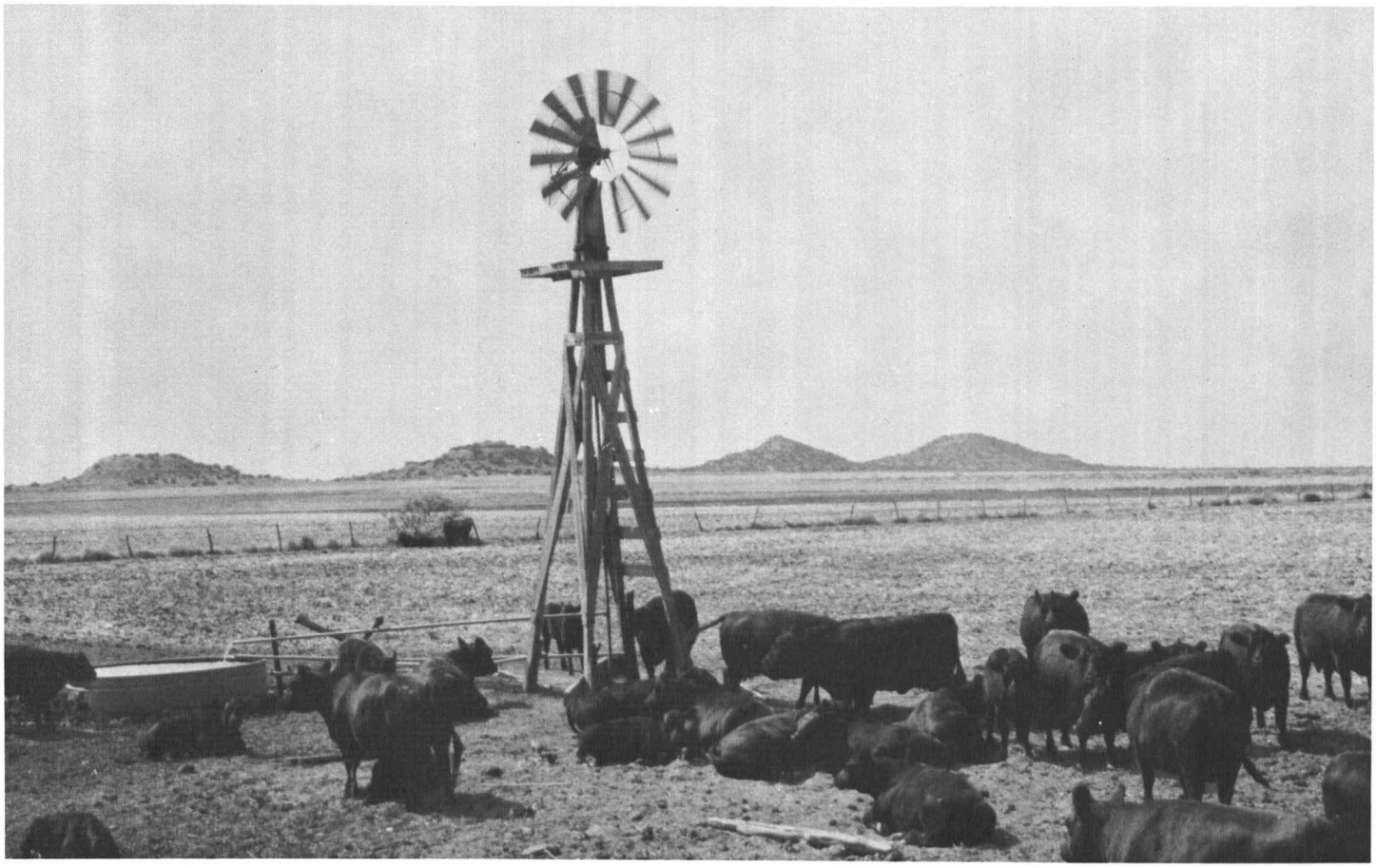
SOIL SURVEY OF

Hardeman County, Texas



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

Issued April 1972

Major fieldwork for this soil survey was done in the period 1959-64. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1965. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Lower Pease River Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commerical photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the dryland capability unit, irrigated capability unit, and range site.

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

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

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

Foresters and others can refer to the section "Windbreaks" for information relating to growth of trees on these soils.

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

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

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

Newcomers to Hardeman County may wish to refer to the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover picture: Legendary Medicine Mounds give a background to cattle utilizing small grain pasture. The soil is a Tillman clay loam.

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Issued April 1972

SOIL SURVEY OF HARDEMAN COUNTY, TEXAS

BY K. T. LOFTON, EARL R. BLAKLEY, AND MARVIN L. DIXON,

SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE,

IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

HARDEMAN COUNTY is in the north-central part of the Rolling Plains of Texas (fig. 1). It is bordered on the east by Wilbarger County and on the west by Childress and Cottle Counties. The Prairie Dog Town Fork of the Red River, between Texas and Oklahoma, forms the northern boundary, and the Pease River and Foard County form the southern boundary.

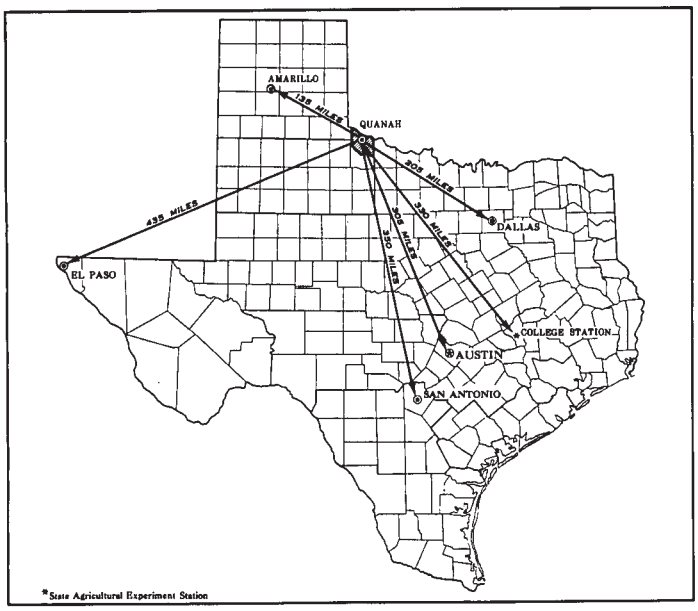

Figure 1.--Location of Hardeman County in Texas.

Hardeman County occupies approximately the northern half of the lower Pease River Soil and Water Conservation District. The total land area of the county is 687 square miles.

Hardeman County has a warm-temperate subtropical climate with dry winters and low summer humidity. The county lies in a transitional zone between the permanently humid region of east Texas and the dry steppe climate of the High Plains.

Farming is the principal enterprise. A little more than 55 percent of the county is cultivated. About 15,000 acres of cropland is irrigated. Wheat grain sorghums, and cotton are the main crops. Guar, alfalfa, forage sorghums, winter peas, barley, and oats are also grown.

Native range occupies approximately 171,000 acres, or about 38 percent of the total agricultural land. Beef cattle ranching is the main livestock enterprise.

In 1970 the population of Hardeman County was 6,795. Quanah, the county seat and largest town, had a population of 3,948.

HOW THIS SURVEY WAS MADE

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

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics (7) 1/. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Vernon and Abilene, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miles fine sandy loam, 0 to 1 percent slopes, is one of several phases within the Miles series.

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

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

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

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

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Weymouth and Vernon clay loams, 3 to 8 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Badland is a land type in Hardeman County.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

1/ Underlined numbers in parentheses refer to Literature Cited, page 81.

GENERAL SOIL MAP

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

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

The soil associations in Hardeman County are described in the following pages.

1. Tillman-Vernon-Weymouth Association

Deep to shallow, nearly level to gently sloping soils that have a surface layer of clay loam and slowly to moderately permeable lower layers

This association is a large, irregular shaped, nearly level to sloping, upland plain. It is on a broad divide between the rivers and adjoins most of the other soil associations.

This is the largest association in the county; it covers about 34 percent of the total land area. Tillman soils make up about 38 percent of the association, Vernon soils 15 percent, and Weymouth soils 11 percent. The remaining 36 percent consists mainly of scattered areas of Hollister, Olton, Colorado, Spur, and Mangum soils. Small areas of Acme and Cottonwood soils and some Badland also are included.

Tillman soils are deep, nearly level to gently sloping, reddish-brown to brown clay loams that have a slowly permeable lower layer.

Vernon soils are gently sloping, are reddish brown, and have a slowly permeable clayey lower layer. They are shallow and are underlain by red-bed clay or shale.

Weymouth soils are deep, gently sloping, brown to reddish-brown clay loams that have a moderately permeable clay loam lower layer. Tillman soils are on the smoother ridges and upland divides, and the Vernon and Weymouth soils are on the more prominent ridges, hilltops, and side slopes flanking creeks or natural drains (fig. 2).

About 70 percent of this association is cultivated, and 30 percent is in native range. Wheat is the principal crop. Sorghum and cotton also are grown.

2. Badland-Vernon-Cottonwood Association

Nearly barren red-bed shale and clay and nearly level to steep, shallow to very shallow soils that have a clay or clay loam surface layer and lower layers of clay or gypsum

This association consists of very shallow rough lands in breaks lying below the adjoining soil associations. The topography is characterized by steep escarpments and smoother benchlike areas dissected by many drainage channels and gullies.

The association makes up a little more than 18 percent of the county. About 70 percent of the association consists of Badland and Vernon, Cottonwood, Talpa, and Latom soils. The remaining 30 percent is made up of soils on the flood plains, including soils of the Yahola, Colorado, Mangum, Lincoln, and Treadway series. Other minor soils are the Hardeman, Olton, and Tivoli, which occur above the bottom-land soils.

The major part of this association is composed of very shallow and shallow soils and Badland. In Hardeman County, Badland consists of nearly barren outcrops of red-bed shale and clay. Vernon soils have about 16 inches of clay loam and clay that is over red-bed clay or shale. Cottonwood soils have about 6 inches of clay loam that is underlain by gypsum.

Little of this association is cultivated. It is used mainly for range.

3. Springer-Miles Association

Deep, nearly level to undulating and hummocky soils that have a loamy fine sand surface layer and lower layers of fine sandy loam and sandy clay loam

The soils in this association form an undulating to hummocky sandy plain that covers about 16 percent of the county. Springer soils make up about 53 percent of the association, and sandy Miles soils 32 percent. The remaining 15 percent is mostly Nobscot and finer textured Miles soils.

Springer soils are deep, neutral, and undulating to hummocky, and have a very friable fine sandy loam lower layer. The underlying material is loamy fine sand to fine sand. Hummocky and severely eroded areas of Springer soils are not suited to cultivasion.

Miles soils are deep, nearly level to gently sloping, and neutral. In the lower part they have a

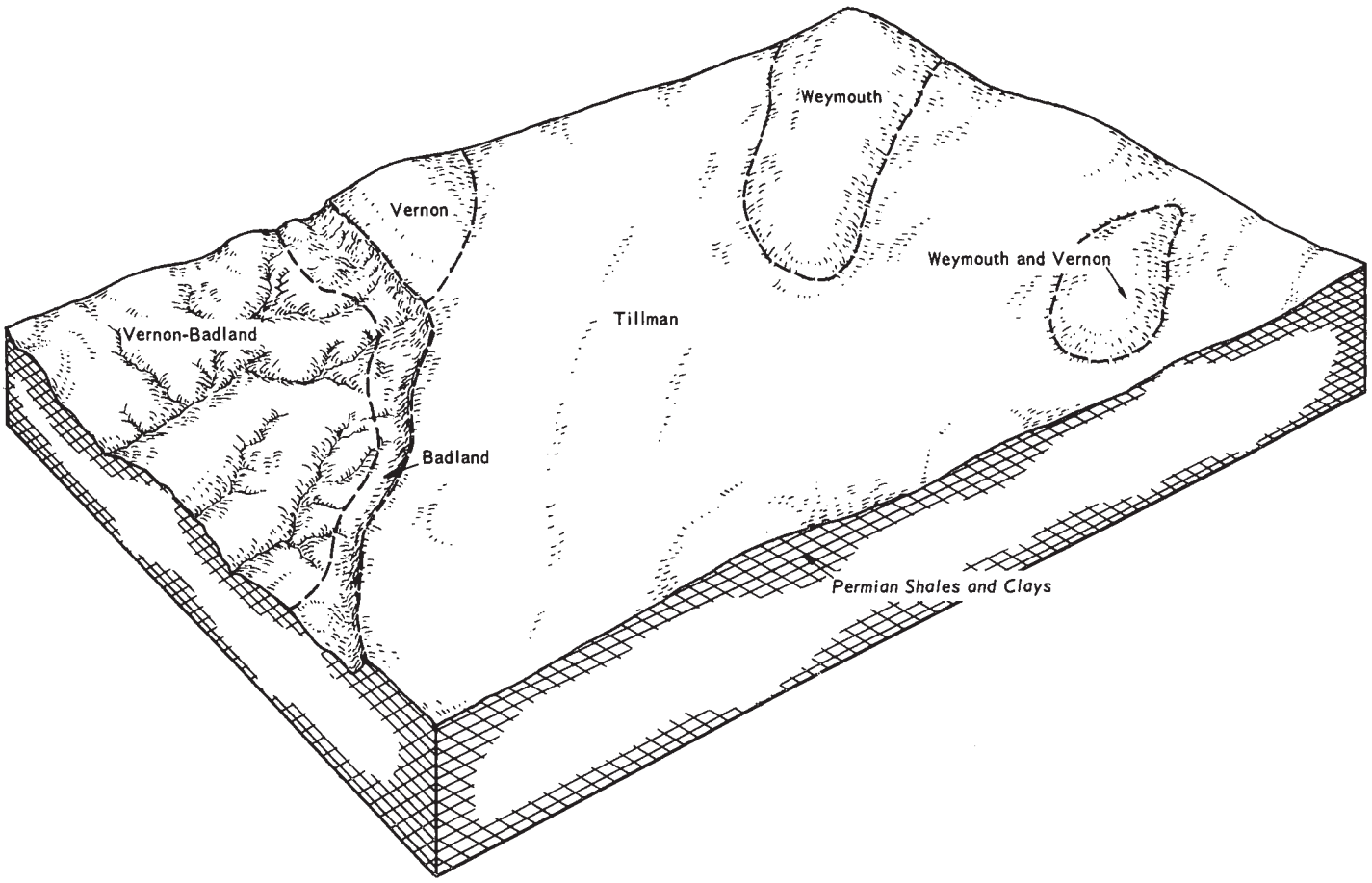

Figure 2.--Pattern of soils in the Tillman-Vernon-Weymouth association.

friable, moderately permeable layer of sandy clay loam. They are nearly level to gently sloping.

About 75 percent of this association is cultivated, and 25 percent is in native range. Wheat, cotton, guar, and sorghum are the principal crops. The soils of this association are susceptible to soil blowing.

4. Hollister-Abilene Association

Deep, nearly level to gently sloping soils that have a clay loam surface layer and lower layers of clay, silty clay, or silty clay loam

The soils in this association form a nearly level to gently sloping upland plain that occupies about 10 percent of the county. Hollister soils make up about 60 percent of the association, and Abilene soils 28 percent. The remaining 12 percent consists mainly of Olton, Tillman, Weymouth, Mansker, and Spur soils.

Hollister soils are deep, are nearly level to gently sloping, and have a slowly permeable lower layer. They occupy valley positions and, in most places, lie below areas of the Tillman-Vernon-Weymouth association.

Abilene soils are deep, are nearly level to gently sloping, and have a lower layer of slowly permeable silty clay. They are in slightly lower valley positions than Hollister soils.

Minor soils in the association are the Olton soils on slightly higher parts of the landscape, Spur soils on the flood plains of major streams, Tillman soils on the smoother ridges, and Weymouth and Mansker soils on the more prominent ridges.

About 90 percent of this association is cultivated; 10 percent is in native range. Wheat is the major crop, but sorghum and cotton also are grown.

5. Miles-Acuff-Olton Association

Deep, nearly level to gently sloping soils that have a surface layer of loam to clay loam and lower layers of sandy clay loam and clay loam to silty clay loam

This soil association occupies nearly level to gently sloping uplands and comprises about 8 percent

of the county. Miles soils make up about 55 percent of the association, Acuff soils 20 percent, and Olton soils 17 percent. The remaining 8 percent is mainly Altus, Portales, Colorado, and Spur soils and Hilly gravelly land.

Miles soils are deep, nearly level to gently sloping, brown to reddish-brown fine sandy loams that have a moderately permeable sandy clay loam lower layer. Acuff soils are deep and nearly level to gently sloping. They have a brown to reddish-brown loam surface layer and a moderately permeable sandy clay loam lower layer.

Olton soils are deep, nearly level to gently sloping, and noncalcareous. They have a brown to reddish-brown loam to clay loam surface layer and a moderately slowly permeable clay loam and silty clay loam lower layer. In most places, Miles soils occur in the higher parts of the landscape and Acuff and Olton soils in the lower parts.

About 85 percent of this association is cultivated, and 15 percent is in native range. Wheat, cotton, and sorghum are the major crops.

6. Quanah-Talpa Association

Deep and very shallow, gently sloping to steep soils that have a surface layer of clay loam over moderately permeable layers

This soil association occupies about 7 percent of the county. It is about 56 percent gently sloping Quanah soils and 30 percent gently sloping to steep Talpa soils. The remaining 14 percent is made up of Vernon, Weymouth, Tillman, and Hollister soils.

Quanah soils are deep, gently sloping, calcareous clay loams that have a silty clay loam lower layer. Talpa soils are very shallow, gently sloping to steep clay loams less than 10 inches thick over dolomitic limestone. Gently sloping Quanah soils occupy foot slopes bordering valleys that meander between gently sloping to sloping Talpa soils on hilltops and ridges (fig. 3). Narrow bands of Weymouth and Vernon soils occur between the areas of Talpa and Quanah soils in some places. Areas of Tillman and Hollister soils are in some of the wider valleys between ridges occupied by Talpa soils.

