*
PrB	Purves gravelly silty clay, 1 to 5 percent slopes	4,200	0.6
ReF	Real-Rock outcrop complex, 12 to 40 percent slopes	49,500	7.3
SeC	Seawillow clay loam, 3 to 5 percent slopes	3,200	0.5
SlB	Slidell silty clay, 1 to 3 percent slopes	57,300	8.5
TpC	Topsey-Pidcoke association, 2 to 8 percent slopes	43,300	6.4
TuC	Topsey-Urban land complex, 3 to 8 percent slopes	3,600	0.5
WsC2	Wise clay loam, 3 to 5 percent slopes, eroded	11,000	1.6
	Total	676,249	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Wheat	Oats	Grain sorghum	Cotton lint	Improved bermudagrass
	Bu	Bu	Bu	Lbs	AUM*
BaB----------------------- Bastsil	40	60	70	350	7.0
BgB----------------------- Bolar	35	40	40	---	5.0
Bo------------------------ Bosque	35	65	70	500	7.0
Bs------------------------ Bosque	35	60	65	450	6.5
BtC2**:					
Brackett------------------	65	25	---	---	3.0
Topsey--------------------	20	35	---	---	4.0
ChB----------------------- Cho	10	20	---	---	2.0
CoB2---------------------- Cisco	25	30	40	350	5.5
CrD----------------------- Cranfill	---	---	---	---	3.0
CwB----------------------- Crawford	30	50	65	350	6.0
DeB----------------------- Denton	40	65	75	400	7.0
DnB----------------------- Desan	---	---	---	---	4.5
DrC----------------------- Doss-Real	---	---	---	---	2.0
EcB----------------------- Eckrant	---	---	---	---	---
ErB----------------------- Eckrant-Rock outcrop	---	---	---	---	---
EuB----------------------- Eckrant-Urban land	---	---	---	---	---
EvB----------------------- Evant	---	---	---	---	3.0
Fr------------------------ Frio	35	60	75	450	7.0
KrB----------------------- Krum	30	70	70	400	7.0
LeB----------------------- Lewisville	35	70	80	450	7.5
MnB----------------------- Minwells	35	50	60	---	6.0
MuB----------------------- Minwells-Urban land	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Wheat	Oats	Grain sorghum	Cotton lint	Improved bermudagrass
	Bu	Bu	Bu	Lbs	AUM*
NuC: Nuff	---	---	---	---	---
OgB: Oglesby	20	35	---	---	3.0
PaC: Patilo	---	---	---	---	4.5
PrB: Purves	20	40	25	---	3.5
ReF: Real-Rock outcrop	---	---	---	---	---
SeC: Seawillow	---	40	40	200	5.0
SlB: Slidell	30	65	70	350	7.0
TpC**:					
Topsey	20	35	---	---	4.0
Pidcoke	10	20	---	---	2.0
TuC: Topsey-Urban land	---	---	---	---	---
WsC2: Wise	---	---	---	---	4.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production		
		Favorable Lb/acre	Normal Lb/acre	Unfavorable Lb/acre
BaB----------------------- Bastsil	Sandy Loam------------------------------	5,500	4,500	3,500
BgB----------------------- Bolar	Clay Loam-------------------------------	6,500	5,000	3,000
Bo, Bs-------------------- Bosque	Loamy Bottomland-----------------------	6,500	5,000	3,500
BtC2*:				
Brackett-----------------	Adobe-----------------------------------	4,000	3,200	1,800
Topsey-------------------	Clay Loam-------------------------------	6,500	5,000	3,000
ChB----------------------- Cho	Very Shallow----------------------------	2,500	2,000	1,000
CoB2---------------------- Cisco	Sandy Loam------------------------------	5,000	4,000	3,000
CrD----------------------- Cranfill	Adobe-----------------------------------	4,200	3,500	1,800
CwB----------------------- Crawford	Deep Redland----------------------------	6,000	5,000	3,500
DeB----------------------- Denton	Clay Loam-------------------------------	6,500	5,000	3,000
DnB----------------------- Desan	Deep Sand-------------------------------	3,000	2,000	1,000
DrC*:				
Doss---------------------	Shallow---------------------------------	4,000	3,000	1,800
Real---------------------	Adobe-----------------------------------	3,500	2,500	1,500
EcB----------------------- Eckrant	Low Stony Hill--------------------------	3,000	2,500	1,500
ErB*:				
Eckrant------------------	Low Stony Hill--------------------------	3,000	2,500	1,500
Rock outcrop.				
EvB----------------------- Evant	Redland---------------------------------	5,000	3,500	2,500
Fr------------------------ Frio	Loamy Bottomland-----------------------	5,500	4,000	3,000
KrB----------------------- Krum	Clay Loam-------------------------------	6,500	6,000	3,500
LeB----------------------- Lewisville	Clay Loam-------------------------------	6,500	5,500	3,000
MnB----------------------- Minwells	Sandy Loam------------------------------	5,000	4,000	3,000
NuC----------------------- Nuff	Stony Clay Loam-------------------------	5,500	4,500	2,500
OgB----------------------- Oglesby	Shallow Clay----------------------------	5,000	4,500	2,500

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production		
		Favorable	Normal	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
PaC----------------------- Patilo	Deep Sand-------------------------------	3,000	2,000	1,000
PrB----------------------- Purves	Shallow---------------------------------	3,000	2,500	1,800
ReF*:				
Real---------------------	Steep Adobe-----------------------------	3,000	2,200	1,500
Rock outcrop.				
SeC----------------------- Seawillow	Clay Loam-------------------------------	5,000	4,000	2,500
SlB----------------------- Slidell	Blackland-------------------------------	6,000	5,000	3,000
TpC*:				
Topsey-------------------	Clay Loam-------------------------------	6,500	5,000	3,000
Pidcoke------------------	Shallow---------------------------------	4,000	3,000	1,800
WsC2---------------------- Wise	Clay Loam-------------------------------	6,000	4,500	3,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
BaB------ Bastsil	Slight------	Slight------	Moderate: slope.	Slight------	Slight.
BgB------ Bolar	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight------	Moderate: small stones, large stones, thin layer.
Bo------ Bosque	Severe: flooding.	Slight------	Slight------	Slight------	Slight.
Bs------ Bosque	Severe: flooding.	Slight------	Moderate: flooding.	Slight------	Moderate: flooding.
BtC2*:					
Brackett------	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight------	Moderate: small stones, droughty.
Topsey------	Slight------	Slight------	Moderate: slope.	Slight------	Slight.
ChB------ Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight------	Severe: thin layer.
CoB2------ Cisco	Slight------	Slight------	Moderate: slope.	Slight------	Slight.
CrD------ Cranfill	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight------	Moderate: small stones.
CwB------ Crawford	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
DeB------ Denton	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
DnB------ Desan	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
DrC*:					
Doss------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight------	Severe: thin layer.
Real------	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: small stones, thin layer.
EcB------ Eckrant	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones.	Severe: large stones, thin layer.
ErB*:					
Eckrant------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones.	Severe: large stones, thin layer.
Rock outcrop.					