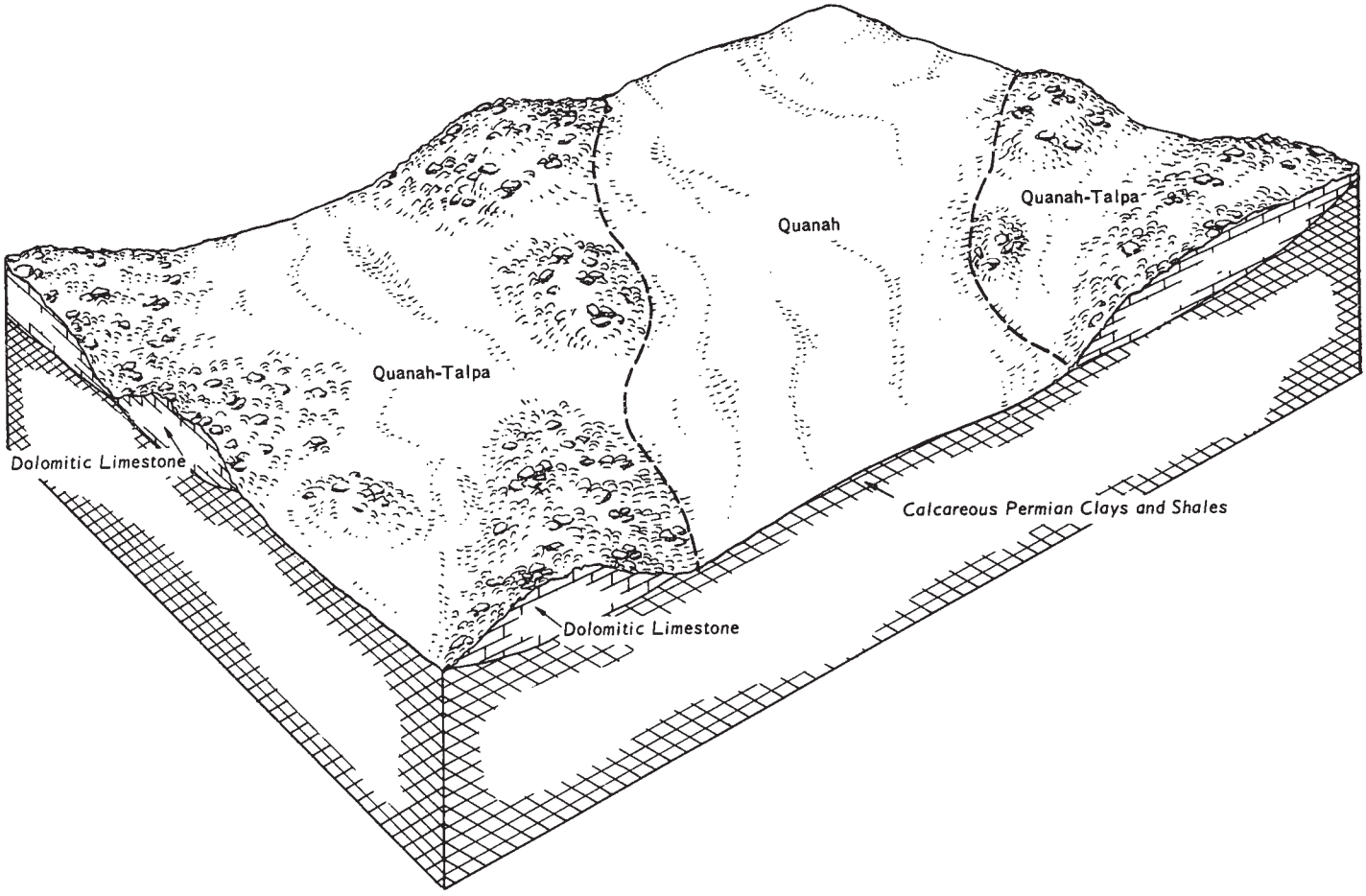

Figure 3.--Pattern of soils in the Quanah-Talpa association

About 10 percent of this association is cultivated, and 90 percent is in native range. Cultivation is mostly on the areas of Quanah and other deep soils. Talpa soils are too shallow and stony for cultivation.

7. Tivoli-Hardeman Association

Deep, nearly level to undulating, duned and steep soils that have a surface layer of fine sand to fine sandy loam and lower layers of fine sand and fine sandy loam

This duny to undulating soil association makes up about 5 percent of the county. Generally it is in areas lower than those occupied by adjoining associations. Tivoli soils make up about 50 percent of this association, and Hardeman soils about 37 percent. The remaining 13 percent is Lincoln soils on bottom lands and areas of Active dunes occurring within areas of Tivoli soils.

Tivoli soils are deep, undulating to hummocky, duned soils of the uplands. They are rapidly permeable fine sand throughout; only a slight accumulation of organic matter is evident in the upper few inches. They are adjacent to flood plains.

Hardeman soils are deep, nearly level to steep soils that are fine sandy loam throughout. They occupy nearly level to undulating areas between the Tivoli soils and adjoining associations. Narrow, discontinuous bands of Lincoln soils occur along flood plains, except where the river channel borders areas of Tivoli soils.

About 30 percent of this association is cultivated, and 70 percent is in native range. The cultivated areas are confined almost entirely to the Hardeman soils. Tivoli soils are not suited to cultivation because of the hazard of soil blowing. Wheat and cotton are the principal crops.

8. Cobb-Cosh Association

Moderately deep to shallow, gently sloping soils that have a surface layer of fine sandy loam and lower layers of sandy clay loam over sandstone

This association occupies gently sloping uplands and comprises less than 2 percent of the county. Cobb soils make up about 42 percent of the association, Cosh soils 18 percent, and Latom soils 3 percent. The remaining 37 percent is Olton, Hollister, and Tillman soils.

Cobb soils are moderately deep, gently sloping, reddish-brown fine sandy loams that have a reddish-brown to red, moderately permeable sandy clay loam lower layer. They occur on ridges and upland divides, and are underlain by sandstone 20 to 48 inches below the surface.

Cosh soils are shallow, gently sloping, reddish-brown fine sandy loams that have a reddish-brown sandy clay loam lower layer. They occur on ridges and hilltops and on the side slopes flanking natural drains. They are underlain by sandstone 12 to 20 inches below the surface.

About 80 percent of this association is cultivated, and 20 percent is in native range. Wheat and sorghum are the principal crops.

DESCRIPTIONS OF THE SOILS

This section describes each of the soil series and the mapping units in Hardeman County, Texas. The procedure is first to describe each soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which it belongs.

Each soil series contains two descriptions of a soil profile, or the major layers of the soil from the surface downward. The first is brief and in terms familiar to a layman. The second is detailed and in technical terms. It is for scientists, engineers, and others who need to make thorough and precise studies of soils. This profile is considered typical, or representative, for all the soils of the series. If the profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, unless they are apparent from the name of the mapping unit. Colors are for dry soil unless specified for moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Active dunes and Badland, for example, do not belong to a series but, nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map at the back of the survey. Listed at the end of each description of a mapping unit are the capability unit and range site in which the mapping unit has been placed. The page on which each capability unit or range site is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Many of the terms used in describing soils can be found in the "Glossary" at the end of the survey. The acreage and proportionate extent of each mapping unit are shown in table 1.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Acres	Percent	Soil	Acres	Percent
Abilene clay loam, 0 to 1 percent slopes	11,374	2.6	Hilly gravelly land	2,340	0.5
Abilene clay loam, 1 to 3 percent slopes	1,624	.4	Hollister clay loam, 0 to 1 percent slopes	25,248	5.7
Abilene clay loam, saline, 0 to 1 percent slopes	386	.1	Hollister clay loam, 1 to 3 percent slopes	12,436	2.8
Acme-Cottonwood complex	3,127	.7	Latom-Rock outcrop complex	4,061	.9
Active dunes	724	.2	Lincoln soils	2,858	.6
Acuff loam, 0 to 1 percent slopes	1,982	.4	Lincoln fine sandy loam	1,530	.3
Acuff loam, 1 to 3 percent slopes	5,254	1.2	Lipan clay	627	.1
Altus fine sandy loam, 0 to 1 percent slopes	489	.1	Mangum clay loam	1,990	.5
Altus fine sandy loam, saline, 0 to 1 percent slopes	731	.2	Mansker clay loam, 1 to 3 percent slopes	1,455	.3
Badland	13,481	3.0	Miles fine sandy loam, 0 to 1 percent slopes	4,026	.9
Cobb fine sandy loam, 1 to 3 percent slopes	3,782	.9	Miles fine sandy loam, 1 to 3 percent slopes	13,116	3.0
Colorado and Spur clay loams	11,927	2.7	Miles fine sandy loam, 3 to 5 percent slopes	3,958	.9
Colorado clay loam	4,332	1.0	Miles fine sandy loam, 3 to 5 percent slopes, eroded	739	.2
Colorado silt loam	1,000	.2	Miles loamy fine sand, 0 to 3 percent slopes	19,986	4.5
Cosh fine sandy loam, 1 to 3 percent slopes	1,657	.4	Miles loamy fine sand, 3 to 5 percent slopes	2,217	.5
Cosh-Latom complex	861	.2	Nobscot fine sand, undulating	2,021	.5
Cottonwood-Vernon complex	30,536	6.9	Olton clay loam, 0 to 1 percent slopes	8,952	2.0
Hardeman fine sandy loam, 0 to 1 percent slopes	1,559	.4	Olton clay loam, 1 to 3 percent slopes	13,430	3.0
Hardeman fine sandy loam, 1 to 3 percent slopes	4,678	1.1	Olton loam, 0 to 1 percent slopes	2,364	.5
Hardeman fine sandy loam, 3 to 5 percent slopes	1,894	.4	Olton loam, 1 to 3 percent slopes	2,280	.5
Hardeman fine sandy loam, 8 to 30 percent slopes, eroded	1,293	.3			

Soil	Acres	Percent	Soil	Acres	Percent
Portales clay loam, 0 to 1 percent slopes	687	0.2	Tipton loam	596	0.1
Quanah clay loam, 1 to 3 percent slopes	8,132	1.8	Tivoli fine sand	11,814	2.7
Quanah-Talpa complex	19,462	4.4	Treadway clay, overflow	959	.2
Springer loamy fine sand, undulating	26,793	6.0	Vernon clay loam, 1 to 3 percent slopes	18,414	4.1
Springer loamy fine sand, hummocky	8,918	2.0	Vernon-Badland complex	21,870	4.9
Springer soils, severely eroded	2,405	.5	Weymouth clay loam, 1 to 3 percent slopes	14,607	3.3
Spur clay loam	4,623	1.0	Weymouth and Vernon clay loams, 3 to 8 percent slopes	5,042	1.1
Talpa soils	2,580	.6	Yahola very fine sandy loam	1,097	.2
Talpa-Vernon complex	4,710	1.1	Gravel pits	148	(1/)
Tillman clay loam, 0 to 1 percent slopes	5,541	1.2	Gypsum mines	781	.2
Tillman clay loam, 1 to 3 percent slopes	52,235	11.8	Water areas more than 40 acres in size	4,421	1.0
			Total area in the county	444,160	100.0

1/ Less than 0.05 percent.

Abilene Series

The Abilene series consists of deep, well-drained, mildly alkaline soils. These soils are nearly level to gently sloping and are on broad upland plains or in valleys. They developed in calcareous, moderately clayey, old alluvium or outwash.

In a representative profile, the surface layer is brown clay loam about 7 inches thick. The next layer is dark grayish-brown friable clay loam 7 inches thick. The next layer, about 30 inches thick, is firm silty clay that is dark brown in the upper part and grayish brown in the lower part. The underlying material is pinkish-white clay loam that contains many soft masses and strongly cemented concretions of calcium carbonate.

Representative profile of Abilene clay loam, 0 to 1 percent slopes, in a cultivated field, 500 feet east of a rural road from a point 0.7 mile north of Farm Road 1167. This intersection is 3 miles west on Farm Road 1167 from Prairie View Church. This church is 4 miles south on Farm Road 392 from its intersection with Farm Road 91, which is 1 mile west and 3 miles south of Chillicothe, Tex.

Ap--0 to 7 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

B1--7 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; common very fine and fine pores; few worm casts; mildly alkaline; gradual, smooth boundary.

B21t--14 to 25 inches, dark-brown (10YR 4/3) silty clay, dark brown (10YR 3/3) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; few very fine pores; common clay films on ped surfaces; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B22t--25 to 44 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; common clay films on ped surfaces; few to common small concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Cca--44 to 64 inches, pinkish-white (7.5YR 8/2) clay loam, pink (7.5YR 7/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; about 40 percent by volume of films, soft masses, and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness, from brown to grayish brown, dark brown, and dark grayish brown in color, and from neutral to mildly alkaline in reaction.

The B1 horizon ranges from 4 to 11 inches in thickness, from brown to dark grayish brown in color, and from neutral to mildly alkaline in reaction. In a few areas the reaction is moderately alkaline. The B21t horizon is 6 to 12 inches thick, brown to grayish brown, dark brown, and dark grayish brown, and mildly to moderately alkaline. The texture is silty clay loam to silty clay. The B22t horizon is 8 to 23 inches thick, brown to grayish brown and dark brown, and silty loam and clay loam to silty clay. Most pedons contain few to common soft masses and hard concretions of calcium carbonate.

The Cca horizon begins at a depth of 28 to 50 inches. An estimated 15 to 50 percent by volume of this horizon is films, soft masses, and strongly cemented concretions of calcium carbonate. In some areas a IIC2 or IIC2ca horizon of weathered red beds is 66 inches or more below the surface. A few areas of Abilene soils are saline and have a high water table.

Abilene clay loam, 0 to 1 percent slopes (AbA).--This soil occurs on upland plains and in valleys. Soil areas are irregular and, in most places, 80 to several hundred acres in size.

This soil has the profile described as representative for the series.

Included with this soil in mapping are areas of Olton clay loam and Hollister clay loam on slightly higher parts of the landscape. Also included are some narrow areas along drains that have slopes of 1 to 3 percent.

Most of the acreage is cultivated. A few areas are irrigated. Runoff is very slow, and the hazard of water erosion is slight. (Dryland capability unit IIc-1; irrigated capability unit I-1; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes (AbB).--This soil is on upland plains and in valleys. The mapped areas are irregular and range from 10 to 260 acres in size. Most areas are less than 50 acres in size, and follow the slope contours above drainage patterns.

The surface layer is dark grayish-brown clay loam about 6 inches thick. Below the surface layer is 34 inches of dark grayish-brown silty clay. The lower layer is calcareous clay loam that contains many soft masses and strongly cemented concretions of calcium carbonate.

Included with this soil in mapping are areas of Olton clay loam and Weymouth clay loam on low ridgetops and slightly more sloping areas along drains. Also included are small areas near the heads of intermittent drains that have slopes of less than 1 percent. A few shallow gullies, 4 to 12 inches deep and more than 300 feet apart, occur in some cultivated fields.

Most areas of Abilene clay loam, 1 to 3 percent slopes, are cultivated, and a few are irrigated. Runoff is slow, and the hazard of water erosion is moderate. (Dryland capability unit IIe-1; irrigated capability unit IIe-1; Deep Hardland range site)

Abilene clay loam, saline, 0 to 1 percent slopes (AcA).--This soil is in an upland valley. It is mapped in only two areas in the county. These areas are irregular in shape and occupy 386 acres.

The surface layer is brown clay loam about 6 inches thick. Saline areas have a white salty crust. Below the surface layer is 26 inches of grayish-brown silty clay. The next layer is silty clay loam that contains many soft masses or strongly cemented concretions of calcium carbonate and common to many accumulations of white crystalline salts. Red-bed clay or shale is 4 to 7 feet below the surface. The water table is at a depth of 2 to 6 feet. Seasonal seepage causes the saline condition and the high water table.

Included with this soil in mapping are areas of Altus fine sandy loam, saline, 0 to 1 percent slopes. Also included are a few small areas of Abilene clay loam that are not saline.

Nearly all areas of Abilene clay loam, saline, that can be cultivated are cultivated even though this soil is best suited to pasture. The soil ranges from slightly to strongly saline. Strongly saline areas, which support little or no vegetation, make up 20 to 50 percent of the acreage of mapped areas and average about 30 percent. (Dryland capability unit IVw-2; Deep Hardland range site)

Acme Series

The Acme series consists of shallow, moderately well drained, calcareous clay loams. These are nearly level to gently sloping soils of the uplands. They are not mapped separately in Hardeman County but occur in a complex with Cottonwood soils.

In a representative profile, the surface layer is grayish-brown clay loam about 7 inches thick. The next layer is brown, calcareous, friable clay loam 8 inches thick. The underlying material is white, weakly cemented gypsite and calcium carbonate.

Representative profile of Acme clay loam, in an area of Acme-Cottonwood complex, in a pasture 250 feet south of the Fort Worth and Denver Railroad and 0.25 mile west of the Acme station at Acme, Tex.

A11--0 to 7 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; many grass roots; many fine and very fine pores; common worm casts; calcareous; moderately alkaline; gradual, smooth boundary.

A12--7 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; many grass roots; many fine and very fine pores; many worm casts; few very fine gypsum particles; calcareous; moderately alkaline; abrupt, wavy boundary.

C--15 to 36 inches, white gypsite and secondary calcium carbonate in the form of coatings in pores and partings in the upper few inches; weakly cemented; has a hardness of about 2, Mohs scale; no evidence of root penetration.

The A horizon ranges from 10 to 20 inches in thickness and from grayish brown to brown, dark brown, and dark grayish brown in color. The C horizon is white to light-gray, weakly cemented gypsite that contains some secondary calcium carbonate in the upper few inches.

Acme-Cottonwood complex (Ad).--This complex consists of nearly level to gently sloping soils on uplands. Slopes range from 0 to 3 percent. These soils are closely associated and occur in intermingled patterns in irregular areas 10 to 320 acres in size. The composition of the complex averages about 43 percent Acme clay loam and 32 percent Cottonwood clay loam. The remaining 25 percent is inclusions of other soils. In most places the Acme soils occur at slightly lower elevations than the Cottonwood soils.

The Acme soil of this mapping unit has the profile described as representative for the series. The Cottonwood soil has a grayish-brown clay loam surface layer about 6 inches thick. This layer is underlain by thick beds of gypsum and calcium carbonate.

Included in mapping are areas of Abilene clay loam and Hollister clay loam in slightly lower parts of the landscape, and small gypsum outcrops on low mounds and around gypsum sinks. Also included is a soil similar to the Acme soil that is 20 to 36 inches deep over beds of gypsum.

About half of this complex is cultivated. The rest is native range. (Both soils in dryland capability unit IVe-6; Acme soil in Deep Hardland range site; Cottonwood soil in Gypland range site)

Active Dunes

Active dunes (Ae) is a miscellaneous land type consisting of nearly barren, active sand dunes. These dunes are reddish-yellow, noncalcareous to weakly calcareous fine sand many feet thick.

Areas of this land type are irregular to oval in shape and 80 to 220 acres in size. The dunes range from 3 to 20 percent in slope, are as much as 45 feet high, and are from one to several hundred feet in diameter at the base.

This land type is generally without vegetation or has only a sparse cover. The amount of vegetation varies with rainfall. During wet seasons the dunes are partially stabilized by vegetation, but during dry seasons the dunes are active and constantly shifting. Most of the vegetation that does grow is at the base of the dunes and between dunes, where it is partly protected from the wind and shifting sand.

Included with this land type in mapping are areas of Tivoli fine sand.

Active dunes are best suited to wildlife or recreational purposes. (Dryland capability unit VIIIe-1; not in a range site)

Acuff Series

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

In a representative profile, the surface layer is brown loam about 7 inches thick. The next layer is reddish-brown friable sandy clay loam 21 inches thick. The next layer is yellowish-red friable sandy clay loam 16 inches thick. The underlying material is pink calcareous clay loam that contains soft masses and concretions of calcium carbonate.

Representative profile of Acuff loam, 1 to 3 percent slopes, in a cultivated field 600 feet south of Farm Road 1167 from a point on this road that is 2.65 miles west from Prairie View Baptist Church. This church is 4 miles south on Farm Road 392 from the intersection of Farm Roads 392 and 91, which is 1 mile west and 3 miles south of Chillicothe, Tex.

Ap--0 to 7 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; hard when dry, very friable when moist; mildly alkaline; abrupt, smooth boundary.

B1--7 to 15 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; compound structure--weak, coarse, prismatic and weak to moderate, medium, subangular blocky structure; hard when dry, friable when moist; common fine and very fine pores; mildly alkaline; gradual, smooth boundary.

B21t--15 to 28 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound structure--weak, coarse, prismatic and moderate, medium, subangular blocky structure; hard when dry, friable when moist; common very fine pores; few clay films; mildly alkaline; gradual, smooth boundary.

B22t--28 to 44 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; compound structure--weak, coarse, prismatic and moderate, fine to medium, subangular blocky structure; hard when dry, friable when moist; many very fine pores; few clay films; mildly alkaline; gradual, smooth boundary.

Cca--44 to 64 inches, pink (5YR 8/4) sandy clay loam, pink (5YR 7/4) when moist; hard when dry, friable when moist; 30 to 40 percent by volume is films, soft masses, and strongly cemented concretions of calcium carbonate up to 1 inch in diameter; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness, from reddish brown to brown in color, and from neutral to mildly alkaline in reaction. The B1 horizon is 4 to 9 inches thick and reddish brown to brown. This horizon is present in about 50 percent of the soil areas. The B2t horizon is 20 to 40 inches thick and red to reddish brown and yellowish red. Reaction ranges from neutral to mildly alkaline in the upper part and from mildly alkaline to moderately alkaline in the lower part.

In about 50 percent of the soil areas, there is a B3 horizon that ranges from 8 to 20 inches in thickness and from red to reddish yellow and yellowish red in color. Depth to the Cca horizon ranges from 28 to 50 inches. Films, soft masses, and strongly cemented concretions of calcium carbonate comprise an estimated 15 to 40 percent of this horizon.

Acuff loam, 0 to 1 percent slopes (AfA).--This soil occupies level upland plains in irregular areas that range from 15 to 275 acres in size. Most areas are less than 100 acres in size.

The surface layer is noncalcareous, brown to reddish-brown loam about 8 inches thick. Beneath the surface layer is a sandy clay loam layer 38 inches thick. It is reddish brown in the upper part and yellowish red in the lower part. In some places the lower part contains a few small masses of calcium carbonate.

The underlying material is reddish sandy clay loam that is 15 to 40 percent soft masses and strongly cemented concretions of calcium carbonate.

Included with this soil in mapping are areas of Miles fine sandy loam in slightly higher parts of the landscape, and lower lying areas of Olton loam. On a few narrow ridges the Acuff loam has slopes of 1 to 3 percent.

Most areas of Acuff loam, 0 to 1 percent slopes, are cultivated. A small part of the acreage is irrigated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit IIc-2; irrigated capability unit I-4; Mixedland range site)

Acuff loam, 1 to 3 percent slopes (AfB).--This soil is on upland plains in irregular areas 10 to 300 acres in size. It has the profile described as representative for the series.

Included with this soil in mapping are areas of Olton loam in slightly lower parts of the landscape, and small areas of Miles fine sandy loam at higher elevation. Also included are small areas on flat-topped ridges and slightly concave areas near the heads of drains where the Acuff loam has slopes of less than 1 percent.

Most of the acreage is cultivated; a few areas are irrigated. This soil has a moderate erosion hazard. (Dryland capability unit IIe-2; irrigated capability unit IIe-2; Mixedland range site)

Altus Series

The Altus series consists of deep, well-drained, noncalcareous fine sandy loams. These soils are nearly level and are in upland valleys that have a relatively shallow ground water table.

In a representative profile, the surface layer is brown fine sandy loam about 9 inches thick. The next layer is brown, friable sandy clay loam 29 inches thick. The underlying material is pale-brown sandy clay loam that contains many soft masses and strongly cemented concretions of calcium carbonate.

Representative profile of Altus fine sandy loam, 0 to 1 percent slopes, in a cultivated field 1 mile east of rural road from a point 1.25 miles north on the rural road from its intersection with Farm Road 91, which is 3.8 miles northeast of Chillicothe, Tex.

Ap--0 to 9 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; hard when dry, very friable when moist; many fine pores; mildly alkaline; abrupt, smooth boundary.

B1--9 to 18 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky and granular structure; hard when dry, friable when moist; many fine pores; few fine masses of white salts; mildly alkaline; gradual, smooth boundary.

B2t--18 to 38 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) when moist; weak, fine to medium, subangular blocky structure; hard when dry, friable when moist; many fine pores; few clay films; few fine masses and deposits of white salts in old root channels; calcareous; moderately alkaline; clear, smooth boundary.

Cca--38 to 62 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; many, fine and medium, soft masses and strongly cemented concretions of calcium carbonate that make up 15 to 20 percent, by volume, of the horizon; calcareous; moderately alkaline.

The Ap horizon ranges from 7 to 10 inches in thickness, from brown to grayish brown in color, and from neutral to mildly alkaline in reaction. The B1 horizon is 5 to 16 inches thick, brown to dark brown and dark grayish brown, and neutral to mildly alkaline. The B2t horizon is 15 to 36 inches thick and brown to dark grayish brown and grayish brown.

The Cca horizon is from 33 to 50 inches below the surface. Soft masses and strongly cemented concretions of calcium carbonate make up an estimated 5 to 25 percent of this horizon.

Altus fine sandy loam, 0 to 1 percent slopes (AlA).--This soil is in slightly concave upland valleys. Most soil areas are oblong and range from 15 to 70 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are areas of Miles fine sandy loam on slightly higher parts of the landscape. Also included are a few small areas of Altus fine sandy loam, saline.

Nearly all of the acreage of this soil is cultivated. The hazard of erosion is slight. (Dryland capability unit IIe-4; irrigated capability unit IIe-4; Sandy Loam range site)

Altus fine sandy loam, saline, 0 to 1 percent slopes (AtA).--This soil is mainly in an upland valley in oblong to irregular areas 40 to 300 acres in size.

The surface layer is brown fine sandy loam about 9 inches thick. Moderately and strongly saline areas have a white salty crust, except where freshly plowed. Below the surface layer is friable sandy clay loam about 30 inches thick. The underlying material is mottled light-gray, reddish-brown, and yellowish-red sandy clay loam that contains many soft masses and strongly cemented concretions of calcium carbonate. Accumulations of white crystalline salts are few to common in this layer in most soil areas. Red-bed clay or shale, which is unrelated to the overlying material, occurs at a depth of 4 to 7 feet. A water table that varies with rainfall is 2 to 6 feet below the surface. Seasonal seepage and the high water table cause the saline condition.

Included in mapping are areas of Abilene clay loam, saline, and Altus fine sandy loam.

Nearly all of the acreage that can be cultivated is cultivated; however, this soil is best suited to

pasture because of the salinity. Open drainage ditches have been installed in some areas, but most of these ditches do not have adequate depth or outlets. Strongly saline areas, which support little or no vegetation, make up 10 to 40 percent of mapped areas and average about 25 percent. Crop yields are moderate to low on the slightly to moderately saline areas (pl. I, top). (Dryland capability unit IVw-2; Sandy Loam range site)

Badland

Badland (Ba) is a miscellaneous land type that consists primarily of nearly barren outcrops of Permian red-bed shale and clay. It occurs on gently sloping to steep uplands. Areas of this land type range from narrow bands of 25 acres or less to large irregular areas several hundred acres in size. Most areas are cut by a network of V-shaped gullies.

Soil development is limited to a mantle, less than 3 inches thick, of fine and very fine aggregates weathered from the red beds. Erosion occurs at such a rapid rate that soil material is lost before vegetation has a chance to become established.

Included in mapping are areas of Vernon soils and narrow bands of Colorado and Spur clay loams along small creeks and drains. Gypsum outcrops and a few sandstone outcrops also are included.

Badland occurs in range areas, though vegetative cover is very sparse. It has practically no agricultural value except for the little grazing value of the small areas mapped with deeper soils. This land type is suited to wildlife or recreation (pl. I, bottom). (Dryland capability unit VIIIs-1; not in a range site)

Cobb Series

The Cobb series consists of moderately deep, gently sloping, well-drained fine sandy loams. These soils developed in material weathered from red-bed sandstone.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 7 inches thick. The next layer is reddish-brown sandy clay loam, about 27 inches thick, that is friable in the upper part and firm in the lower part. The next layer is friable red sandy clay loam about 10 inches thick. The underlying material is weakly cemented reddish sandstone at a depth of 44 to more than 60 inches.

Representative profile of Cobb fine sandy loam, 1 to 3 percent slopes, in a cultivated field, 50 feet west of rural road from a point 0.9 mile south and 3.1 miles east of its intersection with Texas Highway 283, which is 10 miles south of Quanah, Tex.

Ap--0 to 7 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

B1--7 to 18 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; weak, coarse, prismatic structure and weak to moderate, fine, subangular blocky structure; very hard when dry, friable when moist; many very fine pores and common fine pores; few worm casts; neutral; gradual, smooth boundary.

B2t--18 to 34 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; weak, coarse, prismatic structure and moderate, medium, subangular blocky structure; very hard when dry, firm when moist; common fine pores; few worm casts; few clay films on ped surfaces; neutral; gradual, smooth boundary.

B3t--34 to 44 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; neutral; abrupt, smooth boundary.

R--44 to 60 inches, weakly cemented, noncalcareous, red (2.5YR 4/6) sandstone, dark red (2.5YR 3/6) when moist.

The A horizon ranges from 4 to 8 inches in thickness. The B1 horizon ranges from 6 to 15 inches in thickness and is absent in about 15 percent of the soil areas. The B2t horizon ranges from 9 to 27 inches in thickness. The B3t horizon ranges from 10 to 22 inches in thickness and is absent in about 15 percent of the soil areas. The underlying sandstone, or R layer, is 20 to 48 inches from the surface and is noncalcareous in most places.

Cobb fine sandy loam, 1 to 3 percent slopes (CbB).--This soil occupies low ridges and divides on uplands. Soil areas are irregular and 15 to 400 acres in size.

Included with this soil in mapping are areas of Cosh fine sandy loam on low ridgetops and on some of the side slopes along natural drains. Also included are a few small areas of Latom soils on slightly higher parts of the landscape and on sharp breaks in the slopes that flank the drains. Miles fine sandy loam is included in smoother or slightly lower parts of the landscape.

Most areas of this Cobb soil are cultivated. Runoff is slow. The soil is slightly susceptible to soil blowing, and the hazard of water erosion is moderate. (Dryland capability unit IIIe-4; Sandy Loam range site)

Colorado Series

The Colorado series consists of well-drained calcareous loamy soils. These soils are nearly level and occur on flood plains.

In a representative profile, the surface layer is reddish-brown friable clay loam about 24 inches thick that is stratified with slightly more sandy sediments. The next layer is reddish-brown friable sandy clay loam 15 inches thick that is stratified

with silt loam. The lower layer, to a depth of 64 inches, is reddish-brown clay loam.

Representative profile of Colorado clay loam, in the flood plain of Teepee Creek, in a pasture 100 feet east of Farm Road 680 from a point 11.5 miles north of the intersection of Farm Road 680 and U.S. Highway 287. This intersection is 0.6 mile west of Goodlett, Tex.

C1--0 to 24 inches, reddish-brown (5YR 5/4) clay loam stratified with thin layers of slightly more sandy sediments, dark reddish brown (5YR 3/4) when moist; weak, thin, platy structure in upper 3 inches and weak, fine, subangular blocky structure below; hard when dry, friable when moist; many very fine pores; evident bedding planes; calcareous; moderately alkaline; clear, smooth boundary.

C2--24 to 39 inches, reddish-brown (5YR 5/4) sandy clay loam that contains thin layers of silt loam, dark reddish brown (5YR 3/4) when moist; structureless; hard when dry, friable when moist; few fine pores; evident bedding planes; calcareous; moderately alkaline; gradual, smooth boundary.

C3--39 to 64 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) when moist; structureless; hard when dry, friable when moist; few fine pores; calcareous; moderately alkaline.

The C1 horizon ranges from 10 to 24 inches in thickness, from clay loam to silt loam or loam in texture, and from brown to reddish brown and yellowish red in color. Stratification varies from little to much.

Between depths of 10 and 40 inches, the soil is dominantly clay loam or sandy clay loam that, in most places, is stratified with thin layers of fine sandy loam to silty clay loam. Color ranges from light brown to reddish brown and yellowish red. Buried horizons that are darker than the surface horizon also occur.

Colorado and Spur clay loams (Cd).--These nearly level soils are on frequently flooded creek bottoms and along intermittent drains throughout the county. Soil areas are adjacent to stream channels and range from 10 to several hundred acres in size. Some soil areas consist entirely of either Colorado clay loam or Spur clay loam, and some contain areas of both soils.

Colorado clay loam, to a depth of 40 inches or more, is calcareous reddish clay loam or sandy clay loam stratified with thin layers of fine sandy loam to silty clay loam. Thin layers that are darker than the surface layer occur in some areas.

The surface layer of Spur clay loam is brown to dark brown and about 26 inches thick. The next layer, to a depth of about 42 inches, is dark grayish-brown friable clay loam or sandy clay loam. The underlying material is brown or reddish-brown clay loam or sandy clay loam, to depths below 60 inches.

Included in mapping are a few areas in slightly higher parts of the flood plains that are infrequently flooded. Also included are a few areas that are slightly to moderately saline and have a high water table.

Most of the acreage is in range. The soils are not suited to cultivation because of the hazard of flooding (pl. II, top). Overflow occurs about once each year, enough to damage crops. (Dryland capability unit Vw-1; Valley range site)

Colorado clay loam (Ce).--This nearly level soil occupies areas 8 to 150 acres in size on flood plains that are roughly parallel to stream channels. It has the profile described as representative for the series.

Included in mapping are areas of Mangum clay loam on slightly lower parts of the landscape, and narrow bands of Colorado silt loam on slightly higher parts.

About half the acreage is cultivated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit I-1; irrigated capability unit I-2; Valley range site)

Colorado silt loam (Cf).--This is a nearly level soil of the bottom lands. Soil areas are roughly parallel to the stream channels. They range from 10 to 190 acres in size, but generally are less than 50 acres.

The surface layer is brown to reddish-brown or yellowish-red, calcareous silt loam about 12 inches thick. In most areas, it is stratified with slightly more clayey and sandy layers or seams. The underlying layer, to a depth of 40 inches or more, is calcareous reddish-brown to yellowish-red sandy clay loam stratified with thin layers of fine sandy loam to silty clay loam. Below 40 inches is clay loam.

Included with this soil in mapping are areas of Yahola very fine sandy loam on slightly higher parts of the flood plains in narrow bands adjacent to stream channels. Also included are small, low-lying areas of Colorado clay loam.

About 40 percent of the acreage is cultivated. Runoff is slow, and the hazard of erosion is slight. Some areas are occasionally flooded by overflow, but about half of the soil areas are seldom flooded. (Dryland capability unit I-1; irrigated capability unit I-4; Bottomland range site)

Cosh Series

The Cosh series consists of shallow, well-drained, noncalcareous soils on uplands. These gently sloping soils formed in red-bed sandstone.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 6 inches thick. The next layer is reddish-brown friable sandy clay loam about 10 inches thick. The underlying material is red, weakly cemented sandstone.

Representative profile of Cosh fine sandy loam, 1 to 3 percent slopes, in a pasture 20 feet west of rural road from a point 0.65 mile south and 3.6

miles east on the rural road from its intersection with Texas Highway 283. This intersection is 10 miles south of Quanah, Tex.

A1--0 to 6 inches, reddish-brown (2.5YR 5/4) fine sandy loam, dark reddish brown (2.5YR 3/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; many very fine pores and few fine pores; many grass roots; neutral; clear, smooth boundary.

B2t--6 to 16 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; compound structure--moderate, coarse, prismatic and fine, subangular blocky structure; very hard when dry, friable when moist; many very fine pores and few fine pores; many grass roots; few worm casts; few clay films on prism faces; neutral; abrupt, smooth boundary.

R--16 to 36 inches, red (2.5YR 4/6), weakly cemented, noncalcareous sandstone.

The A horizon ranges from 4 to 8 inches in thickness and from neutral to mildly alkaline in reaction.

The B2t horizon ranges from 6 to 14 inches in thickness, from reddish brown to red in color, from fine sandy loam to sandy clay loam in texture, and from neutral to mildly alkaline in reaction. Clay content of this horizon ranges from 18 to 30 percent.

The R layer is from 12 to 20 inches below the surface. The sandstone is weakly cemented, and roots do not penetrate it. In some areas the sandstone is interbedded with calcareous clayey and silty red beds.

Cosh fine sandy loam, 1 to 3 percent slopes (ChB).--This is a soil of the uplands that, in most places, occupies low ridgetops or gently sloping areas flanking drains. Soil areas are irregular and 15 to 200 acres in size. This soil has the profile described as representative for the series.