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
EuB*:					
Eckrant	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones.	Severe: large stones, thin layer.
Urban land.					
EvB Evant	Severe: too clayey, cemented pan.	Severe: too clayey, cemented pan.	Severe: cemented pan.	Severe: too clayey.	Severe: thin layer, too clayey.
Fr Frio	Severe: flooding.	Severe: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
KrB Krum	Moderate: too clayey.	Moderate: too clayey.	Moderate: small stones, slope.	Moderate: too clayey.	Severe: too clayey.
LeB Lewisville	Slight	Slight	Moderate: slope.	Slight	Slight.
MnB Minwells	Slight	Slight	Moderate: slope.	Slight	Slight.
MuB*:					
Minwells	Slight	Slight	Moderate: slope.	Slight	Slight.
Urban land.					
NuC Nuff	Moderate: percs slowly.	Moderate: percs slowly.	Severe: large stones.	Slight	Severe: large stones.
OgB Oglesby	Severe: too clayey, depth to rock.	Severe: too clayey, depth to rock.	Severe: too clayey, depth to rock.	Severe: too clayey.	Severe: thin layer, too clayey.
PaC Patilo	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
PrB Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: too clayey.	Severe: thin layer.
ReF*:					
Real	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.	Severe: small stones, slope, thin layer.
Rock outcrop.					
SeC Seawillow	Slight	Slight	Moderate: slope.	Slight	Moderate: excess lime.
SlB Slidell	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
TpC*:					
Topsey	Slight	Slight	Moderate: slope.	Slight	Slight.
Pidcoke	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
TuC*:					
Topsey	Slight	Slight	Moderate: slope.	Slight	Slight.
Urban land.					
WsC2 Wise	Slight	Slight	Moderate: slope.	Slight	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
BaB----------------- Bastsil	Good	Good	Good	Good	Good	Good.
BgB----------------- Bolar	Fair	Good	Fair	Fair	Fair	Fair.
Bo------------------ Bosque	Good	Good	Good	Good	Good	Good.
Bs------------------ Bosque	Good	Good	Good	Good	Good	Good.
BtC2*:						
Brackett-----------	Very poor.	Poor	Fair	Fair	Poor	Fair.
Topsey-------------	Fair	Good	Fair	Fair	Fair	Fair.
ChB----------------- Cho	Poor	Poor	Poor	Poor	Poor	Poor.
CoB2---------------- Cisco	Fair	Good	Good	Good	Good	Good.
CrD----------------- Cranfill	Poor	Fair	Fair	Fair	Fair	Fair.
CwB----------------- Crawford	Fair	Fair	Fair	Fair	Fair	Fair.
DeB----------------- Denton	Good	Good	Fair	Fair	Good	Fair.
DnB----------------- Desan	Fair	Good	Fair	Fair	Fair	Fair.
DrC*:						
Doss---------------	Fair	Good	Fair	Fair	Fair	Fair.
Real---------------	Very poor.	Poor	Poor	Fair	Poor	Poor.
EcB----------------- Eckrant	Very poor.	Very poor.	Fair	Fair	Poor	Fair.
ErB*:						
Eckrant------------	Very poor.	Very poor.	Fair	Fair	Poor	Fair.
Rock outcrop.						
EuB*:						
Eckrant------------	Very poor.	Very poor.	Fair	Fair	Poor	Fair.
Urban land.						
EvB----------------- Evant	Poor	Fair	Fair	Fair	Fair	Fair.
Fr------------------ Frio	Good	Good	Fair	Good	Good	Fair.
KrB----------------- Krum	Good	Good	Fair	Fair	Good	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Potential as habitat for-: Openland wildlife	Rangeland wildlife
LeB----------------- Lewisville	Good	Good	Fair	Fair	Good	Fair.
MnB----------------- Minwells	Good	Good	Good	Good	Good	Good.
MuB*:						
Minwells----------	Good	Good	Good	Good	Good	Good.
Urban land.						
NuC----------------- Nuff	Poor	Fair	Fair	Fair	Fair	Fair.
OgB----------------- Oglesby	Fair	Fair	Fair	Fair	Fair	Fair.
PaC----------------- Patilo	Fair	Good	Fair	Fair	Fair	Fair.
PrB----------------- Purves	Poor	Fair	Poor	Fair	Fair	Poor.
ReF*:						
Real---------------	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Rock outcrop.						
SeC----------------- Seawillow	Fair	Good	Fair	Good	Fair	Fair.
SlB----------------- Slidell	Good	Good	Fair	Fair	Good	Fair.
TpC*:						
Topsey------------	Fair	Good	Fair	Fair	Fair	Fair.
Pidcoke-----------	Poor	Poor	Poor	Fair	Poor	Poor.
TuC*:						
Topsey------------	Fair	Good	Fair	Fair	Fair	Fair.
Urban land.						
WsC2---------------- Wise	Fair	Fair	Fair	Fair	Fair	Fair.

* See description of the map unit for composition and characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BaB: Bastsil	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
BgB: Bolar	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: small stones, large stones, thin layer.
Bo: Bosque	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
Bs: Bosque	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
BtC2*:						
Brackett	Moderate: too clayey.	Slight	Slight	Moderate: slope.	Moderate: low strength.	Moderate: small stones, droughty.
Topsey	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
ChB: Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: thin layer.
CoB2: Cisco	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
CrD: Cranfill	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Moderate: small stones.
CwB: Crawford	Severe: depth to rock, cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
DeB: Denton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
DnB: Desan	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
DrC*:						
Doss	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Severe: thin layer.
Real	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: small stones, thin layer.
EcB: Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
ErB*:						
Eckrant----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Rock outcrop.						
EuB*:						
Eckrant----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Urban land.						
EvB--------------- Evant	Severe: cemented pan.	Severe: shrink-swell.	Severe: cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: thin layer, too clayey.
Fr---------------- Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
KrB--------------- Krum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
LeB--------------- Lewisville	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
MnB--------------- Minwells	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
MuB*:						
Minwells---------	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Urban land.						
NuC--------------- Nuff	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Severe: large stones.
OgB--------------- Oglesby	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer, too clayey.
PaC--------------- Patilo	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Slight---------	Moderate: droughty.
PrB--------------- Purves	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
ReF*:						
Real-------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope, thin layer.
Rock outcrop.						
SeC--------------- Seawillow	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: excess lime.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SlB--------------- Slidell	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
TpC*:						
Topsey-----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Pidcoke----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
TuC*:						
Topsey-----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Urban land.						
WsC2-------------- Wise	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BaB: Bastsil	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
BgB: Bolar	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
Bo: Bosque	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Bs: Bosque	Severe: flooding.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
BtC2*:					
Brackett	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: thin layer.
Topsey	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
ChB: Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
CoB2: Cisco	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
CrD: Cranfill	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: small stones.
CwB: Crawford	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, thin layer.
DeB: Denton	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Poor: hard to pack.
DnB: Desan	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
DrC*:					
Doss	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Real	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
EcB: Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones, thin layer.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ErB*:					
Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones, thin layer.
Rock outcrop.					
EuB*:					
Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones, thin layer.
Urban land.					
EvB Evant	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, too clayey.	Severe: depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.
Fr Frio	Severe: flooding, percs slowly.	Slight	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
KrB Krum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LeB Lewisville	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
MnB Minwells	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
MuB*:					
Minwells	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
Urban land.					
NuC Nuff	Severe: percs slowly.	Moderate: seepage, slope, large stones.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
OgB Oglesby	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
PaC Patilo	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
PrB Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
ReF*:					
Real	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.					

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SeC: Seawillow	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, excess lime.
SlB: Slidell	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
TpC*:					
Topsey	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Moderate: too clayey.
Pidcoke	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
TuC*:					
Topsey	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Moderate: too clayey.
Urban land.					
WsC2: Wise	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Moderate: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
BaB------------------- Bastsil	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
BgB------------------- Bolar	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Bo, Bs---------------- Bosque	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
BtC2*:				
Brackett-------------	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Topsey---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, too clayey.
ChB------------------- Cho	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
CoB2------------------ Cisco	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
CrD------------------- Cranfill	Fair: low strength, thin layer, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
CwB------------------- Crawford	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
DeB------------------- Denton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
DnB------------------- Desan	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
DrC*:				
Doss-----------------	Poor: area reclaim, low strength.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, thin layer, excess lime.
Real-----------------	Poor: area reclaim, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, small stones, thin layer.
EcB------------------- Eckrant	Poor: area reclaim, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Poor: area reclaim, large stones, thin layer.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
ErB*:				
Eckrant	Poor: area reclaim, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Poor: area reclaim, large stones, thin layer.
Rock outcrop.				
EuB*:				
Eckrant	Poor: area reclaim, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Poor: area reclaim, large stones, thin layer.
Urban land.				
EvB Evant	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
Fr Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KrB Krum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LeB Lewisville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, area reclaim.
MnB Minwells	Good	Probable	Probable	Poor: too clayey.
MuB*:				
Minwells	Good	Probable	Probable	Poor: too clayey.
Urban land.				
NuC Nuff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, large stones.
OgB Oglesby	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
PaC Patilo	Good	Probable	Improbable: too sandy.	Poor: too sandy.
PrB Purves	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, small stones.
ReF*:				
Real	Poor: area reclaim, thin layer, slope.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, small stones, thin layer.
Rock outcrop.				
SeC Seawillow	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: excess lime.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
SlB------------------- Slidell	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
TpC*:				
Topsey---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, too clayey.
Pidcoke--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
TuC*:				
Topsey---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, too clayey.
Urban land.				
WsC2------------------ Wise	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
BaB: Bastsil	Moderate: seepage.	Moderate: piping.	Favorable	Favorable.
BgB: Bolar	Moderate: seepage, depth to rock.	Moderate: thin layer, hard to pack.	Depth to rock	Depth to rock.
Bo, Bs: Bosque	Moderate: seepage.	Moderate: piping.	Favorable	Favorable.
BtC2*:				
Brackett	Moderate: seepage, slope.	Moderate: piping.	Favorable	Droughty.
Topsey	Moderate: seepage.	Slight	Favorable	Favorable.
ChB: Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan	Droughty, cemented pan.
CoB2: Cisco	Moderate: seepage.	Moderate: piping.	Erodes easily	Erodes easily.
CrD: Cranfill	Moderate: seepage, slope.	Moderate: piping.	Favorable	Favorable.
CwB: Crawford	Moderate: depth to rock.	Moderate: hard to pack.	Depth to rock	Depth to rock.
DeB: Denton	Moderate: depth to rock.	Moderate: hard to pack.	Favorable	Favorable.
DnB: Desan	Severe: seepage.	Severe: seepage, piping.	Too sandy, soil blowing.	Droughty.
DrC*:				
Doss	Severe: depth to rock, seepage.	Severe: thin layer.	Depth to rock	Depth to rock.
Real	Severe: depth to rock, seepage.	Severe: thin layer, seepage.	Depth to rock	Depth to rock.
EcB: Eckrant	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Large stones, depth to rock.	Large stones, depth to rock.
ErB*:				
Eckrant	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Large stones, depth to rock.	Large stones, depth to rock.
Rock outcrop.				

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
EuB*:				
Eckrant	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Large stones, depth to rock.	Large stones, depth to rock.
Urban land.				
EvB Evant	Severe: cemented pan.	Severe: hard to pack.	Depth to rock, cemented pan, percs slowly.	Depth to rock, cemented pan, percs slowly.
Fr Frio	Slight	Moderate: hard to pack.	Favorable	Favorable.
KrB Krum	Severe: seepage.	Severe: hard to pack.	Favorable	Favorable.
LeB Lewisville	Moderate: seepage.	Moderate: piping, hard to pack.	Erodes easily	Erodes easily.
MnB Minwells	Moderate: seepage.	Moderate: thin layer.	Soil blowing, percs slowly.	Percs slowly.
MuB*:				
Minwells	Moderate: seepage.	Moderate: thin layer.	Soil blowing, percs slowly.	Percs slowly.
Urban land.				
NuC Nuff	Moderate: seepage.	Moderate: hard to pack, large stones.	Large stones	Large stones.
OgB Oglesby	Severe: depth to rock.	Severe: hard to pack.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
PaC Patilo	Severe: seepage.	Severe: seepage, piping.	Too sandy, soil blowing.	Droughty.
PrB Purves	Severe: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock.
ReF*:				
Real	Severe: depth to rock, slope, seepage.	Severe: thin layer, seepage.	Slope, depth to rock.	Slope, depth to rock.
Rock outcrop.				
SeC Seawillow	Moderate: seepage.	Moderate: piping.	Favorable	Excess lime.
SlB Slidell	Slight	Moderate: hard to pack.	Percs slowly	Percs slowly.
TpC*:				
Topsey	Moderate: seepage.	Slight	Favorable	Favorable.
Pidcoke	Severe: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock.
TuC*:				
Topsey	Moderate: seepage.	Slight	Favorable	Favorable.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
TuC*: Urban land.				
WsC2: Wise	Severe: seepage.	Severe: piping.	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
BaB: Bastsil	0-8	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	95-100	90-100	75-100	36-70	<25	NP-7
	8-80	Clay loam, sandy clay loam.	CL, SC	A-6	0	95-100	90-100	75-100	40-70	26-40	11-24
BgB: Bolar	0-19	Gravelly clay loam.	CL, CH, SC	A-6, A-7	1-15	60-85	50-78	45-74	36-65	35-57	18-34
	19-38	Gravelly clay loam, gravelly loam, gravelly silty clay loam, loam, clay loam, silty clay loam.	CL, CH, SC	A-6, A-7	1-15	65-100	60-100	60-95	50-85	34-59	16-38
	38-53	Weathered bedrock	---	---	---	---	---	---	---	---	---
Bo: Bosque	0-25	Clay loam	CL, CL-ML	A-4, A-6, A-7-6	0	100	95-100	80-100	56-85	23-45	7-25
	25-54	Loam, clay loam	CL, CL-ML	A-6, A-7-6, A-4	0	100	95-100	95-100	56-85	23-45	7-25
	54-80	Loam, clay loam, clay.	CL, CL-ML	A-4, A-6, A-7-6	0	98-100	95-100	80-100	65-94	23-49	7-29
Bs: Bosque	0-54	Clay loam	CL, CL-ML	A-4, A-6, A-7-6	0	100	95-100	80-100	56-85	23-45	7-25
	54-80	Loam, clay loam, clay.	CL, CL-ML	A-4, A-6, A-7-6	0	98-100	95-100	80-100	65-94	23-49	7-29
BtC2*: Brackett	0-6	Gravelly loam	CL, SC	A-6	0-15	70-99	62-88	50-79	43-72	25-40	10-23
	6-17	Loam, clay loam, gravelly loam.	CL, SC	A-6, A-7-6	0-10	70-100	62-100	50-94	43-87	25-43	10-26
	17-34	Loam, clay loam, shaly clay.	CL	A-6, A-7-6	0-3	90-100	85-100	68-98	67-97	25-43	10-26
Topsey	0-8	Clay loam	CL	A-6, A-7-6	0	90-100	85-100	75-100	65-94	32-49	13-25
	8-14	Loam, clay loam	CL	A-6, A-7-6	0	80-100	80-100	70-98	65-94	32-49	13-25
	14-19	Gravelly loam, gravelly clay loam.	CL, GC, SC	A-6, A-2 A-7-6	0	55-80	47-76	36-65	33-62	32-49	13-25
	19-28	Silt loam, loam, clay loam.	CL	A-6, A-7-6	0	80-100	80-100	70-98	55-80	32-49	13-25
	28-67	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7-6	0	80-100	80-100	70-98	67-95	39-49	20-29
ChB: Cho	0-11	Clay loam	CL, CH	A-6, A-7-6	0-3	80-100	80-100	65-94	55-84	35-55	15-30
	11-22	Cemented	---	---	---	---	---	---	---	---	---
	22-59	Gravelly loam, gravelly clay loam, very gravelly loam.	SM-SC, SC, GC, GM-GC	A-2, A-4, A-6, A-7-6	0-5	50-80	35-65	20-50	15-45	24-47	5-22
CoB2: Cisco	0-4	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	95-100	95-100	90-100	40-55	<26	NP-7
	4-41	Sandy clay loam, clay loam.	SC, CL	A-6	0	95-100	95-100	85-100	40-60	25-40	11-25
	41-80	Sandy clay loam, fine sandy loam, pack sand.	SC, SM, SM-SC, ML	A-4, A-6	0	95-100	95-100	80-95	25-54	17-35	NP-15