Included in mapping are areas of Latom soils on slightly higher parts of the landscape. In a few narrow areas, slopes range to 5 percent. Shallow gullies, crossable with tillage implements, occur in some unprotected cultivated areas.

About 60 percent of the acreage is cultivated. The hazard of water erosion is moderate, and the susceptibility to soil blowing is slight. This soil is not well suited to cultivation. It is better suited to pasture or range. (Dryland capability unit IVe-6; Sandy Loam range site)

Cosh-Latom complex (Cl).--This complex is made up of gently sloping soils of the uplands. It is about 62 percent Cosh fine sandy loam and 31 percent Latom soils. The remaining 7 percent is Cobb fine sandy loam, 1 to 3 percent slopes. Slopes are dominantly 3 to 5 percent. Most areas are irregular and 10 to 150 acres in size; if mapped separately, 90 percent or more of the areas of Latom soils would be less than 5 acres in size.

Cosh soils are reddish-brown fine sandy loam about 6 inches thick over reddish-brown to red sandy clay loam about 10 inches thick. The underlying material is red, weakly cemented sandstone.

Latom soils are reddish-brown fine sandy loam about 7 inches thick underlain by strongly cemented, reddish sandstone.

Cosh fine sandy loam is on the smoother ridgetops and the sloping areas along drains. Latom soils are on the more prominent ridgetops and on sharp slope breaks on ridge faces.

Included in mapping are areas of Cobb fine sandy loam, 1 to 3 percent slopes, on lower parts of the landscape along or near the heads of drains. Also included are a few narrow bands of Cosh fine sandy loam, 1 to 3 percent slopes.

About 40 percent of the acreage is cultivated. Runoff is rapid, and water erosion is a moderate to severe hazard. The very shallow Latom soils are not suited to cultivation. The shallow Cosh soils are suited to pasture or range. (Both soils in dryland capability unit IVe-6; Cosh soil in Sandy Loam range site; Latom soil in Very Shallow range site)

Cottonwood Series

The Cottonwood series consists of very shallow, well-drained, calcareous soils over beds of gypsum. These are nearly level to gently sloping soils of the uplands. They are not mapped separately in Hardeman County, but are mapped in two complexes: the Acme-Cottonwood complex and the Cottonwood-Vernon complex.

In a representative profile, the surface layer of Cottonwood soils is grayish-brown clay loam about 6 inches thick. The underlying layer is gypsum and calcium carbonate that extends to a depth of 48 inches.

Representative profile of Cottonwood clay loam, from an area of Cottonwood-Vernon complex, in a pasture, 25 feet west of a rural road from a point 0.75 mile south and 1 mile east from its intersection with Texas Highway 283. This intersection is 4.6 miles south of Quanah, Tex.

A1--0 to 6 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, platy structure in upper 1 inch and moderate, fine, subangular blocky and granular structure below; slightly hard when dry, friable when moist; common fine pores and many very fine pores; many grass roots; calcareous; moderately alkaline; abrupt, wavy boundary.

C--6 to 48 inches, white (N 8/0), soft chalky gypsite, white (2.5Y 8/2) when moist, in the upper 4 inches; light-gray (2.5Y 7/2) weakly cemented gypsite below; calcareous; moderately alkaline; roots do not penetrate.

The A horizon ranges from 3 to 10 inches in thickness, from grayish brown to pale brown and brown in color, and from clay loam to loam in texture.

The C horizon ranges from caliche beds that contain 10 to 50 percent gypsum to gypsite or alabaster that is weakly consolidated to strongly cemented.

Cottonwood-Vernon complex (Ct).--This complex consists of gently sloping to moderately steep soils of the uplands. These soils are closely associated and occur in intricate patterns.

The complex averages about 42 percent Cottonwood soils and 32 percent Vernon soils. The rest is about 10 percent Acme soils, 3 percent Talpa soils, 3 percent Colorado and Spur clay loams, 7 percent gypsum outcrops, and 3 percent Badland. Areas of this complex range from narrow bands of less than 20 acres to large irregular areas of several hundred acres.

In most places the topography of the complex consists of a series of steep scarps and steplike benches dissected by few to many intermittent streams and gullies. Slopes are dominantly 1 to 12 percent.

Cottonwood soils are gently sloping and occupy benches, 50 to 500 feet wide, between the steep scarps. Vernon soils are on some of the smoother, less eroded benches and on some scarp faces. Acme soils are on benches below the Cottonwood soils and, in some places, below steep scarps of gypsum outcrops. The steep scarps are mostly gypsum outcrops or Badland; a few are Talpa-Vernon complex. Narrow bands of Colorado and Spur clay loams occur along some of the larger creeks or drains.

The Cottonwood soils are about 6 inches of grayish-brown clay loam underlain by thick beds of gypsum. The Vernon soils are about 16 inches of reddish-brown clay loam and clay underlain by red-bed shale.

Very little of this mapping unit is suited to cultivation. Most of it is in range. The hazard of water erosion severely limits most uses. (Both soils in dryland capability unit VIIs-1; Cottonwood soil in Gypland range site; Vernon soil in Shallow Redland range site)

Hardeman Series

The Hardeman series consists of deep well-drained fine sandy loams. These soils are nearly level to steep and occur on uplands. They formed in eolian deposits blown from the channels of nearby rivers.

In a representative profile, the surface layer is brown fine sandy loam about 10 inches thick. The next layer is reddish-brown friable fine sandy loam 26 inches thick that contains many films and threads of calcium carbonate in the lower part. The underlying material is reddish-brown fine sandy loam that contains only a few films and threads of calcium carbonate.

Representative profile of Hardeman fine sandy loam, 1 to 3 percent slopes, in a cultivated field 100 feet west of county road from a point on the county road 2.8 miles north of Hooleyann Church. This church is 0.95 mile north and 2.85 miles west on a rural road from the intersection of the rural road and Farm Road 680, which is 11.5 miles north of the intersection of Farm Road 680 and U.S. Highway 287, and 0.6 mile west of Goodlett, Tex.

Ap--0 to 10 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist; mildly alkaline; clear, smooth boundary.

A1--10 to 18 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky and granular structure; slightly hard when dry, very friable when moist; calcareous; moderately alkaline; clear, smooth boundary.

B2--18 to 36 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; many white threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C--36 to 64 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; few faint films and threads of calcium carbonate in upper part; calcareous; moderately alkaline.

The A horizon ranges from 8 to 20 inches in thickness, from reddish brown to light brown and brown in color, and from mildly alkaline to moderately alkaline in reaction.

The B2 horizon ranges from 12 to 24 inches in thickness, from reddish brown to yellowish red or reddish yellow in color, and from fine sandy loam to very fine sandy loam in texture. This horizon contains less than 18 percent clay and more than 15 percent sand that is coarser than very fine sand.

Depth to the C horizon ranges from 24 to 42 inches. This horizon is several feet thick in most profiles. It is reddish brown to yellowish red and reddish yellow and fine sandy loam to very fine sandy loam and loam. In a few of the profiles, buried horizons of contrasting materials occur at depths of 3 to 6 feet.

Hardeman fine sandy loam, 0 to 1 percent slopes (HaA).--This soil occurs on uplands in irregular areas 15 to 200 acres in size.

The surface layer is brown fine sandy loam about 10 inches thick. The next layers are reddish-brown friable fine sandy loam that extend to a depth of about 64 inches.

Included in mapping are narrow bands on slightly higher parts of the landscape where slopes range to 3 percent.

This soil is well suited to crops, and nearly all the acreage is cultivated. The hazard of erosion is slight. (Dryland capability unit IIe-6; irrigated capability unit IIe-6; Sandy Loam range site)

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Hardeman fine sandy loam, 1 to 3 percent slopes (HaB).--This soil occupies areas 15 to 400 acres in size on uplands. It has the profile described as representative for the series.

Included in mapping are narrow bands where slopes are less than 1 percent. These bands occur at the base of some of the gently sloping ridges. Also included are areas in which a few inches of loamy fine sand blown from surrounding areas of sandier soils has been deposited on top of the Hardeman fine sandy loam.

Most areas of Hardeman fine sandy loam, 1 to 3 percent slopes, are cultivated. Soil blowing is a slight hazard, and water erosion is a moderate hazard. (Dryland capability unit IIIe-5; irrigated capability unit IIe-8; Sandy Loam range site)

Hardeman fine sandy loam, 3 to 5 percent slopes (HaC).--This soil occurs on uplands, generally in relatively narrow bands along natural drains. In a few places it is on ridges or hilltops.

The surface layer is fine sandy loam about 12 inches thick. It is brown in the upper part and reddish brown in the lower part. Below this is reddish-brown fine sandy loam, 18 inches thick, that contains many films and threads of calcium carbonate. The underlying material has the same color and texture as the layer above, but contains fewer threads and films of calcium carbonate.

Included in mapped areas of this soil are narrow bands that have slopes of less than 3 percent. These bands occur on the top of some ridges and in some narrow valleys between ridges. U-shaped gullies more than 300 feet apart, 2 to 10 feet deep, and 4 to 12 feet wide, occur in some unprotected cultivated fields, along natural drains, and in other areas where runoff water concentrates.

Most areas of Hardeman fine sandy loam, 3 to 5 percent slopes, are cultivated. Soil blowing is a slight hazard, and water erosion is a moderate hazard. Gullies form easily where runoff water concentrates on areas of unprotected soil. (Dryland capability unit IVe-3; Sandy Loam range site)

Hardeman fine sandy loam, 8 to 30 percent slopes, eroded (HaE2).--This strongly sloping to steep soil occurs on erosion scarps above flood plains. Soil areas are irregular and 20 to 250 acres in size.

The surface layer is reddish-brown fine sandy loam about 8 inches thick. Below is a layer of reddish-brown fine sandy loam. This layer is about 18 inches thick except in gullies and on the lower part of some of the scarp faces where the underlying red beds are exposed.

Most areas of this soil are dissected by U-shaped gullies that are 5 to 30 feet deep and from a few feet to 30 feet wide. Most of these gullies are now stabilized by a moderate to good growth of grasses. Gully erosion is active along a few drainageways and on the steeper scarps.

Included with this soil in mapping are areas that have slopes of 5 to 8 percent. Also included are a few narrow bands of Badland on the lower part of some of the steep scarp faces and narrow bands of Colorado and Spur clay loams along some of the natural drains.

This Hardeman soil is too steep and eroded for cultivation. (Dryland capability unit VIe-3; Sandy Loam range site)

Hilly Gravelly Land

Hilly gravelly land (Hg) is a gently sloping to steep miscellaneous land type consisting of gravelly soil material. Slopes range from about 5 to 50 percent. Areas of this land type are irregular and 20 to 260 acres in size.

In a representative profile, the surface layer is 6 to 10 inches of reddish-brown noncalcareous sandy loam that contains about 60 percent waterworn gravel. Below this layer, to a depth of 20 to 40 inches, is reddish-brown to pink or red sandy loam that contains 50 to 65 percent waterworn gravel. The underlying material is stratified loamy sand to coarse sand that contains 10 to 50 percent waterworn gravel. The gravelly layers are generally several feet thick, but in a few places the gravelly material is only 12 to 36 inches thick over sandy clay loam.

Included in mapping are areas of Miles fine sandy loam and Miles loamy fine sand. These soils are on the outer edges of the gravelly soils and in some of the narrow valleys between the gravelly hills. Vernon soils and a few small outcrops of Badland also are included.

Hilly gravelly land is not suited to cultivation because it has steep slopes and high gravel content. Most large areas of this land type contain enough sand and gravel for commercial use, and many gravel pits have been excavated. (Dryland capability unit VIs-1; Gravelly range site)

Hollister Series

The Hollister series consists of deep, well-drained, nearly level to gently sloping soils on upland plains.

In a representative profile, the surface layer is grayish-brown clay loam about 6 inches thick. The next layer is grayish-brown firm silty clay loam 6 inches thick. Below this layer is grayish-brown very firm clay that contains strongly cemented concretions of calcium carbonate. The underlying material is reddish clay that contains soft masses and strongly cemented concretions of calcium carbonate and a few pockets of gypsum and other salts.

Representative profile of Hollister clay loam, 0 to 1 percent slopes, in a cultivated field, 130 feet east of a rural road from a point 2.05 miles south of its intersection with U.S. Highway 287. This intersection is 3.4 miles west of Chillicothe, Tex.

Ap--0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

B1--6 to 12 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; few very fine pores; mildly alkaline; clear, smooth boundary.

B21t--12 to 32 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, blocky structure; extremely hard when dry, very firm when moist; few very fine pores; many clay films; few, fine, strongly cemented calcium-carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B22t--32 to 52 inches, grayish-brown (10YR 5/2) clay, dark brown (10YR 4/3) when moist; moderate, medium and coarse, blocky structure; extremely hard when dry, very firm when moist; few very fine pores; many clay films; common, fine, strongly cemented calcium-carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B23tca--52 to 60 inches, grayish-brown (10YR 5/2) clay, dark brown (10YR 4/3) when moist; few yellowish-red mottles in lower part; weak, coarse, blocky structure; extremely hard when dry, firm when moist; 3 to 5 percent by volume soft accumulations and strongly cemented concretions of calcium carbonate; few streaks and pockets of white salts, probably gypsum; calcareous; moderately alkaline; gradual, smooth boundary.

B24tca--60 to 70 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; weak, coarse, blocky structure; hard when dry, friable when moist; contains 5 to 10 percent by volume soft masses of calcium carbonate; few pockets of gypsum crystals or other salts; calcareous; moderately alkaline; gradual, smooth boundary.

C--70 to 75 inches, red (2.5YR 5/6) clay, red (2.5YR 4/6) when moist; contains light-gray and light olive-gray laminae; very hard when dry, firm when moist; calcareous; moderately alkaline.

The A horizon ranges from 4 to 8 inches in thickness, from brown to dark brown, grayish brown, and dark grayish brown in color, and from clay loam to silty clay loam in texture.

The B1 horizon ranges from 3 to 10 inches in thickness, from dark brown to grayish brown or very dark grayish brown in color, from silty clay loam to silty clay in texture, and from mildly to moderately alkaline in reaction.

The B21t and B22t horizons range from 26 to 50 inches in thickness and from brown to dark brown, grayish brown, and very dark grayish brown in color. In most profiles these horizons contain few to common soft masses or strongly cemented concretions of calcium carbonate. The B2tca horizon is 10 to 25 inches thick and brown to reddish brown to grayish brown and dark grayish brown. It is about 3 to 20 percent calcium carbonate. The C horizon, made up of weathered red beds, is from 60 to 75 inches from the surface.

Hollister clay loam, 0 to 1 percent slopes (HoA).--This soil occupies upland plains and valleys in irregular areas 40 to several hundred acres in size. It has the profile described as representative for the series.

Included in mapping are areas of Abilene clay loam in slightly lower positions of the landscape. In a few small areas along drains, slopes are 1 to 3 percent. Also included are small, slightly higher areas of Tillman clay loam, 0 to 1 percent slopes.

About 90 percent of the acreage is cultivated (pl. II, bottom). Some areas are irrigated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit IIc-1; irrigated capability unit I-1; Deep Hardland range site)

Hollister clay loam, 1 to 3 percent slopes (HoB).--This soil occurs on upland plains and in valleys. In most places soil areas follow the slope contours above the drainageways. This soil also occurs on long gentle slopes below areas of Tillman clay loam. Soil areas range from 20 to 500 acres in size but are generally less than 80 acres.

The surface layer is grayish-brown clay loam about 6 inches thick. The next layer is grayish-brown and about 44 inches thick. It is silty clay loam in the upper 4 to 9 inches and clay below. The underlying layer is clay and contains soft masses and strongly cemented concretions of calcium carbonate.

Included with this soil in mapping are areas in slightly lower parts of the landscape where slopes are less than 1 percent. Also included are a few slightly depressed areas of Lipan clay and areas of Tillman clay loam, 1 to 3 percent slopes. A few shallow gullies, more than 300 feet apart and crossable with farm machinery, occur in some cultivated fields.

Most of the acreage of this soil is cultivated, and a few areas are irrigated. The hazard of water erosion is moderate. (Dryland capability unit IIe-1; irrigated capability unit IIe-1; Deep Hardland range site)

Latom Series

The Latom series consists of very shallow, moderately well drained, loamy soils underlain by sandstone. These gently sloping to steep soils are on uplands. They formed in material weathered from red-bed sandstone. Latom soils are not mapped separately in Hardeman County but in two complexes; the Cosh-Latom complex and the Latom-Rock outcrop complex.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 7 inches thick. The underlying material is light reddish-brown strongly cemented sandstone.

Representative profile of Latom soils, from an area of Latom-Rock outcrop complex, in a pasture,

70 feet west of a rural road from a point that is 0.7 mile south, and 3.8 miles west on the rural road from its intersection with Farm Road 1167. This intersection is 2.5 miles south of Medicine Mound, Tex.

A1--0 to 7 inches, reddish-brown (2.5YR 4/4) fine sandy loam, dark reddish brown (2.5YR 3/4) when moist; weak, thin, platy structure in the upper 1 inch; weak, fine, granular structure below; slightly hard when dry, very friable when moist; calcareous; abrupt, smooth boundary.
R--7 to 12 inches, light reddish-brown (2.5YR 6/4), calcareous, strongly cemented sandstone.

The A horizon ranges from 4 to 10 inches in thickness, from reddish brown to red and weak red in color, and from neutral to moderately alkaline in reaction.

The R layer ranges from light reddish brown to red and gray. A small part of this strongly cemented sandstone is noncalcareous. In some places it is interbedded with calcareous red beds.

Latom-Rock outcrop complex (La).--This complex consists of gently sloping to steep soils on uplands. Slopes range from 1 to about 30 percent but are dominantly 1 to 12 percent. The soils are closely associated and intermingled. The complex averages about 37 percent Latom soils, 28 percent unclassified soils that have only 1 to 3 inches of soil over sandstone, and 25 percent bare sandstone outcrops. The remaining 10 percent is inclusions of Cosh fine sandy loam, 1 to 3 percent slopes, Colorado and Spur clay loams, and Badland.

The Latom soils and the unclassified soils are in narrow, discontinuous bands above the steeper rock outcrops and on gently sloping to sloping benches below the rock outcrops. The rock outcrops occur on steep scarps and on rough, gently sloping to steep, canyonlike areas along drainageways (pl. III, top).