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CrD-------------- Cranfill	0-11	Gravelly clay loam.	SC, CL, GC	A-6, A-7	0-5	65-85	60-75	50-75	36-70	30-45	11-24
	11-57	Gravelly clay loam, gravelly loam, gravelly silty clay loam.	SC, CL, GC	A-6, A-7, A-2-6, A-2-7	0-5	55-80	50-75	40-75	30-70	30-45	11-24
	57-74	Gravelly clay loam, gravelly silty clay loam.	SC, CL, GC	A-6, A-7	0-5	65-85	60-75	50-75	36-70	35-48	18-28
CwB-------------- Crawford	0-28	Silty clay, clay.	CH, CL	A-7-6	0-5	85-100	85-100	75-100	70-100	45-75	25-50
	28-38	Weathered bedrock	---	---	---	---	---	---	---	---	---
DeB-------------- Denton	0-13	Silty clay--------	CH, MH	A-7	0	97-100	94-100	90-100	85-98	50-70	29-45
	13-19	Silty clay, silty clay loam.	CH, CL	A-7	0	97-100	94-100	90-100	80-98	41-60	25-40
	19-36	Silty clay loam, silt loam, loam.	CH, CL	A-7, A-6	0-15	95-100	91-100	80-100	70-97	36-54	17-36
	36-52	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0-15	95-100	85-100	70-99	65-94	36-54	17-36
	52-70	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
DnB-------------- Desan	0-77	Fine sand, sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2-4, A-3	0	98-100	95-100	85-100	8-28	<25	NP-5
	77-90	Sandy clay loam, fine sandy loam.	SC	A-2, A-4, A-6	0	98-100	95-100	90-100	25-50	20-36	8-20
DrC*:											
Doss------------	0-18	Clay loam, silty clay loam.	CL	A-7-6, A-6	0-20	80-100	80-100	75-95	60-90	28-49	13-29
	18-22	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Real------------	0-15	Gravelly clay loam, very gravelly clay loam, very gravelly loam.	GC, SC, GP-GC, SP-SC	A-2-6, A-2-4	1-10	25-75	10-50	10-45	10-35	25-35	8-15
	15-21	Variable, weathered bedrock.	---	---	---	---	---	---	---	---	---
EcB-------------- Eckrant	0-5	Cobbly silty clay	CL, CH, MH	A-7	15-25	75-100	71-100	70-98	65-94	47-73	25-45
	5-15	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC, MH	A-7	25-75	56-85	50-79	45-75	44-74	47-73	26-45
	15-17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ErB*:											
Eckrant----------	0-5	Cobbly silty clay	CL, CH, MH	A-7	15-25	75-100	71-100	70-98	65-94	47-73	25-45
	5-12	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC, MH	A-7	25-75	56-85	50-79	45-75	44-74	47-73	26-45
	12-13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
EuB*:											
Eckrant---------	0-4	Cobbly silty clay	CL, CH	A-7-6	15-25	75-100	71-100	70-98	65-94	47-73	25-45
	4-11	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC	A-7-6	25-75	56-85	50-79	45-75	44-74	47-73	26-45
	11-13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
EvB-------------- Evant	0-8	Silty clay-------	CL, CH	A-7-6	0-2	85-100	75-100	65-95	60-93	41-55	22-34
	8-19	Clay-------------	CH	A-7-6, A-7-5	0-2	100	95-100	75-100	75-98	70-90	41-55
	19-27	Cemented---------	---	---	---	---	---	---	---	---	---
	27-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
Fr--------------- Frio	0-8	Silty clay-------	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-96	36-59	17-34
	8-80	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-5	90-100	90-100	85-100	68-96	36-59	17-34
KrB-------------- Krum	0-5	Silty clay-------	CH, CL	A-7-6	0	95-100	85-100	85-100	85-95	47-65	25-42
	5-25	Silty clay, clay	CH	A-7-6	0	95-100	85-100	80-100	65-95	51-74	28-50
	25-80	Silty clay loam, silty clay, clay.	CH, CL	A-7-6, A-6	0	85-100	75-100	70-99	65-95	36-60	20-39
LeB-------------- Lewisville	0-12	Clay loam--------	CL, CH	A-7	0	95-100	95-100	82-99	77-95	41-61	20-37
	12-77	Silty clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0	75-100	72-99	69-98	62-95	30-55	12-34
MnB-------------- Minwells	0-6	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	60-90	36-60	18-30	5-15
	6-63	Clay, clay loam, gravelly sandy clay loam, gravelly sandy clay, sandy clay.	CL, CH, SC	A-7-6	0	80-100	70-100	67-96	47-80	43-58	21-35
	63-80	Gravelly sandy clay loam, very gravelly sandy clay loam.	SC, GC	A-2-7, A-2-6	0-5	40-75	30-60	20-50	13-30	32-45	15-25
MuB*:											
Minwells--------	0-5	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	60-90	36-60	18-30	5-15
	5-44	Sandy clay loam, sandy clay.	CL, CH, SC	A-7-6	0	90-100	80-100	67-96	47-80	43-58	21-35
	44-80	Gravelly sandy clay loam, very gravelly sandy clay loam.	CL, SC	A-2-7, A-2-6	0-5	40-75	30-60	20-50	13-30	32-45	15-25
Urban land.											
NuC-------------- Nuff	0-11	Very stony silty clay loam.	CL, CH, MH	A-6, A-7	15-35	94-100	90-100	80-100	65-90	35-61	15-36
	11-30	Silt loam, silty clay loam.	CL, CH	A-6, A-7-6	0-3	95-100	95-100	85-100	70-95	35-55	15-29
	30-36	Stony silt loam, stony silty clay loam, very stony silty clay.	CL, CH	A-6, A-7-6	5-35	95-100	90-100	80-100	65-90	35-53	15-28
	36-80	Shaly silt loam, shaly silty clay loam, shaly silty clay.	CL, CH	A-6, A-7-6	0-5	88-100	84-100	80-100	70-95	35-61	15-36
OgB-------------- Oglesby	0-16	Silty clay-------	CH	A-7-6	0-5	90-100	90-100	85-100	75-100	55-75	30-45
	16-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
PaC-------------- Patilo	0-53	Fine sand--------	SM, SP-SM, SM-SC	A-2-4, A-3	0	100	95-100	85-100	8-28	<25	NP-5
	53-80	Sandy clay loam	SC	A-2, A-4, A-6	0	90-100	90-100	90-100	25-50	22-36	8-20
PrB-------------- Purves	0-6	Gravelly silty clay.	CH, SC, GC	A-7-6	0-10	60-100	60-100	55-95	45-90	51-65	30-40
	6-14	Gravelly clay, very gravelly clay, very gravelly silty clay.	CH, SC, GC	A-7-6	0-35	60-100	60-100	55-95	45-90	51-65	30-40
	14-16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ReF*: Real------------	0-17	Gravelly clay loam, very gravelly clay loam, very gravelly loam.	GC, SC, GP-GC, SP-SC	A-2-6, A-2-4	1-10	25-75	10-50	10-45	10-35	25-35	8-15
	17-20	Variable, weathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
SeC-------------- Seawillow	0-21	Clay loam--------	CL	A-7-6, A-6	0-5	80-100	75-100	75-100	60-90	29-46	14-30
	21-80	Clay loam, silty clay loam, loam.	CL	A-6, A-7-6	0-5	75-100	65-100	60-100	51-75	27-45	10-25
SlB-------------- Slidell	0-66	Silty clay-------	CH	A-7-6	0	95-100	95-100	95-100	85-100	50-67	31-46
	66-80	Silty clay, clay	CH, CL	A-7-6	0	95-100	93-100	85-100	70-98	34-51	18-30
TpC*: Topsey----------	0-7	Clay loam--------	CL	A-6, A-7-6	0	90-100	85-100	75-100	65-94	32-49	13-25
	7-24	Silty clay loam, loam, clay loam.	CL	A-6, A-7-6	0	80-100	80-100	70-98	65-94	32-49	13-25
	24-80	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7-6	0	80-100	80-100	70-98	67-95	39-49	20-29
Pidcoke---------	0-8	Clay loam--------	CL	A-6, A-7-6	0	90-100	85-100	80-100	65-94	32-49	13-26
	8-13	Gravelly clay loam, gravelly silty clay loam.	CL, SC	A-6, A-7-6	0-5	55-80	45-74	36-65	36-65	32-49	13-26
	13-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
TuC*: Topsey----------	0-7	Clay loam--------	CL	A-6, A-7-6	0	90-100	85-100	75-100	65-94	32-49	13-25
	7-22	Loam, clay loam	CL	A-6, A-7-6	0	80-100	80-100	70-98	65-94	32-49	13-25
	22-80	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7-6	0	80-100	80-100	70-98	67-95	39-49	20-29
Urban land.											
WsC2------------- Wise	0-6	Clay loam--------	CL, CL-ML	A-6, A-4	0	95-100	95-100	85-100	75-95	17-40	5-22
	6-29	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	95-100	95-100	85-100	75-95	17-40	5-22
	29-80	Stratified very fine sandy loam to shaly silty clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	95-100	85-100	49-85	17-40	5-22

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
BaB: Bastsil	0-8	7-20	1.50-1.65	2.0-6.0	0.11-0.15	5.1-7.3	Low	0.24	5	3	<2
	8-80	20-35	1.50-1.65	0.6-2.0	0.12-0.16	5.6-7.8	Moderate	0.32			
BgB: Bolar	0-19	20-40	1.20-1.50	0.06-2.0	0.11-0.18	7.9-8.4	Moderate	0.20	2	8	1-3
	19-38	20-40	1.20-1.50	0.06-2.0	0.10-0.15	7.9-8.4	Moderate	0.20			
	38-53	---	---	---	---	---	---	---			
Bo: Bosque	0-25	20-35	1.20-1.40	0.6-2.0	0.15-0.20	7.4-8.4	Low	0.28	5	4L	1-4
	25-54	20-35	1.20-1.40	0.6-2.0	0.15-0.20	7.4-8.4	Low	0.28			
	54-80	20-45	1.20-1.40	0.6-2.0	0.11-0.18	7.9-8.4	Low	0.28			
Bs: Bosque	0-54	20-35	1.20-1.40	0.6-2.0	0.15-0.20	7.4-8.4	Low	0.28	5	4L	1-4
	54-80	20-45	1.20-1.40	0.6-2.0	0.11-0.18	7.9-8.4	Low	0.28			
BtC2*:											
Brackett	0-6	10-35	1.30-1.50	0.6-2.0	0.08-0.12	7.9-8.4	Low	0.17	2	8	1-3
	6-17	18-35	1.30-1.55	0.6-2.0	0.11-0.16	7.9-8.4	Low	0.32			
	17-34	18-45	1.35-1.65	0.2-0.6	0.10-0.15	7.9-8.4	Low	0.32			
Topsey	0-8	20-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate	0.32	5	4L	1-4
	8-14	20-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate	0.32			
	14-19	20-35	1.32-1.50	0.6-2.0	0.10-0.16	7.9-8.4	Moderate	0.17			
	19-28	20-35	1.50-1.65	0.6-2.0	0.12-0.17	7.9-8.4	Moderate	0.32			
	28-67	35-50	1.50-1.73	0.2-0.6	0.09-0.16	7.9-8.4	Moderate	0.32			
ChB: Cho	0-11	28-35	1.30-1.50	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.28	1	4L	1-2
	11-22	---	---	---	---	---	---	---			
	22-59	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	Low	0.15			
CoB2: Cisco	0-4	10-20	1.35-1.55	2.0-6.0	0.10-0.13	6.1-7.3	Low	0.37	5	3	<1
	4-41	20-35	1.40-1.65	0.6-2.0	0.11-0.16	6.1-7.8	Moderate	0.32			
	41-80	15-30	1.50-1.65	2.0-6.0	0.10-0.15	7.4-8.4	Low	0.32			
CrD: Cranfill	0-11	27-40	1.32-1.45	0.6-2.0	0.10-0.14	7.9-8.4	Moderate	0.17	5	8	<2
	11-57	20-40	1.32-1.50	0.6-2.0	0.08-0.14	7.9-8.4	Moderate	0.28			
	57-74	27-40	1.35-1.60	0.6-2.0	0.08-0.14	7.9-8.4	Moderate	0.28			
CwB: Crawford	0-28	40-60	1.30-1.55	<0.06	0.12-0.18	6.1-8.4	Very high	0.32	2	4	1-3
	28-38	---	---	---	---	---	---	---			
DeB: Denton	0-13	35-57	1.18-1.32	0.06-0.2	0.11-0.16	7.9-8.4	High	0.32	4	4	1-4
	13-19	35-55	1.28-1.50	0.06-0.2	0.10-0.16	7.9-8.4	High	0.32			
	19-36	20-37	1.40-1.65	0.6-2.0	0.11-0.14	7.9-8.4	Moderate	0.43			
	36-52	12-35	1.40-1.65	0.6-2.0	0.11-0.14	7.9-8.4	Moderate	0.43			
	52-70	---	---	---	---	---	---	---			
DnB: Desan	0-77	2-12	1.30-1.60	6.0-20	0.05-0.08	5.1-7.3	Very low	0.17	5	2	<1
	77-90	18-35	1.35-1.65	0.6-2.0	0.12-0.16	5.1-6.5	Low	0.24			
DrC*:											
Doss	0-18	27-40	1.20-1.55	0.2-0.6	0.12-0.16	7.9-8.4	Moderate	0.32	1	4L	1-3
	18-22	---	---	---	---	---	---	---			
Real	0-15	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low	0.10	1	8	1-4
	15-21	---	---	---	---	---	---	---			
EcB: Eckrant	0-5	40-60	1.35-1.55	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.15	1	8	1-4
	5-15	40-60	1.35-1.60	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.10			
	15-17	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
ErB*:											
Eckrant	0-5	40-60	1.35-1.55	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.15	1	8	1-4
	5-12	40-60	1.35-1.60	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.10			
	12-13	---	---	---	---	---	---	---			
Rock outcrop.											
EuB*:											
Eckrant	0-4	40-60	1.35-1.55	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.15	1	8	1-4
	4-11	40-60	1.35-1.60	0.2-0.6	0.05-0.12	6.6-8.4	Moderate	0.10			
	11-13	---	---	---	---	---	---	---			
Urban land.											
EvB	0-8	40-50	1.30-1.50	0.2-0.6	0.10-0.18	6.1-7.3	Moderate	0.32	1	4	2-4
Evant	8-19	60-80	1.12-1.42	0.06-0.2	0.12-0.20	5.6-7.8	High	0.32			
	19-27	---	---	---	---	---	---	---			
	27-50	---	---	---	---	---	---	---			
Fr	0-8	40-50	1.25-1.55	0.2-0.6	0.11-0.20	7.9-8.4	Moderate	0.32	5	4	1-4
Frio	8-80	35-50	1.40-1.60	0.2-0.6	0.10-0.20	7.9-8.4	Moderate	0.32			
KrB	0-5	40-55	1.35-1.55	0.2-0.6	0.15-0.20	7.4-8.4	High	0.32	5	4	1-3
Krum	5-25	40-60	1.35-1.65	0.2-0.6	0.14-0.20	7.9-8.4	High	0.32			
	25-80	35-60	1.40-1.65	0.2-0.6	0.14-0.20	7.9-8.4	High	0.32			
LeB	0-12	28-40	1.20-1.40	0.6-2.0	0.16-0.20	7.9-8.4	High	0.32	5	4	1-3
Lewisville	12-77	27-50	1.30-1.50	0.6-2.0	0.14-0.18	7.9-8.4	High	0.37			
MnB	0-6	10-20	1.35-1.55	2.0-6.0	0.10-0.15	6.1-7.8	Low	0.24	5	3	<1
Minwells	6-63	35-45	1.35-1.60	0.06-0.2	0.11-0.16	5.6-7.3	Moderate	0.32			
	63-80	20-35	1.35-1.60	0.2-0.6	0.10-0.16	6.6-8.4	Moderate	0.32			
MuB*:											
Minwells	0-5	10-20	1.35-1.55	2.0-6.0	0.10-0.15	6.1-7.8	Low	0.24	5	3	<1
	5-44	35-45	1.35-1.60	0.06-0.2	0.11-0.16	5.6-7.3	Moderate	0.32			
	44-80	20-35	1.35-1.60	0.2-0.6	0.10-0.16	6.6-8.4	Moderate	0.32			
Urban land.											
NuC	0-11	27-40	1.35-1.55	0.2-0.6	0.12-0.16	7.9-8.4	Moderate	0.17	5	8	2-4
Nuff	11-30	20-40	1.35-1.55	0.6-2.0	0.15-0.18	7.9-8.4	Moderate	0.32			
	30-36	20-40	1.40-1.60	0.6-2.0	0.12-0.16	7.9-8.4	Moderate	0.20			
	36-80	25-45	1.45-1.69	0.2-0.6	0.15-0.18	7.9-8.4	Moderate	0.32			
OgB	0-16	40-50	1.35-1.60	0.06-0.2	0.13-0.18	7.4-8.4	High	0.32	1	4	1-3
Oglesby	16-24	---	---	---	---	---	---	---			
PaC	0-53	2-15	---	6.0-20	0.05-0.08	5.6-7.3	Very low	0.17	5	1	<1
Patilo	53-80	20-35	---	0.2-0.6	0.14-0.18	5.1-6.5	Low	0.24			
PrB	0-6	35-50	1.35-1.55	0.2-0.6	0.12-0.18	7.9-8.4	High	0.32	1	8	1-3
Purves	6-14	35-50	1.35-1.55	0.2-0.6	0.08-0.18	7.9-8.4	High	0.32			
	14-16	---	---	---	---	---	---	---			
ReF*:											
Real	0-17	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low	0.10	1	8	1-4
	17-20	---	---	---	---	---	---	---			
Rock outcrop.											
SeC	0-21	22-40	1.40-1.55	0.6-2.0	0.12-0.20	7.9-8.4	Moderate	0.28	5	4L	<1
Seawillow	21-80	22-40	1.35-1.60	0.6-2.0	0.12-0.18	7.9-8.4	Low	0.32			
SlB	0-66	40-60	1.35-1.55	<0.06	0.15-0.20	7.4-8.4	High	0.32	5	4	1-4
Slidell	66-80	40-60	1.40-1.60	<0.06	0.15-0.20	7.4-8.4	High	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
TpC*:											
Topsey----------	0-7	27-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate-----	0.32	5	4L	1-4
	7-22	20-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate-----	0.32			
	22-80	35-50	1.50-1.73	0.2-0.6	0.09-0.16	7.9-8.4	Moderate-----	0.32			
Pidcoke---------	0-8	27-35	1.35-1.50	0.2-0.6	0.13-0.17	7.9-8.4	Moderate-----	0.32	1	4L	1-3
	8-13	27-35	1.30-1.50	0.2-0.6	0.11-0.15	7.9-8.4	Moderate-----	0.20			
	13-17	---	---	---	---	---	-------------	----			
TuC*:											
Topsey----------	0-7	27-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate-----	0.32	5	4L	1-4
	7-24	20-35	1.32-1.50	0.6-2.0	0.12-0.17	7.9-8.4	Moderate-----	0.32			
	24-80	35-50	1.50-1.73	0.2-0.6	0.09-0.16	7.9-8.4	Moderate-----	0.32			
Urban land.											
WsC2------------- Wise	0-6	27-30	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Moderate-----	0.37	3	6	.5-2
	6-29	20-30	1.35-1.60	0.6-2.0	0.12-0.18	7.4-8.4	Moderate-----	0.37			
	29-80	10-30	1.35-1.65	0.6-6.0	0.11-0.15	7.4-8.4	Moderate-----	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "occasional," "brief," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In		In			
BaB: Bastsil	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
BgB: Bolar	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
Bo: Bosque	B	Rare	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Bs: Bosque	B	Occasional	Brief	Oct-May	>6.0	---	---	>60	---	---	---	High	Low.
BtC2*:													
Brackett	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Topsey	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
ChB: Cho	C	None	---	---	>6.0	---	---	>60	---	7-20	Thin	High	Low.
CoB2: Cisco	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
CrD: Cranfill	B	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
CwB: Crawford	D	None	---	---	>6.0	---	---	20-40	Hard	---	---	High	Low.
DeB: Denton	D	None	---	---	>6.0	---	---	40-60	Hard	---	---	High	Low.
DnB: Desan	A	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate.
DrC*:													
Doss	C	None	---	---	>6.0	---	---	11-20	Soft	---	---	High	Low.
Real	D	None	---	---	>6.0	---	---	9-20	Soft	---	---	High	Low.
EcB: Eckrant	D	None	---	---	>6.0	---	---	6-15	Hard	---	---	High	Low.
ErB*:													
Eckrant	D	None	---	---	>6.0	---	---	6-15	Hard	---	---	High	Low.
Rock outcrop.													