Latom soils are 4 to 10 inches of reddish-brown to red fine sandy loam underlain by sandstone. The unclassified soils are 1 to 3 inches of reddish-brown to red fine sandy loam over sandstone. The Rock outcrop consists of bare, medium-grained, red-bed sandstone.

Included in mapping are narrow bands of Colorado and Spur clay loams along some of the larger natural drains. Also included are narrow bands of Cosh fine sandy loam above some of the sandstone scarps, and narrow bands of Badland on the lower parts of some steep scarp faces.

Latom-Rock outcrop complex is in range. The water-erosion hazard is severe. Most areas are dissected by shallow to deep V-shaped gullies cut into the sandy red beds. This complex is not suitable for cultivation. (Dryland capability unit VIIs-1; Latom soil in Very Shallow range site; Rock outcrop not in a range site)

Lincoln Series

The Lincoln series consists of somewhat excessively drained loamy and sandy soils that have a water table within 6 feet of the surface most of the time. These nearly level to gently undulating soils are on flood plains and consist of little altered sandy alluvium.

In a representative profile, the surface layer is brown fine sandy loam, about 10 inches thick, that contains thin lenses of sandier and siltier material. The underlying layer is stratified light-brown fine sand that extends to a depth of 60 inches or more.

Representative profile of Lincoln fine sandy loam, in the flood plain of Prairie Dog Town Fork of the Red River, 1 mile north on a private road from the end of a rural road that is 0.5 mile east and 5.5 miles north of the intersection of the rural road and Farm Road 91. This intersection is 3.8 miles northeast of Chillicothe, Tex.

A1--0 to 10 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/3) when moist; contains thin lenses of sandier and siltier soil material; weak, fine, granular structure; slightly hard when dry, very friable when moist; many grass roots; many fine pores; calcareous; moderately alkaline; clear, smooth boundary.
C--10 to 60 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; contains thin strata of siltier and coarser textured material; structureless; single grain; loose when dry or moist; calcareous; moderately alkaline; water table at a depth of 48 inches.

The A horizon ranges from 6 to 15 inches in thickness, from very fine sandy loam to loamy fine sand in texture, and from brown to light brown and light reddish brown in color. The C horizon is loamy fine sand to fine sand and light brown to light reddish brown and pink. It contains thin strata of very fine sandy loam to fine sandy loam and, in some profiles, thin strata of fine gravel. Depth to the water table varies with rainfall but is within 3 to 6 feet of the surface most of the time.

Lincoln soils (Lc).--These nearly level to gently undulating soils occupy frequently flooded low flood plains. Soil areas are 40 to 300 acres in size and from 1 to 4 feet above river channels. In many places river channels dissect areas of Lincoln soils. This gives the areas a braided appearance.

This unit is about 45 percent Lincoln fine sandy loam, 30 percent Lincoln very fine sandy loam, and 19 percent Lincoln loamy fine sand. The remaining 6 percent is inclusions of other soils.

In most areas, the surface layer is light-brown fine sandy loam about 10 inches thick. The underlying layer is light reddish-brown fine sand. It is stratified with lenses or thin layers of finer or coarser sediments.

Included in mapped areas of Lincoln soils are narrow bands of Yahola very fine sandy loam, which occur in slightly higher parts of the flood plains and are subject to less frequent flooding and deposition of fresh alluvial sediments. Also included are old sloughs, or low areas, that have a clay loam to clay surface layer.

Lincoln soils are in range. They are not suited to cultivation because of frequent flooding and deposition of fresh alluvial sediments. The water table is 3 to 5 feet below the surface most of the time. These soils are slightly to moderately saline in most areas. Although subject to periodic flooding, the soils have remained stable long enough for plants to become established. (Dryland capability unit Vw-2; Sandy Bottomland range site)

Lincoln fine sandy loam (Ln).--This nearly level to gently undulating soil occurs mainly on flood plains. Soil areas are 20 to 300 acres in size, lie roughly parallel to river channels, and in most places are much longer than they are wide. This soil has the profile described as representative for the series.

Included in mapping are areas of Yahola very fine sandy loam in slightly higher parts of the landscape. Also included are bands of Lincoln soils, which occur at slightly lower elevations adjacent to the river channels and are frequently flooded, and a few areas that have a loamy fine sand surface layer.

Most of the acreage is in range. Some areas are cultivated, and a few areas have been seeded to pasture. This soil is moderately susceptible to soil blowing if not protected. It has a high water table that varies with rainfall, and some areas are saline. Most areas of this soil are subject to occasional overflow; however, some areas are seldom if ever overflowed because they are high enough or are separated from the river channel by narrow bands of Tivoli soils. (Dryland capability unit IVe-5; Sandy Bottomland range site)

Lipan Series

The Lipan series consists of deep, moderately well drained clay soils that formed in old calcareous alluvium or outwash. These soils are nearly level and lie in areas that have many microbasins and microknolls that present a gilgai microrelief. Water ponds on these soils after a heavy rain.

In a representative profile, the surface layer is gray, firm, noncalcareous clay about 12 inches thick. The next layer is gray, very firm, calcareous clay that contains a few, strongly cemented, calcium-carbonate concretions in the lower part and is about 46 inches thick. The underlying material is gray very firm clay that has common, fine, strongly cemented, calcium-carbonate concretions.

Representative profile of Lipan clay in a cultivated field, 50 feet north of a rural road from a point 1.6 miles west on the rural road from its intersection with Texas Highway 283. This intersection is 5.5 miles south of the intersection of Texas Highway 283 and U.S. Highway 287 in Quanah, Tex. At this location the soil occurs in a slightly depressed area of about 20 acres that is surrounded by Hollister and Tillman soils.

Ap--0 to 6 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak, fine, granular structure; very hard when dry, firm when moist; mildly alkaline; abrupt, smooth boundary.

A1--6 to 12 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak and moderate, fine, blocky structure; extremely hard when dry, very firm when moist; mildly alkaline; gradual, smooth boundary.

AC--12 to 58 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak to moderate, coarse, blocky structure; extremely hard when dry, very firm when moist; few very fine pores; few, very fine, strongly cemented, calcium-carbonate concretions below a depth of 30 inches; calcareous; moderately alkaline; gradual, smooth boundary.

Cca--58 to 64 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak, coarse, blocky structure; extremely hard when dry, very firm when moist; few to common, fine, strongly cemented, calcium-carbonate concretions; calcareous; moderately alkaline.

The A horizon ranges from 10 to 18 inches in thickness and from mildly alkaline to moderately alkaline in reaction. Areas of Lipan clay that occur in association with Talpa soils have a few limestone fragments on the surface in places. The AC horizon ranges from 30 to 50 inches in thickness.

The Cca horizon occurs at a depth of 45 to 68 inches. It ranges from gray to light brownish gray in color, and the content of calcium carbonate ranges from a few small masses and concretions to about 10 percent by volume. Cracks that form when the soil drys range up to 1 to 2 inches in width at the soil surface and are 3 to 6 feet deep.

Lipan clay (Lp).--This nearly level soil is on slightly depressed uplands. Soil areas are round to oval and 2 to 25 acres in size.

Included with this soil in mapping are areas of Hollister clay loam at slightly higher elevations and on the outer edges of slightly depressed areas.

Most of the acreage is cultivated. Runoff is slow after heavy rains. Planting and harvesting are sometimes delayed for 1 week to 4 weeks because of standing water or wet soil. A few areas have been drained or partly drained by surface ditches. Terraces or diversions on the surrounding higher lying soils reduce the amount of water that accumulates on this soil. (Dryland capability unit IIIw-1; Deep Hardland range site)

Mangum Series

The Mangum series consists of moderately well drained nearly level clay loams on flood plains.

In a representative profile, the surface layer is reddish-brown clay loam about 8 inches thick. The underlying material is reddish-brown, very firm clay that extends to a depth of about 60 inches.

Representative profile of Mangum clay loam in the flood plain of the Pease River, 0.4 mile east of a private ranch road from a point 2.45 miles southeast on a private road and 3 miles south on a rural road from the intersection of the rural road with Farm Road 392 at Prairie View Church. This church is about 8 miles south of Chillicothe, Tex.

A1--0 to 8 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; weak, thin, platy structure in the upper 3 inches and weak, fine, subangular blocky structure in lower part; very hard when dry, firm when moist; many grass roots; few fine pores; calcareous; moderately alkaline; clear, smooth boundary.

C--8 to 60 inches, reddish-brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) when moist; massive; distinct horizontal cleavage planes that have dull surfaces; very hard when dry, very firm when moist; few masses of white crystalline salts in the lower part; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness and has weak, thin, platy structure to weak, fine, subangular blocky or weak, medium, blocky structure.

The part of the C horizon that extends from 10 to 40 inches below the surface ranges from silty clay to clay in texture and from reddish brown to yellowish red in color.

Buried A1 horizons occur at depths beginning at 10 to 40 inches in some profiles. These buried horizons are 2 to 8 inches thick, are clay loam or silty clay loam, and are darker than the surface A1 horizon. Cracks that form on drying range from about 1/2 inch to 2 inches in width at the soil surface and from 3 to 6 feet in depth.

Mangum clay loam (Ma).--This nearly level soil occurs on flood plains. Soil areas are roughly parallel to stream channels and 15 to 275 acres in size. In many places they are in slightly lower parts of the flood plains adjacent to upland soils.

Included with this soil in mapping are areas of Colorado clay loam and Spur clay loam that are in slightly higher parts of the flood plains. Also included are a few areas that have a clay or silty clay surface layer.

Most areas of Mangum clay loam are in range. A few small areas are cultivated. Runoff is slow, and the erosion hazard is slight; however, most areas of this soil are occasionally flooded. (Dryland capability unit IIc-1; irrigated capability unit 1-1; Valley range site)

Mansker Series

The Mansker series consists of well-drained, calcareous, loamy soils. These gently sloping soils formed in calcareous, medium-textured to moderately fine textured, old alluvial or outwash sediments.

In a representative profile, the surface layer is brown clay loam about 8 inches thick. The next layer is brown friable clay loam, 8 inches thick, that contains soft masses and cemented concretions of calcium carbonate. The next layer is light-brown clay loam, 28 inches thick, that is about 35 percent soft masses and cemented concretions of calcium carbonate. The underlying material, which extends to a depth of about 60 inches, consists of alternating layers of white calcium carbonate and mottled sandy clay loam.

Representative profile of Mansker clay loam, 1 to 3 percent slopes, in a cultivated field, 1,100 feet west of a rural road, from a point 0.8 mile north on the rural road from its intersection with Farm Road 91. This intersection is 1 mile west and 3 miles south of Chillicothe, Tex.

Ap--0 to 8 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak, medium, granular structure; slightly hard when dry, friable when moist; few, strongly cemented, calcium-carbonate concretions; calcareous; moderately alkaline; abrupt, smooth boundary.

B2ca--8 to 16 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) when moist; moderate, fine, granular and subangular blocky structure; hard when dry, friable when moist; many fine pores; few worm casts; 15 to 20 percent by volume soft masses and fine, weakly and strongly cemented, calcium-carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

C1ca--16 to 44 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; common, faint, light-gray and yellowish-red mottles below a depth of 30 inches; 30 to 40 percent by volume soft masses and weakly and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2ca--44 to 60 inches, alternating layers of almost pure-white calcium carbonate and mottled gray, brownish-yellow, and reddish-brown sandy clay loam that contains common soft masses of calcium carbonate.

The A horizon ranges from 7 to 10 inches in thickness and from clay loam to loam in texture. The B2ca horizon is 6 to 10 inches thick, clay loam to sandy clay loam, and brown to light brown and pale brown. The Cca horizon is at a depth of 10 to 20 inches. Calcium-carbonate content of this horizon ranges from 30 to 70 percent by volume. A C horizon that is sandy clay loam to loam and reddish-yellow to yellowish-red is 46 inches to more than 5 feet below the surface. It is below 5 feet in more than half the soil areas.

Mansker clay loam, 1 to 3 percent slopes (McB).--This soil occurs on uplands in areas 10 to 160 acres in size. Most areas are along natural drains, are

less than 50 acres in size, and are oval to irregular in shape.

Included in mapping are areas of Portales clay loam, 0 to 1 percent slopes, near the heads of drains or in slightly lower parts of the landscape. Also included are narrow bands of Colorado and Spur clay loams along intermittent streams, and a few areas of Weymouth clay loam, 1 to 3 percent slopes.

Most of the acreage is cultivated. A few areas are irrigated. Water erosion is a slight to moderate hazard. (Dryland capability unit IIIe-7; irrigated capability unit IIIe-7; Deep Hardland range site)

Miles Series

The Miles series consists of deep, nearly level to gently sloping, noncalcareous, well-drained, loamy and sandy soils. These soils developed in sandy alluvium on uplands. The loamy fine sands are enough different from the fine sandy loams that a description of each soil is needed.

In a representative profile of Miles fine sandy loam, the surface layer is about 7 inches thick. The next layer is reddish-brown friable sandy clay loam about 21 inches thick. The next layer is 26 inches of friable sandy clay loam that is yellowish red in the upper part and reddish yellow and calcareous in the lower part. The underlying material, to a depth of about 72 inches, is reddish-yellow fine sandy loam.

In a representative profile of Miles loamy fine sand, the surface layer is brown loamy fine sand about 16 inches thick. The next layer is reddish-brown friable sandy clay loam about 22 inches thick. The underlying material is reddish-yellow, friable sandy clay loam that extends to a depth of about 62 inches.

Representative profile of Miles fine sandy loam, 1 to 3 percent slopes, in a cultivated field, 1,500 feet east along fence line and 45 feet north in field from a point on a rural road that is 1.25 miles north on the rural road and 2 miles west on Farm Road to Market Road 1167 from Prairie View Church. This church is located at the intersection of Farm Roads 392 and 1167 about 8 miles south of Chillicothe, Tex.

Ap--0 to 7 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; few quartz pebbles; mildly alkaline; clear, smooth boundary.

B1--7 to 12 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound structure--weak, fine, subangular blocky structure and weak, coarse, prismatic structure; hard when dry, friable when moist; common fine pores and many very fine pores; few quartz pebbles; mildly alkaline; gradual, smooth boundary.

B21t--12 to 28 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3.5/4) when moist; compound structure--weak, very coarse, prismatic structure and weak, fine to medium, subangular blocky structure; very hard when dry, friable when moist; common fine and very fine pores; few clay films on ped surfaces; few quartz pebbles; mildly alkaline; gradual, smooth boundary.

B22t--28 to 37 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; compound structure--weak, very coarse, prismatic structure and weak, fine to medium, subangular blocky structure; very hard when dry, friable when moist; few fine and medium pores and common very fine pores; few clay films on ped surfaces; mildly alkaline; gradual, smooth boundary.

B3t--37 to 54 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca--54 to 62 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; hard when dry, friable when moist; contains 5 to 10 percent by volume soft accumulations and a few hard concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C2--62 to 72 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; soft when dry, very friable when moist; calcareous; moderately alkaline.

In areas where the A horizon is fine sandy loam, it ranges from 5 to 9 inches in thickness, from neutral to mildly alkaline in reaction, and from reddish brown to brown in color. The B1 horizon ranges from 4 to 10 inches in thickness. The Bt horizon is from 36 to 67 inches thick, neutral to moderately alkaline, and reddish brown to yellowish red.

Depth to the C horizon ranges from 50 inches to about 72 inches, and texture ranges from sandy clay loam to loamy fine sand. In most pedons calcium-carbonate accumulation is evident in the upper part of the C horizon. The amount of visible calcium carbonate ranges from 0 to about 10 percent.

Representative profile of Miles loamy fine sand, 0 to 3 percent slopes, in a cultivated field, 0.1 mile south of rural road from a point on the rural road 0.8 mile east and 2 miles north of its intersection with Farm Road 91. This intersection is 3.8 miles northeast of Chillicothe, Tex.

Ap -0 to 16 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, loose when moist; neutral; abrupt, smooth boundary.

B21t--16 to 23 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound structure--weak to moderate, very coarse, prismatic structure and fine to

medium, subangular blocky structure; very hard when dry, friable when moist; many fine pores; few clay films on ped surfaces; neutral; gradual, smooth boundary.

B22t--23 to 38 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/3) when moist; compound structure--moderate, very coarse, prismatic structure and moderate, fine to medium, subangular blocky structure; very hard when dry, friable when moist; common fine pores and many very fine pores; few clay films on ped surfaces; neutral; clear, smooth boundary.

B3t--38 to 62 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; contains slightly less clay than the B22t horizon; weak, fine to medium, subangular blocky structure; hard when dry, friable when moist; neutral.

Where the Ap horizon is loamy fine sand, it ranges from 10 to 24 inches in thickness because of deep plowing, but it is dominantly about 16 inches thick. In unplowed areas, the A horizon is less than 20 inches thick. Color ranges from brown to light brown and reddish brown.

A B1 horizon occurs in about 35 percent of the soil areas. It ranges from 3 to 12 inches in thickness. About 80 percent of the Miles loamy fine sand in Hardeman County has been deep plowed to depths of 12 to 24 inches. Thus, part or all of the original B1 horizon has been mixed with the plowed layer in many of these deep-plowed areas.

The Bt horizon ranges from 36 to 70 inches in thickness, from neutral to moderately alkaline in reaction, and from red to reddish brown and yellowish red in color.

In some profiles a C horizon occurs at a depth of 50 to about 76 inches. Texture of the C horizon ranges from fine sandy loam to loamy fine sand. A horizon of calcium carbonate accumulation is evident in the upper part of the C horizon in a few of the soils. The amount of visible calcium carbonate ranges from 0 to 10 percent.

Dark, buried horizons, unrelated to the upper horizons, occur in a few places 40 to 60 inches below the surface. In some places, the soil is underlain by red-bed sandstone 40 to 60 inches below the surface.

Miles fine sandy loam, 0 to 1 percent slopes (MfA).--This level soil occupies upland plains. The areas are irregular and 10 to several hundred acres in size.

The surface layer is about 8 inches of noncalcareous brown fine sandy loam. The next layer is noncalcareous reddish-brown sandy clay loam about 52 inches thick. In most areas the yellowish-red fine sandy loam underlying material contains a few soft masses and concretions of calcium carbonate.