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In		In			
EuB*:													
Eckrant	D	None	---	---	>6.0	---	---	6-15	Hard	---	---	High	Low.
Urban land.													
EvB Evant	D	None	---	---	>6.0	---	---	20-40	Soft	14-20	Thin	High	Moderate.
Fr Frio	B	Occasional	Brief	Oct-May	>6.0	---	---	>60	---	---	---	High	Low.
KrB Krum	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
LeB Lewisville	B	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
MnB Minwells	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
MuB*:													
Minwells	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Urban land.													
NuC Nuff	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
OgB Oglesby	D	None	---	---	6.0	---	---	10-20	Hard	---	---	High	Low.
PaC Patilo	B	None	---	---	4.0-6.0	Perched	Oct-May	>60	---	---	---	High	Moderate.
PrB Purves	D	None	---	---	>6.0	---	---	9-19	Hard	---	---	High	Low.
ReF*:													
Real	D	None	---	---	>6.0	---	---	9-20	Soft	---	---	High	Low.
Rock outcrop.													
SeC Seawillow	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
SlB Slidell	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
TpC*:													
Topsey	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
Pidcoke	D	None	---	---	6.0	---	---	10-20	Hard	---	---	Moderate	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
TuC*:													
Topsey------------	C	None---------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
Urban land.													
WsC2--------------- Wise	C	None---------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL ANALYSIS OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Particle-size distribution (Percent less than 2 mm): Sand: Very coarse (2.0-1.0)	Sand: Coarse (1.0-0.5)	Sand: Medium (0.5-0.25)	Sand: Fine (0.25-0.1)	Sand: Very fine (0.1-0.05)	Sand: Total (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	COLE	Bulk density	Water content: 1/3 bar	Water content: 15 bar	Available water capacity
	In											G/cc	Pct (wt)		
Crawford[1] (S63TX-50-5)	0-5	Ap	0.4	0.6	0.8	3.5	5.2	10.5	47.8	41.7	---	---	---	15.3	---
	5-12	A1	0.4	0.4	0.7	2.6	4.6	8.7	43.8	47.5	0.67	1.39	27.0	17.6	0.18
	12-21	A2	0.5	0.3	0.7	2.7	4.2	8.4	42.5	49.1	0.86	1.37	28.0	18.5	0.13
	21-28	A3	0.2	1.1	0.6	2.2	3.9	7.2	42.5	50.3	0.76	1.34	29.8	20.0	0.13
Denton[1] (S82TX-099-001)	0-6	Ap	0.3	0.2	0.1	0.4	1.6	2.6	44.4	53.0	---	---	---	---	---
	6-13	A	0.2	0.3	0.2	0.8	2.0	3.5	39.7	56.8	0.14	1.23	36.6	---	---
	13-19	Bw	0.4	0.4	0.3	1.3	2.6	5.0	41.6	53.4	0.10	1.32	32.6	---	---
	19-36	2Bk	2.8	1.6	1.8	5.1	6.4	17.8	59.0	23.9	0.03	1.47	21.7	---	---
	36-52	2Ck	1.7	1.2	1.4	5.5	7.9	17.7	66.4	15.9	---	---	---	---	---
Evant[1] (S80TX-099-004)	0-8	[2]/A1, A2	1.8	1.3	1.0	1.1	3.5	8.7	51.0	40.3	0.06	1.38	24.3	16.8	---
	8-15	Bt1	2.2	1.3	0.7	0.9	3.0	8.1	44.2	47.7	0.07	1.31	30.2	18.8	---
	15-17	Bt2	0.4	0.4	0.3	0.3	0.8	2.2	15.1	82.7	0.17	1.12	45.6	33.5	---
	17-19	Bk	TR	0.2	0.1	0.2	0.7	1.2	10.5	88.3	0.16	1.14	41.6	36.8	---
	19-27	Bkm	8.2	5.9	3.8	3.6	3.1	24.6	23.1	52.3	---	---	---	21.4	---
Frio[1] (S80TX-099-003)	0-8	A1	0.2	0.1	0.1	2.4	7.6	10.4	45.4	44.2	0.097	1.25	31.3	19.2	0.14
	8-22	A2	TR	0.1	0.2	6.1	19.0	25.4	42.0	32.6	0.067	1.45	24.5	14.1	0.10
	22-29	A3	TR	0.1	0.1	3.1	13.1	16.4	46.9	36.7	0.065	1.45	23.9	15.9	0.12
	29-40	A4	TR	0.1	0.1	2.6	10.5	13.3	47.4	39.3	0.069	1.54	23.2	15.8	0.13
	40-80	Bk	0.1	0.2	0.2	1.0	5.1	6.6	46.8	46.6	0.086	1.43	27.1	18.5	0.14
Topsey[1] (S80TX-099-005)	0-8	A	3.6	5.6	4.7	5.9	7.5	27.3	44.8	27.9	0.04	1.45	22.0	12.2	0.14
	8-14	Bw1	5.7	4.4	3.4	5.4	6.4	25.3	44.7	30.0	0.02	1.38	21.1	10.1	0.13
	14-19	Bw2	8.5	4.5	3.2	3.8	4.5	24.5	50.2	25.3	0.02	1.32	23.3	8.7	0.15
	19-28	BCk	1.5	1.3	1.3	2.6	3.9	10.6	70.2	19.2	0.01	1.53	17.9	6.2	0.14
	28-67	2C	0.8	0.5	0.6	0.7	1.9	4.5	55.6	39.9	0.04	1.73	16.5	11.1	0.09

[1]/Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."
[2]/Horizons mixed in sampling.

TABLE 17.--CHEMICAL ANALYSIS OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Extractable bases: Ca	Mg	Na	K	Sum	Cation Exchange Capacity	Organic carbon	$CaCO_3$	pH: H_2O (1:1)	$CaCl_2$
	In		Meq/100g						Pct	Pct		
Crawford[1]/ (S63TX-50-5)	0-5	Ap	26.5	3.8	0.1	0.8	31.2	---	1.06	---	6.0	---
	5-12	A1	30.4	3.7	0.1	0.6	34.8	---	1.03	---	5.8	---
	12-21	A2	32.6	3.3	0.1	0.6	36.6	---	0.94	---	6.2	---
	21-28	A3	34.7	3.3	0.1	0.6	38.7	---	0.92	---	6.6	---
Denton[1]/ (S82TX-099-001)	0-6	Ap	86.1	1.6	0.1	1.3	89.1	52.6	1.91	11.3	7.8	---
	6-13	A	81.5	1.1	0.1	0.8	83.4	47.2	1.64	17.6	8.0	---
	13-19	Bw	74.5	0.8	0.1	0.6	76.0	38.9	1.51	27.7	8.2	---
	19-36	2Bk	50.0	0.2	0.0	0.2	50.4	13.7	0.42	73.9	8.2	---
	36-52	2Ck	45.8	0.2	0.0	0.1	46.1	8.2	0.74	80.1	8.2	---
Evant[1]/ (S80TX-099-005)	0-8	A1, A2	---	---	---	---	---	---	2.73	---	7.0	6.4
	8-15	Bt1	---	---	---	---	---	---	1.75	---	6.2	5.5
	15-17	Bt2	---	---	---	---	---	---	1.25	---	5.9	5.7
	17-19	Bk	---	---	---	---	---	---	1.32	---	6.8	6.7
	19-27	Bkm	---	---	---	---	---	---	1.78	---	7.8	7.5
Frio[1]/ (S80TX-099-003)	0-8	A1	---	2.4	0.1	1.4	---	72.0	2.11	28.0	7.9	7.5
	8-22	A2	---	1.9	TR	0.9	---	68.0	1.14	25.0	8.1	7.6
	22-29	A3	---	2.5	0.1	0.7	---	67.0	0.89	29.0	8.2	7.7
	29-40	A4	---	3.4	0.1	0.7	---	64.0	0.73	31.0	8.2	7.8
	40-80	Bk	---	8.2	1.2	0.8	---	62.0	0.55	32.0	8.1	7.8
Topsey[1]/ (S80TX-099-005)	0-8	A	---	---	---	---	---	---	2.70	63.0	7.8	7.4
	8-14	Bw1	---	---	---	---	---	---	1.22	69.0	8.1	7.6
	14-19	Bw2	---	---	---	---	---	---	1.05	74.0	8.1	7.6
	19-28	BCk	---	---	---	---	---	---	0.34	81.0	8.2	7.6
	28-67	2C	---	---	---	---	---	---	0.70	68.0	8.2	7.7

[1]/Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

TABLE 18.--CLAY MINERALOGY OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Percentage of clay minerals: Montmorillonite	14-Angstrom intergrade	Kaolinite	Feldspars	Quartz	Mica	Calcite
	In								
Crawford (563TX-50-5)	0-5	Ap	>40	---	10-40	<10	<10	---	---
	5-12	A1	>40	---	10-40	<10	<10	---	---
	12-21	A2	>40	<10	10-40	<10	<10	---	---
	21-28	A3	>40	<10	10-40	<10	<10	---	---
Denton[1]/ (S82TX-099-001)	0-6	Ap	>50	---	10-50	---	10-50	Trace	---
	13-17	Bw	>50	---	10-50	---	10-50	Trace	---
	36-52	2Ck	>50	---	10-50	---	10-50	Trace	---
Evant[1, 2]/ (S80TX-099-004)	15-17	Bt2	3	---	2	---	---	1	---
Frio[1, 2]/ (S80TX-099-003)	8-22	A2	4	---	3	---	---	3	2
Topsey[1, 2]/ (S80TX-099-005)	14-19	Bw2	3	---	3	---	---	1	2
	28-67	2C	3	---	3	---	---	1	2