Included with this soil in mapping are areas of Altus fine sandy loam, 0 to 1 percent slopes, in slightly lower parts of the landscape, and a few areas of Miles fine sandy loam, 1 to 3 percent slopes, on low ridges. In some areas the underlying material has a layer of strong lime accumulation within 50 inches of the surface.

Most areas of Miles fine sandy loam, 0 to 1 percent slopes, are cultivated. Some areas are irrigated. This soil has a slight erosion hazard. (Dryland capability unit IIe-4; irrigated capability unit IIe-4; Sandy Loam range site)

Miles fine sandy loam, 1 to 3 percent slopes (MfB).--This soil is on upland plains in irregular areas 10 to several hundred acres in size.

This soil has a profile similar to that described as representative for Miles fine sandy loam. Soil blowing has removed some of the silt and clay from the surface layer in cultivated fields, and as a result this layer is sandier than in areas where the soil is in grass. Shallow rills and gullies occur in some places.

Included with this soil in mapping are areas of Miles fine sandy loam, 0 to 1 percent slopes, on flat-topped ridges or near the heads of drains. Also included are areas of Miles fine sandy loam, 3 to 5 percent slopes, that flank natural drains, and a few areas of Miles loamy fine sand. In some areas a layer of strong lime accumulation is within 50 inches of the surface.

Most areas of Miles fine sandy loam, 1 to 3 percent slopes, are cultivated. Some areas are irrigated from wells. Water erosion and soil blowing are slight hazards. (Dryland capability unit IIe-5; irrigated capability unit IIe-5; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes (MfC).--This soil is on uplands and in most places follows the slope contours above the drainage patterns. Some areas occur on ridges or hilltops.

The surface layer is brown fine sandy loam about 6 inches thick. In cultivated areas some winnowing of the silt and clay from the plowed layer has resulted in a sandier surface layer than in the same soil under native grass. The reddish-brown sandy clay loam lower layer is about 45 inches thick. In most areas the underlying material is yellowish-red fine sandy loam that contains a few soft masses and concretions of calcium carbonate. Shallow gullies, more than 300 feet apart and crossable with farm machinery, occur in some places.

Included with this soil in mapping are eroded areas that occur in narrow bands along drains, and a few rounded hilltops occupied by Hilly gravelly land. In a few areas a layer of strong lime accumulation is within 50 inches of the surface.

About half of the acreage is cultivated. This soil is subject to a moderate hazard of water erosion and a slight hazard of soil blowing. (Dryland capability unit IIIe-4; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes, eroded (MfC2).--This soil is on uplands. Mapped areas follow the slope contours above intermittent drains. A few areas are on hilltops and ridges.

The surface layer is reddish-brown fine sandy loam about 5 inches thick. Some of the lower layer has been mixed with the plowed layer in most places. The reddish-brown sandy clay loam lower layer is about 45 inches thick. In most areas the yellowish-red fine sandy loam underlying material contains a few soft masses and concretions of calcium carbonate. Gullies, 100 to 300 feet apart and from a few inches to 6 feet deep, occur in most areas.

Included with this soil in mapping are areas between gullies that are not eroded and a few areas in which depth to the underlying material is less than 50 inches. Also included is Hilly gravelly land on a few rounded hilltops.

Most areas of Miles fine sandy loam, 3 to 5 percent slopes, eroded, were once cultivated but now are reseeded to grass or have been idle for several years. The erosion hazard on this soil is moderately severe. (Dryland capability unit IVe-7; Sandy Loam range site)

Miles loamy fine sand, 0 to 3 percent slopes (MlB).--This soil is on uplands in irregular areas that range from 30 to several hundred acres in size but are mostly more than 300 acres.

This soil has the profile described as representative for Miles loamy fine sand. Winnowing of some silt and clay from the plowed layer of cultivated areas has resulted in a sandier surface than areas under native grass. Sandy accumulations, from a few inches to several feet in height, occur along some fence rows or next to other obstructions. About 80 percent of the cultivated areas of this soil have been deep plowed to depths of 12 to 24 inches.

Included with this soil in mapping are areas of Springer loamy fine sand, undulating, on low ridges or on higher parts of the landscape. Also included are small areas of Nobscot fine sand, undulating.

Most areas of Miles loamy fine sand, 0 to 3 percent slopes, are cultivated. Some areas are irrigated from wells. The hazard of water erosion is slight, but the soil is moderately susceptible to soil blowing. (Dryland capability unit IIIe-6; irrigated capability unit IIIe-6; Sandyland range site)

Miles loamy fine sand, 3 to 5 percent slopes (MlC).--This soil occupies ridges and the side slopes flanking natural drains in the uplands. Soil areas range from 10 to 180 acres in size but are dominantly less than 80 acres.

The surface layer is noncalcareous brown loamy fine sand about 12 inches thick. Soil blowing has removed some of the silt and clay from the plowed layer in most cultivated areas. The lower layer is noncalcareous reddish-brown sandy clay loam about 50 inches thick. In a few areas this layer is underlain by red-bed sandstone at a depth of 40 to 60 inches.

Included with this soil in mapping are areas of Springer loamy fine sand, hummocky, on the more prominent ridge tops. Also included is Hilly gravelly loam on small rounded hilltops. A few gullies, generally crossable with farm machinery, occur along natural drains.

Most areas of Miles loamy fine sand, 3 to 5 percent slopes, are cultivated. This soil is subject to a moderate hazard of erosion and soil blowing. (Dryland capability unit IVe-4; Sandyland range site)

Nobscot Series

The Nobscot series consists of deep, well-drained, sandy soils that occur on undulating to hummocky uplands. These soils formed in wind-deposited sands.

In a representative profile, the surface layer is grayish-brown slightly acid fine sand about 6 inches thick. The next layer is light-brown slightly acid fine sand about 18 inches thick. Below this is yellowish-red slightly acid sandy loam, 14 inches thick, over reddish-brown slightly acid loamy fine sand 16 inches thick. The underlying material is light-brown fine sand.

Representative profile of Nobscot fine sand, undulating, in a pasture, 200 feet south of a rural road from a point 1.25 miles west on the rural road from its intersection with Farm Road 680. This intersection is 12 miles north on Farm Road 680 from its intersection with U.S. Highway 287, which is 0.6 mile west of Goodlett, Tex.

A1--0 to 6 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) when moist; structureless; single grain; loose when dry or moist; many grass roots; slightly acid; clear, smooth boundary.

A2--6 to 24 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 4/3) when moist; structureless; single grain; loose when dry or moist; common grass roots; slightly acid; clear, smooth boundary.

B2t--24 to 38 inches, yellowish-red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; few grass roots; clay bridges between sand grains; slightly acid; gradual, smooth boundary.

B3t--38 to 54 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; thin lenses of fine sandy loam; structureless; loose when dry or moist; slightly acid; gradual, smooth boundary.

C--54 to 60 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 4/4) when moist; structureless; single grain; loose when dry or moist; slightly acid.

The A1 horizon ranges from 4 to 6 inches in thickness and from light brown to grayish brown or brown in color. In cultivated fields, the Ap horizon is about the same color as the A2 horizon. The A2 horizon is 16 to 24 inches thick and light brown to pale brown and light yellowish brown.

The Bt horizon ranges from 20 to 40 inches in thickness, from reddish brown to yellowish red in color, and from sandy loam to loamy fine sand in texture. This horizon contains lenses of fine sandy loam.

The C horizon is 50 to 60 inches below the surface. This horizon is light brown to reddish yellow and yellowish red.

Nobscot fine sand, undulating (No).--This is an undulating to hummocky soil of the uplands. Soil areas are irregular and 20 to 300 acres in size. Most are less than 100 acres.

Wind-deposited soil material 1 foot to several feet high, has accumulated along fence rows or other obstructions in most cultivated or formerly cultivated fields.

Included with this soil in mapping are areas of Springer loamy fine sand in slightly lower parts of the landscape. Also included are small bare areas, or blowouts, that are severely eroded. In some areas the fine sand underlying material is at a depth of less than 50 inches.

About half the acreage was cultivated at one time, but most of this has been reseeded to grass or has been idle for several years. This soil is not suitable for cultivation. Runoff is very slow. The hazard of soil blowing is severe. (Dryland capability unit VIe-5; Deep Sand range site)

Olton Series

The Olton series consists of deep, well-drained, nearly level to gently sloping loamy soils on uplands.

In a representative profile, the surface layer is reddish-brown clay loam about 6 inches thick. The next layer is 9 inches of reddish-brown friable clay loam over 12 inches of reddish-brown firm silty clay loam. The next layer is yellowish-red firm silty clay loam 11 inches thick. The underlying material is light reddish-brown clay loam that contains 15 to 25 percent soft masses and strongly cemented concretions of calcium carbonate.

Representative profile of Olton clay loam, 1 to 3 percent slopes, in a pasture, 40 feet west of a rural road from a point 0.3 mile north and 2.4 miles west on the rural road from its intersection with Farm Road 2006. This intersection is 5 miles north on Farm Road 2006 from its intersection with U.S. Highway 287, and 5.5 miles west of Chillicothe, Tex.

A1--0 to 6 inches, reddish-brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky and granular structure; hard when dry, friable when moist; many fine and very fine pores; many grass roots; neutral; clear, smooth boundary.

B1--6 to 15 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine to medium, subangular blocky structure; hard when dry, friable when moist; common fine pores and many very fine pores; neutral; clear, smooth boundary.

B21t--15 to 27 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/3) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, firm when moist; few fine and very fine pores; common clay films on ped surfaces; mildly alkaline; gradual, smooth boundary.

B22t--27 to 38 inches, yellowish-red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) when moist; moderate, fine and medium, blocky structure; very hard when dry, firm when moist; common clay films on ped surfaces; few, fine, strongly cemented calcium-carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

Cca--38 to 62 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; 15 to 25 percent by volume is films, soft masses, and a few small strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness, from clay loam to loam in texture, from brown to reddish brown in color, and from neutral to mildly alkaline in reaction.

The B1 horizon ranges from 4 to 11 inches in thickness, from clay loam to silty clay loam in texture, from reddish brown to dark reddish brown and dark reddish gray in color, and from neutral to mildly alkaline in reaction. This horizon is absent in about 15 percent of the soils. The B21t horizon is 6 to 19 inches thick, clay loam that has more than 35 percent clay to silty clay loam, reddish brown to dark reddish brown, and neutral to moderately alkaline. The B22t horizon is 5 to 36 inches thick, clay loam that has more than 35 percent clay to silty clay loam, and red to reddish brown and yellowish red.

Depth to the Cca horizon ranges from 30 to 50 inches. Films, soft masses, and cemented concretions of calcium carbonate make up an estimated 15 to 40 percent by volume of this horizon.

In most profiles, the C2 horizon is below a depth of 66 inches. It is heavy clay loam to sandy clay loam.

A IIC or IICca horizon of weathered red-bed clay, shale, or sandstone occurs at a depth of 36 to 60 inches in a few areas, but it is dominantly at depths of more than 60 inches.

Olton clay loam, 0 to 1 percent slopes (OcA).--This nearly level soil is on upland plains in irregular areas that range from 15 to 600 acres in size but are mainly less than 100 acres.

The surface layer is reddish-brown clay loam about 6 inches thick. The next layer is 21 inches thick and is reddish-brown clay loam in the upper

part and silty clay loam in the lower part. The next layer is yellowish-red firm silty clay loam 11 inches thick. The underlying material is light reddish-brown clay loam that is from 15 to 40 percent by volume soft masses and strongly cemented concretions of calcium carbonate.

Included with this soil in mapping are areas of Abilene clay loam and Hollister clay loam in slightly lower parts of the landscape. Also included are narrow areas near the heads of drains and on low ridgetops where slopes range to 3 percent.

Most of the acreage is cultivated, and a small percentage is irrigated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit IIc-1; irrigated capability unit I-1; Deep Hardland range site)

Olton clay loam, 1 to 3 percent slopes (OcB).--This soil occurs on upland plains in irregular areas mainly 10 to 300 acres in size. In many places the areas follow the slope contours above the drainage patterns. This soil has the profile described as representative for the series. A few shallow gullies, more than 300 feet apart and crossable with farm machinery, occur in some unprotected cultivated areas.

Included with this soil in mapping are areas of Weymouth clay loam, 1 to 3 percent slopes, in slightly higher parts of the landscape and on the side slopes along natural drains. Also included are areas on the flatter ridgetops and near the heads of drains where slopes are less than 1 percent. Other inclusions are narrow bands of Tillman clay loam.

Most areas of this Olton soil are cultivated, and a few are irrigated. The hazard of water erosion is moderate. (Dryland capability unit IIe-1; irrigated capability unit IIe-1; Deep Hardland range site)

Olton loam, 0 to 1 percent slopes (OlA).--This soil occurs on uplands in irregular areas that range from 15 to 400 acres in size but are generally less than 100 acres.

The surface layer is about 6 inches of neutral reddish-brown loam. The next layer, about 21 inches thick, is reddish brown and is clay loam in the upper part and silty clay loam in the lower part. The next layer is yellowish-red firm silty clay loam. The underlying material is light reddish-brown clay loam that is from 15 to 40 percent by volume soft masses and strongly cemented concretions of calcium carbonate. In a few places this layer is underlain by red-bed sandstone that is unrelated to the overlying layers.

Included in mapping are areas of Abilene clay loam, in slightly lower parts of the landscape. Also included are areas on low ridgetops or near the heads of natural drains that have 1 to 3 percent slopes. Areas of Cobb fine sandy loam and Acuff loam are included in a few places.

Almost all of the acreage is cultivated, and a few areas are irrigated. The hazard of erosion is slight. (Dryland capability unit IIc-1; irrigated capability unit I-1; Deep Hardland range site)

Olton loam, 1 to 3 percent slopes (OlB).--This soil occupies irregular areas 20 to 350 acres in size on uplands. Areas are dominantly less than 200 acres in size and, in places, follow the slope contours above the drainage patterns.

The surface layer is reddish-brown loam about 5 inches thick. The next layer is 20 inches thick, is reddish brown, and is clay loam in the upper part to silty clay loam in the lower part. The next layer is yellowish-red firm silty clay loam 11 inches thick. The underlying material is light reddish-brown clay loam that is 15 to 40 percent by volume soft masses and strongly cemented concretions of calcium carbonate. In a few places this layer is underlain by red-bed sandstone at a depth of 36 to 60 inches.

Included with this soil in mapping are areas on some ridgetops and in narrow valleys that have 0 to 1 percent slopes. Also included are areas of Cobb fine sandy loam and a few areas of Acuff loam, 1 to 3 percent slopes. Shallow gullies and rills, crossable with farm machinery, occur in some cultivated areas.

Most of the acreage is cultivated, and a few areas are irrigated. The water-erosion hazard is moderate. (Dryland capability unit IIe-1; irrigated capability unit IIe-1; Deep Hardland range site)

Portales Series

The Portales series consists of well-drained, loamy, nearly level soils of the uplands.

In a representative profile, the surface layer is grayish-brown clay loam about 12 inches thick. The next layer is light brownish-gray friable clay loam 13 inches thick. The underlying material is in three layers: the first is light brownish-gray clay loam 11 inches thick; the second is light reddish-brown clay loam 14 inches thick; and the third is reddish-yellow sandy clay loam that extends to a depth of about 60 inches. This underlying material is 50 to 60 percent by volume soft masses and strongly cemented concretions in the upper part and 15 to 25 percent in the lower part.

Representative profile of Portales clay loam, 0 to 1 percent slopes, in a cultivated field, 75 feet south of Farm Road 91 from a point 1.8 miles west and 3 miles south on Farm Road 91 from Chillicothe, Tex.

Ap--0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard when dry, friable when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

A1--6 to 12 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; common very fine pores; calcareous; moderately alkaline; gradual, smooth boundary.

B2--12 to 25 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; common films and fine, strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C1ca--25 to 36 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; 50 to 60 percent by volume is soft masses and a few strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2ca--36 to 50 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; few yellowish-brown and grayish-brown mottles; 50 to 60 percent by volume is soft masses and a few strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C3--50 to 60 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; 15 to 25 percent by volume is soft masses and a few strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 8 to 14 inches in thickness, from clay loam to loam in texture, and from grayish brown to brown and dark grayish brown in color. The B2 horizon is 12 to 22 inches thick, clay loam to sandy clay loam, and brown to pale brown and light brownish gray.

Depth to the Cca horizon ranges from 20 to 36 inches but is dominantly 25 to 30 inches. Soft masses and cemented concretions of calcium carbonate make up 40 to 60 percent by volume of this horizon. The Cca horizon is 20 to 50 inches thick.

Depth to the C horizon, which contains much less calcium carbonate, ranges from 42 inches to more than 6 feet.

Portales clay loam, 0 to 1 percent slopes (PoA).--This soil is in upland valleys in irregular areas 20 to 200 acres in size.

Included with this soil in mapping are areas of Mansker clay loam, 1 to 3 percent slopes, on slightly higher parts of the landscape. Also included are areas of Abilene clay loam.

Most of the acreage is cultivated, and a small acreage is irrigated. The hazard of erosion is slight. (Dryland capability unit IIc-2; irrigated capability unit I-2; Deep Hardland range site)

Quanah Series

The Quanah series consists of well-drained, gently sloping, loamy soils on uplands.

In a representative profile, the surface layer is dark-brown clay loam about 11 inches thick. The next layer is friable silty clay loam about 23 inches thick. The upper part is brown, and the lower part is reddish brown and contains a few strongly cemented, calcium-carbonate concretions. The underlying material is reddish-yellow silty clay loam. The upper part is about 25 to 30 percent strongly cemented concretions of calcium carbonate; the lower part contains only a few concretions.

Representative profile of Quanah clay loam, 1 to 3 percent slopes, in a pasture, 200 feet west of a rural road from a point 1 mile north and 1.75 miles west of its intersection with Texas Highway 283, which is 2.2 miles north of the courthouse at Quanah, Tex.

A1--0 to 11 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky and granular structure; hard when dry, friable when moist; many grass roots; many very fine pores; calcareous; moderately alkaline; clear, smooth boundary.

B21--11 to 25 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/3) when moist; moderate, fine to medium, subangular blocky structure; hard when dry, friable when moist; many fine pores and common medium pores; calcareous; moderately alkaline; gradual, smooth boundary.