1/Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."
2/Relative Amounts: 5, dominant; 4, abundant; 3, moderate; 2, small; 1, trace.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]									Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		G/cc	Pct	Pct	Pct
Bosque[3] 82TX-099-001																	
A1 0-9	A-6 (17)	CL	100	100	100	100	100	79	-	--	---	40	22	2.66	16.0	11.7	1.89
Ak2 31-54	A-7-6(16)	CL	100	100	100	100	99	75	-	--	---	41	23	2.66	16.0	12.3	1.93
Brackett[4] 77TX099-001																	
Bk 7-18	A-6 (11)	CL	100	100	96	94	92	87	85	60	34	35	13	2.67	23.0	5.8	1.66
C 18-60	A-6 (23)	CL	100	100	100	99	98	97	96	69	43	38	23	2.73	15.0	11.5	1.92
Cisco[3] 80TX099-008																	
Bt1 4-23	A-6 (6)	SC	100	100	100	100	100	49	46	27	28	36	19	2.65	18.0	8.7	1.76
Bt2 23-41	A-6 (8)	CL	100	100	100	100	100	54	46	31	30	40	21	2.60	18.0	10.2	1.80
Crawford[3] 80TX099-020																	
Ap 0-5	A-7-6(25)	CL	100	100	100	100	99	93	87	49	45	45	25	2.63	14.0	14.5	1.91
A1 5-12	A-7-6(32)	CH	100	100	100	100	100	91	88	55	50	54	32	2.66	14.0	17.4	1.94
A2 12-21	A-7-6(41)	CH	100	100	100	100	99	95	90	52	48	61	39	2.68	13.0	19.9	2.01
A3 21-28	A-7-6(48)	CH	100	100	100	100	99	95	87	60	52	67	43	2.66	16.0	20.0	1.85
Denton[3] 82TX099-002																	
A 6-13	A-7-5(43)	MH	100	100	100	100	99	97	-	--	---	70	35	2.64	14.0	21.8	1.99
Bw 13-19	A-7-6(29)	CH	100	100	100	99	98	80	-	--	---	63	34	2.64	12.0	21.3	2.04
2Bk 19-36	A-6 (10)	CL	100	100	97	92	85	70	-	--	---	36	17	2.69	20.0	8.6	1.78
Eckrant[3] 80TX099-016																	
A1[5] 0-5	A-7-5(26)	MH	92	89	87	86	84	79	74	42	35	70	27	2.52	24.0	16.8	1.58
A2[5] 5-12	A-7-5(23)	MH	81	77	74	72	70	68	57	37	33	70	30	2.54	20.0	18.2	1.64
Evant[3] S80TX099-022																	
A1 0-3	A-7-6(20)	CL	100	100	100	100	83	79	-	--	---	49	24	2.64	16.0	14.4	1.82
A2 3-8	A-7-6(30)	CH	100	100	100	100	92	90	-	--	---	53	29	2.57	14.0	16.8	1.88
Bt1 & Bt2 8-17	A-7-5(55)	CH	100	100	100	99	97	96	-	--	---	81	46	2.71	19.0	22.1	1.87
Bk 17-19	A-7-5(58)	MH	100	100	100	100	99	98	-	--	---	88	44	2.62	14.0	25.7	1.94
Frio[3] S80TX099-021																	
A1 0-8	A-7-6(37)	CH	100	100	100	100	100	96	-	--	---	59	34	2.64	17.0	17.2	1.80
A2 8-22	A-7-6(25)	CL	100	100	100	100	100	89	-	--	---	46	26	2.64	15.0	14.0	1.91
A3 22-29	A-7-6(22)	CL	100	100	100	100	100	90	-	--	---	42	23	2.64	16.0	12.3	1.87
A4 29-40	A-7-6(31)	CL	100	100	100	100	100	95	-	--	---	49	30	2.66	14.0	16.3	1.99
Bk 40-80	A-7-6(34)	CH	100	100	100	100	100	96	-	--	---	52	32	2.68	13.0	17.4	1.96
Lewisville[3] S80TX099-018																	
A 5-12	A-7-6(17)	CL	100	100	100	100	97	75	57	36	31	43	23	2.61	17.0	12.3	1.85
Bk1 12-27	A-7-6(20)	CL	100	100	100	100	98	78	66	39	33	44	25	2.62	14.0	13.8	1.90
Bk2 27-54	A-7-6(24)	CL	100	100	99	99	97	81	73	47	38	48	29	2.65	13.0	15.8	1.98

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution1/									Liquid limit2/	Plasticity index2/	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		G/cc	Pct	Pct	Pct
Minwells3/																	
S80TX099-017																	
Bt1 6-18	A-7-6 (7)	SC	100	98	91	81	68	47	-	--	---	43	24	2.63	16.0	12.7	1.85
Nuff3/																	
S81TX099-001																	
A16/ 0-5	A-7-5(29)	MH	95	95	94	94	92	88	-	--	---	61	28	2.60	16.0	18.3	1.86
Bk1 11-21	A-7-6(29)	CH	100	100	100	99	96	88	-	--	---	55	29	2.69	15.0	17.3	1.91
Bk2 21-30	A-7-6(24)	CL-CH	99	99	97	94	87	81	-	--	---	50	28	2.70	16.0	14.9	1.89
CBk 36-58	A-6 (18)	CL	98	97	94	91	88	84	-	--	---	39	22	2.73	17.0	10.9	1.87
Oglesby3/																	
S81TX099-002																	
A1 0-6	A-7-6(37)	CH	100	100	100	100	99	95	-	--	---	60	33	2.60	17.0	18.2	1.89
A2 6-16	A-7-6(46)	CH	100	100	100	100	100	93	-	--	---	70	42	2.66	12.0	22.9	2.02
Slidell5/																	
S77TX099-002																	
A 0-26	A-7-6(46)	CH	100	100	100	99	96	94	92	61	54	66	44	2.69	10.0	22.7	2.06
AC 26-60	A-7-6(49)	CH	100	100	100	98	96	95	92	63	55	67	46	2.72	11.0	22.4	2.04
Topsey3/																	
S80TX099-007																	
A 0-8	A-7-6(13)	CL	100	100	99	96	80	67	-	--	---	41	20	2.61	18.0	10.6	1.75
Bw1 8-14	A-7-6(14)	CL	100	100	99	96	85	74	-	--	---	41	20	2.66	20.0	9.8	1.75
Bw2 14-19	A-2-7(02)	SC	94	82	64	48	38	34	-	--	---	43	21	2.63	20.0	10.5	1.76
BCk 19-28	A-6 (8)	CL	98	92	87	82	77	68	-	--	---	35	15	2.68	22.0	6.3	1.72
2C 28-67	A-7-6(22)	CL	98	95	93	86	82	79	-	--	---	42	29	2.69	15.0	14.3	1.92

1/For grain size larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sleeves, but these differences do not seriously affect the data.

2/Liquid limit and plasticity index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

3/Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

4/Brackett-From TX-36 in N. Fort Hood, 2 miles W. on W. Range Rd, 3.5 miles W. on Bald Knob Rd., 100 ft S.

5/Slidell-From Tx-36 in N. Fort Hood, 2 miles W. on W. Range Rd, 5 miles S. on Turnover Creek Rd, 300 ft W.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bastsil	Fine-loamy, siliceous, thermic Udic Paleustalfs
Bolar	Fine-loamy, carbonatic, thermic Typic Calciustolls
Bosque	Fine-loamy, mixed, thermic Cumulic Haplustolls
Brackett	Fine-loamy, carbonatic, thermic, shallow Typic Ustochrepts
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Cisco	Fine-loamy, siliceous, thermic Udic Haplustalfs
Cranfill	Fine-loamy, carbonatic, thermic Typic Ustochrepts
Crawford	Fine, montmorillonitic, thermic Udic Chromusterts
Denton	Fine-silty, carbonatic, thermic Typic Calciustolls
Desan	Loamy, siliceous, thermic Grossarenic Paleustalfs
Doss	Loamy, carbonatic, thermic, shallow Typic Calciustolls
Eckrant	Clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls
Evant	Clayey, montmorillonitic, thermic, shallow Petrocalcic Paleustolls
Frio	Fine, montmorillonitic, thermic Cumulic Haplustolls
*Krum	Fine, montmorillonitic, thermic Vertic Haplustolls
Lewisville	Fine-silty, mixed, thermic Typic Calciustolls
Minwells	Fine, mixed, thermic Udic Paleustalfs
Nuff	Fine-silty, carbonatic, thermic Typic Calciustolls
Oglesby	Clayey, montmorillonitic, thermic Lithic Vertic Haplustolls
Patilo	Loamy, siliceous, thermic Grossarenic Paleustalfs
Pidcoke	Loamy, carbonatic, thermic Lithic Calciustolls
Purves	Clayey, montmorillonitic, thermic Lithic Calciustolls
Real	Loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls
Seawillow	Fine-loamy, carbonatic, thermic Typic Ustochrepts
Slidell	Fine, montmorillonitic, thermic Udic Pellusterts
Topsey	Fine-loamy, carbonatic, thermic Typic Calciustolls
Wise	Fine-silty, siliceous, thermic Typic Ustochrepts

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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