B22--25 to 34 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) when moist; moderate, fine to medium, subangular blocky structure; hard when dry, friable when moist; many very fine pores; few, fine, strongly cemented, calcium-carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca--34 to 46 inches, reddish-yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; estimated 25 to 30 percent by volume is soft masses and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2--46 to 72 inches, reddish-yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) when moist; very hard when dry, firm when moist; many threads and films of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 12 inches in thickness, from brown to dark brown and dark grayish brown in color, and from clay loam to silty clay loam in texture.

The B21 horizon ranges from 7 to 22 inches in thickness, from reddish brown to dark reddish gray, brown, and dark brown in color, and from clay loam to silty clay loam in texture. A few threads, films, and small masses of calcium carbonate occur in some areas. The B22 horizon is 7 to 12 inches thick, reddish brown to light brown, and clay loam to silty clay loam. Few to common fine soft masses, films, or fine strongly cemented concretions of calcium carbonate occur in most areas. This calcium carbonate makes up less than 5 percent by volume of the soil.

The Cca horizon is from 26 to 40 inches below the surface. Films, soft masses, or strongly cemented concretions of calcium carbonate comprise from 5 to 30 percent by volume of this horizon.

Quanah clay loam, 1 to 3 percent slopes (QcB).--This soil is in upland valleys and on foot slopes in irregular areas 20 to 200 acres in size. In most places the soil areas follow the slope contours below the more sloping Talpa soils and above the drainage patterns. This soil has the profile described as representative for the series.

Included in mapping are areas of Talpa soils on low rounded hilltops, and narrow bands of Weymouth clay loam, 1 to 3 percent slopes, and Vernon clay loam, 1 to 3 percent slopes, on slightly higher parts of the landscape.

About half the acreage is cultivated. A moderate water-erosion hazard limits use of this soil. (Dryland capability unit IIe-2; irrigated capability unit IIe-2; Deep Hardland range site)

Quanah-Talpa complex (Qt).--This complex consists of gently sloping to sloping soils on uplands. These soils are closely associated and occur in intermingled patterns. Slopes are mainly 1 to 8 percent. About 50 percent of this complex is Quanah clay loam, and 36 percent is Talpa soils. The remaining 14 percent is inclusions of Weymouth, Tillman, and Vernon clay loams.

The Quanah soils occur on gently sloping foot slopes, which meander between gently sloping to sloping hilltops and ridges occupied by Talpa soils. The surface layer of the Quanah soils is calcareous, dark-brown clay loam about 11 inches thick. The next layer is calcareous, friable silty clay loam 23 inches thick. It is brown in the upper part and reddish brown in the lower part. The upper part of the underlying material is from 15 to 40 percent by volume soft masses and strongly cemented concretions of calcium carbonate.

The surface layer of Talpa soils is calcareous, brown clay loam about 6 inches thick that is about 10 to 30 percent limestone fragments. The underlying material is limestone bedrock.

Included in mapping are narrow bands of Weymouth and Vernon clay loams that occur just below the Talpa soils and above the Quanah soils. Also included are areas of Tillman clay loam in some of the wider valleys.

Most of the acreage is in range. The Quanah soils in this complex are suited to cultivation but are so intermingled with the nonarable Talpa soils that most areas are not practical to cultivate. (Both soils in dryland capability unit IVe-6; Quanah soils in Deep Hardland range site; Talpa soils in Very Shallow range site)

Springer Series

The Springer series consists of deep, well-drained, nearly level to sloping soils of the uplands. They formed in sandy eolian deposits or alluvial sediments.

In a representative profile, the surface layer is brown loamy fine sand about 18 inches thick. The next layer is reddish-brown very friable fine sandy loam 20 inches thick. Below this is yellowish-red very friable fine sandy loam 10 inches thick. The underlying material is light-brown loamy fine sand that extends to a depth of 62 inches.

Representative profile of Springer loamy fine sand, undulating, in a pasture, 50 feet west of rural road from a point 3.75 miles north and 0.3 mile east of its intersection with Farm Road 2006. This intersection is 5 miles north-northwest of Chillicothe, Tex.

A1--0 to 18 inches, brown (7.5YR 5/3) loamy fine sand, dark brown (7.5YR 4/3) when moist; structureless; single grain; soft when dry, loose when moist; many very fine pores; neutral; clear, smooth boundary.

B2t--18 to 38 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; many fine pores; clay bridging sand grains; neutral; gradual, smooth boundary.

B3t--38 to 48 inches, yellowish-red (5YR 5/6) fine sandy loam; reddish brown (5YR 4/4) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; neutral; gradual, smooth boundary.

C--48 to 62 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) when moist; structureless; single grain; loose when dry or moist; neutral.

The A horizon ranges from 10 to 20 inches in thickness, from brown to light brown and reddish yellow in color, and from neutral to slightly acid in reaction. The Bt horizon is 12 to 40 inches thick, reddish brown to yellowish red, and neutral to slightly acid.

Depth to the C horizon ranges from 24 to 49 inches but is dominantly 36 to 48 inches. The C horizon is light-brown to reddish-yellow and yellowish-red loamy fine sand to fine sand but is dominantly loamy fine sand.

Springer loamy fine sand, undulating (SgB).--This soil is on uplands in irregular areas 20 to several hundred acres in size. Slopes are mainly 0 to 3 percent.

This soil has the profile described as representative for the series. In most cultivated areas some winnowing of the silt and clay from the plowed layer has resulted in a sandier surface layer than when the soil was in grass. Accumulations of soil material, a few inches to several feet high, occur along fence rows or other obstructions in most cultivated fields.

Included in mapping are areas of Miles loamy fine sand on slightly lower parts of the landscape. Also included are narrow ridges that have a hummocky surface. In a few areas the loamy fine sand

substratum is below a depth of 50 inches. Also included are small areas of Hardeman fine sandy loam.

Most of the acreage is cultivated; part is irrigated. Runoff is slow, and the soil-blowing hazard is moderate to severe. (Dryland capability unit IVe-5; irrigated capability unit IVe-3; Sandyland range site)

Springer loamy fine sand, hummocky (SgD).--This soil is on hummocky uplands in elongated to irregular areas 10 to 300 acres in size. Slopes are mainly 3 to 8 percent.

The surface layer is brown loamy fine sand about 15 inches thick. The next layer, 24 inches thick, is reddish-brown very friable fine sandy loam. Below this is yellowish-red very friable fine sandy loam. The underlying material is light-brown loamy fine sand that extends to a depth of 60 inches. In most cultivated areas soil blowing has removed some of the silt and clay from the plowed layer. Accumulations of soil material, 1 foot to several feet high, are common in cultivated fields and along fence rows or other obstructions.

Included in mapping are areas in lower parts of the landscape that are undulating instead of hummocky. Also included are areas of Tivoli fine sand and Nobscot fine sand, undulating, in higher parts of the landscape. Small blowouts, or severely eroded spots, of Springer soils are also included.

A small acreage of this Springer soil is cultivated. Most of the acreage that was formerly cultivated has been reseeded to grass or has been idle for several years. Runoff is slow, and the soil-blowing hazard is severe. This soil is not suitable for cultivation because of the soil-blowing hazard and steep slopes. (Dryland capability unit VIe-4; Sandyland range site)

Springer soils, severely eroded (Sp3).--These soils occur on uplands. Slopes are generally 0 to 8 percent. Soil areas range from 10 to 250 acres in size but are mainly less than 100 acres.

The surface layer is light-brown loamy fine sand about 8 inches thick. The next layer, 24 inches thick, is yellowish-red very friable fine sandy loam except in blowout areas where part or all of it has been removed. The underlying material is light-brown loamy fine sand that extends to a depth of 60 inches. Blowouts in which all of the surface layer has been removed and the lower layers are exposed make up 25 to 35 percent of most mapped areas. Mounds of accumulated sand, 1 foot to 6 feet high, occur in about 15 percent of the mapped areas. Shallow to deep gullies that are uncrossable with farm machinery occur in a few places along natural drains.

Included in mapped areas of these soils are small mounds of Tivoli fine sand and Nobscot fine sand, undulating.

Most of the acreage was cultivated at one time but has been reseeded to grass or abandoned. This soil is not suitable for cultivation. (Dryland capability unit VIe-4; Sandyland range site)

Spur Series

The Spur series consists of deep, well-drained, nearly level loamy soils on flood plains.

In a representative profile, the surface layer is brown friable clay loam about 26 inches thick. The next layer is very dark grayish-brown friable clay loam that contains common threads and films of calcium carbonate and is 16 inches thick. The underlying material is brown clay loam that contains common threads and films of calcium carbonate.

Representative profile of Spur clay loam in the flood plain of Wanderers Creek, 80 feet south of U.S. Highway 287 and 0.65 mile west of Chillicothe, Tex.

Ap--0 to 6 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky and granular structure; hard when dry, friable when moist; many fine pores; calcareous; moderately alkaline; abrupt, smooth boundary.

A11--6 to 26 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine to medium, subangular blocky and granular structure; hard when dry, friable when moist; many very fine pores; calcareous; moderately alkaline; gradual, smooth boundary.

A12--26 to 42 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak and moderate, fine, subangular blocky structure; hard when dry, friable when moist; common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C--42 to 84 inches, brown (7.5YR 5/3) clay loam, brown (7.5YR 4/3) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; common threads and films of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 21 to 48 inches in thickness and from brown or dark brown to dark grayish brown in color. The C horizon is brown to reddish brown, has a clay loam to sandy clay loam texture, and occurs at depths of from 37 to 60 inches.

Spur clay loam (Sr).--This nearly level soil of the bottom lands occurs on flood plains. Soil areas are roughly parallel to the creek channels and are 30 to several hundred acres in size. This soil has the profile described as representative for the series.

Included in mapping are areas of Tipton loam in slightly higher parts of the landscape, and narrow bands of Colorado and Spur clay loams at lower elevations along the stream channels. A few small bands of Colorado clay loam adjacent to the uplands also are included.

Most of the acreage is cultivated; small acreages are irrigated. Runoff is slow, and the hazard of

erosion is slight. Most areas of this soil are flooded on the average of one to three times in 5 years. (Dryland capability unit I-1; irrigated capability unit I-2; Valley range site)

Talpa Series

The Talpa series consists of very shallow, well-drained, calcareous, loamy and stony soils. These soils are gently sloping to steep and are on hilltops and ridges. They formed in dolomitic limestone that is interbedded in places with red-bed clay or shale.

In a representative profile, the surface layer is brown friable clay loam about 6 inches thick that contains many limestone fragments. The underlying material is fractured indurated limestone.

Representative profile of Talpa soils, in a pasture, 100 feet west of rural road from a point 0.1 mile north and 1.75 miles west of its intersection with Texas Highway 283. This intersection is 2.2 miles north of the courthouse in Quanah, Tex.

A1--0 to 6 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak to moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; many very fine and fine pores; dolomitic limestone fragments, mostly less than 15 inches across the long axis, make up 10 to 30 percent of the volume; calcareous; moderately alkaline; abrupt, irregular boundary.

R--6 to 12 inches, indurated, fractured, dolomitic limestone that has coatings of reprecipitated calcium carbonate in crevices and on the surface and lower side of stones.

The A horizon ranges from 4 to 10 inches in thickness, from clay loam to loam in texture, and from brown to grayish brown in color. This horizon is from 10 to 30 percent by volume coarse fragments.

The R layer ranges from 4 inches to several feet in thickness. In some areas it is interbedded with red-bed clay or shale.

Talpa soils (Ta).--These gently sloping to sloping soils occur on upland ridges and knolls in irregular areas 5 to 130 acres in size. Slopes generally range from 1 to about 8 percent. The profile is representative for the series. The texture of the surface layer ranges from clay loam to loam.

Included in mapping are areas of Quanah, Weymouth, and Vernon clay loams in narrow valleys and lower parts of the landscape. Narrow limestone outcrops or ledges are also included.

Almost all the acreage of these Talpa soils is in range. Runoff is rapid, and permeability is moderate. (Dryland capability unit VIIs-1; Very Shallow range site)

Talpa-Vernon complex (Tc).--This complex consists of gently sloping to steep soils on uplands. These soils are closely associated and intermingled.

Slopes are dominantly 1 to about 12 percent but range to 30 percent. This complex averages about 44 percent Talpa soils and 40 percent Vernon soils. The remaining 16 percent is inclusions of other soils and land types.

The topography is characterized by a series of steep scarps and steplike benches dissected in places by intermittent streams and gullies. The Talpa soils are on the scarps, ledges, or hilltops, and the Vernon soils are on the less sloping benches and the lower part of the scarp faces below the limestone ledges.

The surface layer of the Talpa soils is about 6 inches of calcareous brown clay loam. Coarse fragments of limestone make up 10 to 30 percent by volume of the surface layer. This layer is abruptly underlain by fractured indurated limestone.

The surface layer of the Vernon soils is reddish-brown clay loam about 6 inches thick. Below this layer is 10 inches of reddish-brown very firm clay. The underlying material is red and gray red-bed clayey shale that extends to a depth of about 48 inches.

Included in mapping are a few narrow areas of Colorado and Spur clay loams along some of the larger drains. Other inclusions are Badland and gypsum outcrops on some of the steep scarp faces.

This complex is not suitable for cultivation. All the acreage is in range. The water-erosion hazard is severe. (Both soils in dryland capability unit VIIs-1; Talpa soil in Very Shallow range site; Vernon soil in Shallow Redland range site)

Tillman Series

The Tillman series consists of deep, well-drained, nearly level to gently sloping loamy soils on uplands. These soils formed in clayey red beds.

In a representative profile, the surface layer is brown clay loam about 5 inches thick. The next layer is reddish-brown firm silty clay loam 4 inches thick. The next layer, 33 inches thick, is reddish-brown very firm clay. Below this is a layer of light reddish-brown clay 20 inches thick that contains 30 to 40 percent by volume soft masses and strongly cemented concretions of calcium carbonate. The underlying material is weathered red-bed clay.

Representative profile of Tillman clay loam, 1 to 3 percent slopes, in a cultivated field, 80 feet north of U.S. Highway 287 from a point 1.6 miles east of the intersection of U.S. Highway 287 and Texas Highway 283 at Quanah, Tex.

Ap--0 to 5 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

B1--5 to 9 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium and weak, fine, blocky structure; very hard when dry, firm when moist; few very fine pores; mildly alkaline; clear, smooth boundary.

C1ca--42 to 62 inches, light reddish-brown (5YR 6/4) clay, reddish brown (5YR 5/4) when moist; weak, coarse, blocky structure; hard when dry, firm when moist; 30 to 40 percent by volume is soft masses and a few, fine, strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.
C2--62 to 72 inches, weathered, calcareous, red-bed clay.

The A horizon ranges from 4 to 8 inches in thickness and from brown to reddish brown in color. The B1 horizon, where present, is as much as 6 inches thick and silty clay loam to silty clay. This horizon occurs in about 60 percent of the profiles. The Bt horizon is 20 to 44 inches thick and mildly to moderately alkaline.

Depth to the Cca horizon ranges from 32 to 50 inches. Visible calcium-carbonate content ranges from about 5 to 50 percent by volume. Depth to the C2 horizon of weathered red-bed shale or clay ranges from 38 to 72 inches. It is below a depth of 60 inches in about half of the areas.

Tillman clay loam, 0 to 1 percent slopes (TmA).--This soil occurs on upland plains in irregular areas 10 to 200 acres in size.

The surface layer is brown clay loam about 6 inches thick. The next layer is reddish-brown silty clay loam 4 inches thick. Below this layer is 36 inches of reddish-brown very firm clay. The underlying material is reddish calcareous clay that is 5 to 50 percent by volume soft masses and strongly cemented concretions of calcium carbonate in the upper part.

Included with this soil in mapping are areas of Hollister clay loam, 0 to 1 percent slopes, in slightly lower parts of the landscape. In a few areas is a soil similar to the Tillman soil that is calcareous throughout and has a surface layer redder than described for the series.

Most of the acreage is cultivated. A small part is irrigated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit IIs-1; irrigated capability unit IIs-1; Deep Hardland range site)

Tillman clay loam, 1 to 3 percent slopes (TmB).--This gently sloping soil occupies ridges and areas along natural drainageways on upland plains. Soil areas are irregular and 15 to several hundred acres in size. This soil has the profile described as representative for the series.

Included in mapping are areas of Vernon clay loam, 1 to 3 percent slopes, on low rounded hilltops and on narrow ridges and a few small areas of Quanah clay loam, 1 to 3 percent slopes, on low ridgetops. Also included are small areas of Hollister clay loam and areas of soil similar to Tillman clay loam that is calcareous throughout and is redder than described for the series.

Most of the acreage is cultivated. A small acreage is irrigated. Runoff is moderate, and the hazard of water erosion is moderate. (Dryland capability unit IIIe-1; irrigated capability unit IIIe-1; Deep Hardland range site)

Tipton Series

The Tipton series consists of deep, nearly level, well-drained soils. These soils occur in valleys or on terraces.

In a representative profile, the surface layer is brown loam about 17 inches thick. The next layer is brown friable clay loam 22 inches thick. The underlying material is pinkish-gray clay loam that is about 5 percent by volume films and soft masses of calcium carbonate. The underlying material extends to a depth of 62 inches.

Representative profile of Tipton loam, in a cultivated field, 0.45 mile south of Farm Road 2533 from a point 1.95 miles east of its intersection with Texas Highway 283. This intersection is 4.2 miles north of Quanah, Tex.

Ap--0 to 8 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; many very fine pores; neutral; abrupt, smooth boundary.
A1--8 to 17 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; moderate, fine, subangular blocky and granular structure; slightly hard when dry, very friable when moist; many fine pores; few worm casts; neutral; gradual, smooth boundary.
B21t--17 to 24 inches, brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; common fine pores; few clay films on ped surfaces; neutral; clear, smooth boundary.
B22t--24 to 39 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; common fine pores; few clay films; mildly alkaline; clear, smooth boundary.
Cca--39 to 62 inches, pinkish-gray (7.5YR 6/2) clay loam, brown (7.5YR 4/3) when moist; hard when dry, friable when moist; about 5 percent by volume is films and fine soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 10 to 22 inches in thickness and from brown to dark grayish brown in color. The B21t horizon is 4 to 19 inches thick and brown to dark brown and grayish brown. It has a clay loam to silty clay loam texture and is neutral to mildly alkaline in reaction. The B22t horizon ranges from 9 to 15 inches in thickness, from reddish brown to brown in color, from clay loam to silty clay loam in texture, and from neutral to moderately alkaline in reaction. A B3 horizon occurs in a few places.

Depth to the Cca horizon ranges from 36 inches to more than 5 feet. Films, soft masses, and cemented concretions of calcium carbonate make up about 5 to 20 percent by volume of this horizon.

Tipton loam (Tp).--This nearly level soil occurs in upland valleys, mainly above bottom lands. Mapped areas are irregular and range from 10 to 320 acres in size, but are mostly 30 to 60 acres.

Included with this soil in mapping are areas that have slopes of 1 to 3 percent. Also included are areas of Acuff loam and Portales clay loam, 0 to 1 percent slopes, that occur in slightly higher parts of the landscape.

Almost all the acreage is cultivated; a few small areas are irrigated. Runoff is slow, and the hazard of erosion is slight. (Dryland capability unit I-1; irrigated capability unit I-4; Mixedland range site)

Tivoli Series

The Tivoli series consists of deep, loose, sandy soils that are excessively drained. These soils occur in hummocky to duny uplands. They formed in sands blown from the broad sandy river channels.

In a representative profile, the surface layer is light-brown noncalcareous fine sand about 12 inches thick. The underlying material, to a depth of about 60 inches, is reddish-yellow, loose, calcareous fine sand.

Representative profile of Tivoli fine sand, in a pasture, 1 mile north of a rural road from a point 2 miles north of its intersection with Farm Road 2006. This intersection is 9.05 miles north-northwest of Chillicothe, Tex.

A1--0 to 12 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 4/3) when moist; structureless; single grain; loose when dry or moist; many grass roots; mildly alkaline; gradual, smooth boundary.

C--12 to 60 inches, reddish-yellow (7.5YR 6/6) fine sand, reddish brown (5YR 4/4) when moist; structureless; single grain; loose when dry or moist; calcareous; moderately alkaline.

The A horizon ranges from 6 to 16 inches in thickness, from light brown to brown and reddish yellow in color, and from neutral to mildly alkaline in reaction. The C horizon is several feet to many feet thick, light brown to reddish yellow, and neutral to moderately alkaline.

Tivoli fine sand (Tv).--This soil occurs in hummocky to duny uplands above the flood plains. Slopes range from 0 to about 8 percent. Soil areas are 50 to several hundred acres in size.

Included in mapping are areas of Hardeman fine sandy loam in some places between dunes, and areas of Springer loamy fine sand in narrow bands between dunes of Tivoli fine sand.

Almost all the acreage is in range. A small part was once cultivated, but most of this has been reseeded to grass or has been idle for several years and is returning to grass naturally. This soil is not suitable for cultivation. Runoff is very slow. The hazard of soil blowing is severe. (Dryland capability unit VIIe-1; Deep Sand range site)

Treadway Series

The Treadway series consists of well-drained, calcareous, clayey alluvial soils. These soils are nearly level to gently sloping and occupy flood plains and alluvial fans.

In a representative profile, the surface layer is reddish-brown very firm clay about 18 inches thick. The underlying material is reddish-brown very firm clay that extends to a depth of about 58 inches.

Representative profile of Treadway clay, overflow, in the flood plain of Hackberry Creek at a point 0.85 mile north-northeast on a private road from its intersection with a rural road. This intersection is 0.6 mile east, 2 miles south, and 3 miles east on the rural road from its intersection with Texas Highway 283, which is 11.6 miles south of the junction of Texas Highway 283 and U.S. Highway 287 at Quanah, Tex.

C1--0 to 18 inches, reddish-brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) when moist; weak, thin, platy structure in upper 2 inches, weak, fine, angular blocky structure below; very hard when dry, very firm when moist, sticky and very plastic when wet; common grass roots; calcareous; moderately alkaline; gradual, smooth boundary.

C2--18 to 58 inches, reddish-brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) when moist; weak, fine, angular blocky structure when dry that apparently is rock structure; massive when wet; extremely hard when dry, very firm when moist; sticky and very plastic when wet; few roots in upper 12 inches; very few visible pores; few fine masses of calcium carbonate; few to common salt crystals; calcareous; moderately alkaline; gradual, smooth boundary.

The C horizon and the C2 horizon to a depth of 40 inches or more range from clay to silty clay in texture and from reddish brown to red in color. Roots do not penetrate below a depth of about 18 inches.

Treadway clay, overflow (Tw).--This nearly level to gently sloping soil is on flood plains and alluvial fans below areas of Vernon soils and Badland. In most places the soil areas are parallel to the stream channels and are 20 to 400 acres in size.

Included with this soil in mapping are narrow bands of Colorado and Spur clay loams along some of the main stream channels. Also included are a few areas of Mangum clay loam adjacent to the flood plains.

All the acreage is in range. This soil is not suited to cultivation. Runoff is very rapid. This

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soil is frequently flooded by runoff from surrounding areas that are more sloping. (Dryland capability unit Vw-1; Clay Flats range site)

Vernon Series

The Vernon series consists of well-drained, calcareous soils that are clayey below the surface layer. These gently sloping to moderately steep soils occur on uplands. They formed in calcareous, clayey, red-bed material.

In a representative profile, the surface layer is reddish-brown clay loam about 6 inches thick. The next layer is reddish-brown very firm clay 10 inches thick. The underlying material is red and gray, red-bed, clayey shale.

Representative profile of Vernon clay loam, 1 to 3 percent slopes, in a cultivated field, 100 feet west of a rural road from a point 1.5 miles north of its intersection with U.S. Highway 287, which is 2.9 miles northwest of Goodlett, Tex.

Ap--0 to 6 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/3) when moist; weak, fine, granular structure; hard when dry, friable when moist; few hard calcium-carbonate concretions; calcareous; moderately alkaline; abrupt, smooth boundary.

B2--6 to 16 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; moderate, fine and very fine, angular blocky structure; very hard when dry, very firm when moist; few fine calcium-carbonate concretions and a few lime-coated shale fragments; calcareous; moderately alkaline; clear, smooth boundary.

C--16 to 48 inches, red and gray, red-bed, clayey shale; calcareous; moderately alkaline.

The A horizon ranges from 4 to 9 inches in thickness. The B2 horizon ranges from 6 to 15 inches in thickness and from clay loam to clay in texture. Depth to the C horizon ranges from about 10 to 20 inches. In the top few inches the C horizon ranges from little altered red-bed clay, shale, or claystone to weathered red beds.

Vernon clay loam, 1 to 3 percent slopes (VeB).--This soil occupies hilltops and ridges and the side slopes along natural drains on uplands. Soil areas are irregular to oval and, in most places, 10 to 250 acres in size. This soil has the profile described as representative for the series.

Included in mapping are areas of Tillman clay loam on lower parts of the landscape along natural drains, and a few small areas of Talpa soils on low rounded hilltops. Also included are small areas of Quanah clay loam, 1 to 3 percent slopes, and Weymouth clay loam, 1 to 3 percent slopes, on lower parts of the landscape.

About 20 percent of the acreage is cultivated. A few areas are irrigated. Runoff is rapid. (Dryland capability unit IVe-6; irrigated capability unit IVe-5; Shallow Redland range site)

Vernon-Badland complex (Vr).--This gently sloping to moderately steep complex is on uplands. Mapped areas are irregular and 20 to several hundred acres in size. The complex averages about 63 percent Vernon soils and 32 percent Badland. The remaining 5 percent is inclusions of other soils and land types. The Vernon soils and Badland are closely associated and intermingled. Slopes are dominantly less than 12 percent but range to about 20 percent.

Vernon soils are gently sloping to steep and, in most places, are below areas of Badland. The Badland is made up of steep eroded scarps and gently sloping to sloping footslopes below the scarps.

Vernon soils have a 6 inch surface layer of reddish-brown clay loam. The next layer is 10 inches of reddish-brown clay. The underlying material is red-bed clay or shale.

Badland consists of nearly barren outcrops of red-bed shale or clay.

In some places the Vernon soils in this complex support a moderate cover of grasses and are only slightly eroded. In other places the Vernon soils are 25 to 50 percent bare and have shallow gullies 100 to 300 feet apart. The Badland is 85 to 95 percent bare shale or clay and is cut by a network of V-shaped gullies.

Included in mapping are narrow bands of Colorado and Spur clay loams along the larger drains, and areas of Talpa soils on narrow ledges and hilltops. Also included is a soil similar to Vernon soils except it is less than 10 inches deep over red shale; it makes up about 15 percent of the acreage. Other inclusions are mainly small areas of Cottonwood soils and gypsum outcrops.

This complex is not suitable for cultivation, and all the acreage is in range. Runoff is rapid, and the water-erosion hazard is severe. (Vernon soil and Badland in dryland capability unit VIIs-1; Vernon soil in Shallow Redland range site; Badland is not assigned to a range site)

Weymouth Series

The Weymouth series consists of well-drained, gently sloping to sloping, calcareous soils on uplands. These soils formed in calcareous, moderately fine textured red beds or in old alluvium that contains red-bed material consisting mainly of clay loam.

In a representative profile, the surface layer is brown clay loam about 8 inches thick. The next layer, 10 inches thick, is reddish-brown friable clay loam. The underlying material is light reddish-brown clay loam that extends to a depth of 60 inches. The upper part of the underlying material is about 30 to 50 percent by volume soft masses and strongly cemented concretions of calcium carbonate. The lower part contains only a few soft masses of calcium carbonate.

Representative profile of Weymouth clay loam, 1 to 3 percent slopes, in a cultivated field, 60 feet west of a rural road from a point 0.85 mile south

of its intersection with U.S. Highway 287, which is 2.3 miles west of Chillicothe, Tex.

Ap--0 to 8 inches, brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; few, fine, strongly cemented calcium carbonate concretions; calcareous; moderately alkaline; abrupt, smooth boundary.

B2--8 to 18 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; weak and moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; many very fine and fine pores; many worm casts; few films, soft masses, and fine strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca--18 to 42 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; 30 to 50 percent by volume soft masses and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2--42 to 60 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 7 to 10 inches in thickness and from brown to reddish brown in color. The B2 horizon is 5 to 14 inches thick.

Depth to the C1ca horizon ranges from 12 to 20 inches. The C1ca horizon ranges from 10 to 50 inches in thickness and from light reddish brown to reddish brown, reddish yellow, and yellowish red in color. The estimated calcium-carbonate content is 15 to 60 percent by volume. In a few places, where this soil is associated with Talpa soils, the C1ca horizon is underlain by strata of dolomitic limestone. The C2 horizon ranges from old alluvial or outwash sediments of clay loam texture to weathered silty or clayey red beds.

Weymouth clay loam, 1 to 3 percent slopes (WeB).--This gently sloping soil occurs on uplands in irregular areas 10 to 130 acres in size. It occupies ridges, hilltops, and side slopes of natural drains. This soil has the profile described as representative for the series.

Included with this soil in mapping are areas of Olton clay loam and Quanah clay loam, 1 to 3 percent slopes, in slightly lower parts of the landscape. Also included are Talpa soils on a few low rounded hilltops and small areas of Vernon clay loam, 1 to 3 percent slopes. A few shallow gullies, as much as 12 inches deep, are in some unprotected cultivated areas.

About 60 percent of the acreage is cultivated, and a small part is irrigated. This soil has a moderate water-erosion hazard. (Dryland capability unit IIIe-7; irrigated capability unit IIIe-7; Shallow Redland range site)

Weymouth and Vernon clay loams, 3 to 8 percent slopes (WvD).--This unit consists of soils in scattered areas on uplands. Soil areas are irregular and range from 8 to 400 acres in size but are dominantly less than 100 acres. In most places they follow the slope contours above the drainage patterns. Some soil areas consist entirely of either Weymouth clay loam or Vernon clay loam, but most contain both soils. Both soils are in about the same topographic position.

The surface layer of the Weymouth clay loam is about 7 inches of calcareous brown clay loam. The next layer is reddish-brown friable clay loam 8 inches thick. The upper part of the underlying material is 15 to 60 percent by volume soft masses and concretions of calcium carbonate.

The surface layer of the Vernon clay loam is about 5 inches of calcareous reddish-brown clay loam. The next layer is reddish-brown firm clay 7 inches thick. The underlying red-bed shale or clay is at a depth of about 12 inches.

Included in mapping are areas of Weymouth clay loam, 1 to 3 percent slopes, and Vernon clay loam, 1 to 3 percent slopes, on ridgetops or in narrow valleys between ridges. Also included are Talpa soils on narrow scarps and hilltops, a reddish clay loam soil less than 10 inches thick over red-bed clays, and Badland on a few narrow scarps. A few gullies, 6 inches to 3 feet deep and more than 300 feet apart, occur in some places along natural drains or in areas where runoff water concentrates.

This mapping unit is not suitable for cultivation. Most of it is in range. A few small areas are cultivated. The principal crops are small grain and forage sorghum. The water-erosion hazard is moderate to severe. (Dryland capability unit VIe-1; Shallow Redland range site)

Yahola Series

The Yahola series consists of deep, well-drained, calcareous soils. These are nearly level to gently undulating alluvial soils of the flood plains.

In a representative profile, the surface layer is reddish-brown very fine sandy loam about 6 inches thick. The underlying material is light reddish-brown very friable very fine sandy loam that contains thin strata of fine sandy loam and silt loam.

Representative profile of Yahola very fine sandy loam, in a cultivated field on the flood plain of the Pease River, 0.1 mile west of a private road from a point 2.65 miles south on the private road, and 3 miles south on a rural road from the intersection of the rural road and Farm Road 392. This intersection is 4 miles south of the intersection of Farm Roads 392 and 91, which is 1 mile west and 3 miles south of Chillicothe, Tex.

Ap--0 to 6 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

C--6 to 60 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; contains thin strata of fine sandy loam and silt loam; structureless; remnants of bedding planes are evident; slightly hard when dry, very friable when moist; few threads and films of calcium carbonate; calcareous; moderately alkaline.

Between depths of 10 and 40 inches, the texture ranges from very fine sandy loam to loam, but in most places the soil is stratified and contains thin strata of silt loam to fine sandy loam and loamy fine sand. Between these depths the average clay content is less than 18 percent. The color of all horizons, to a depth of 60 inches or more, ranges from reddish brown to light reddish brown, reddish yellow, and yellowish red.

Yahola very fine sandy loam (Ya).--This is a nearly level to gently undulating soil of the flood plains. Soil areas are roughly parallel to the river channels or to areas of Lincoln soils.

Included with this soil in mapping are narrow bands of Colorado silt loam in slightly lower parts of the flood plains, and bands of gently sloping Yahola soils on narrow benches that separate different levels of the flood plains.

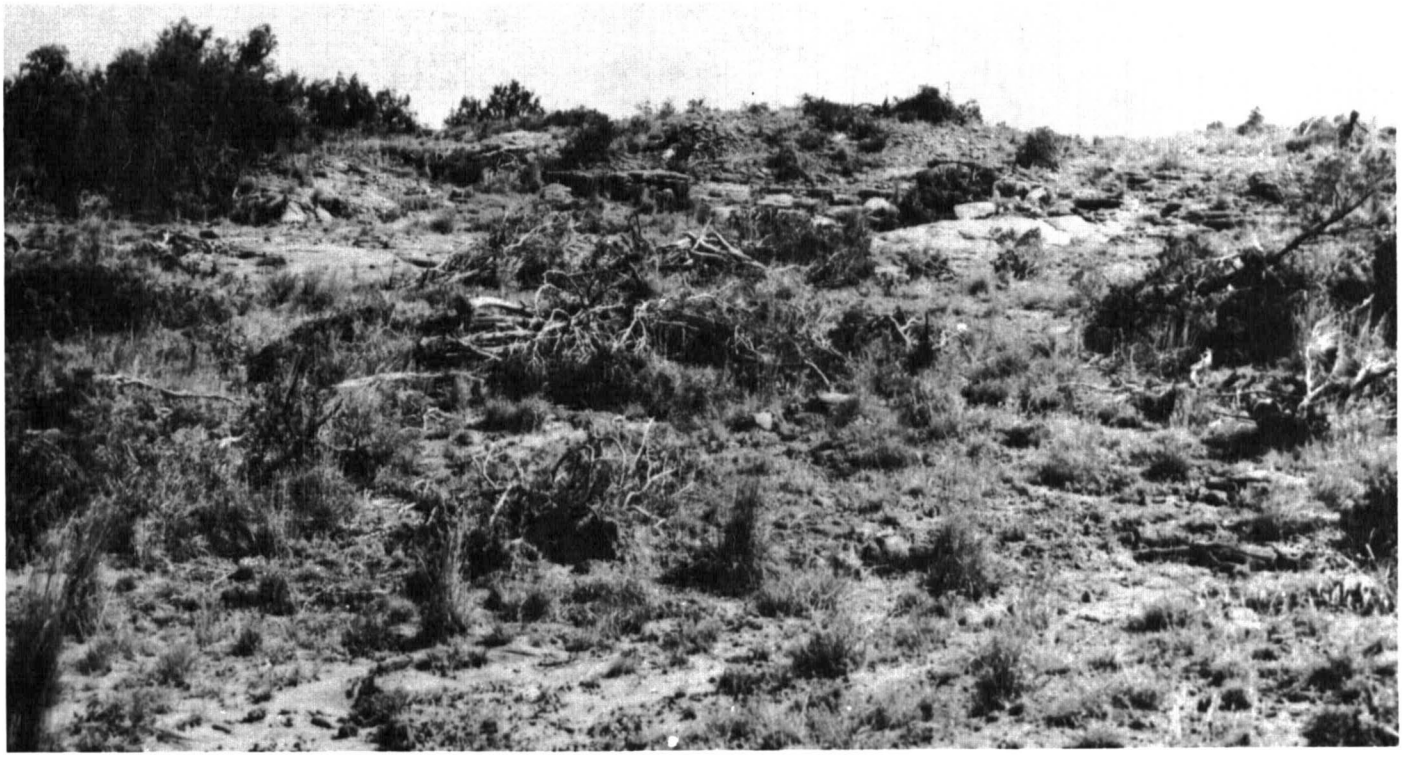
About half the acreage is cultivated. Runoff is slow, and the erosion hazard is slight. Some areas of this soil are subject to overflow about once in 1 to 10 years, but the water remains on the surface for only a few hours. (Dryland capability unit I-1; irrigated capability unit I-4; Bottomland range site)

Altus fine sandy loam, saline, 0 to 1 percent slopes. Bare white areas are strongly saline.

Typical landscape of Badland showing topography and scant vegetation.

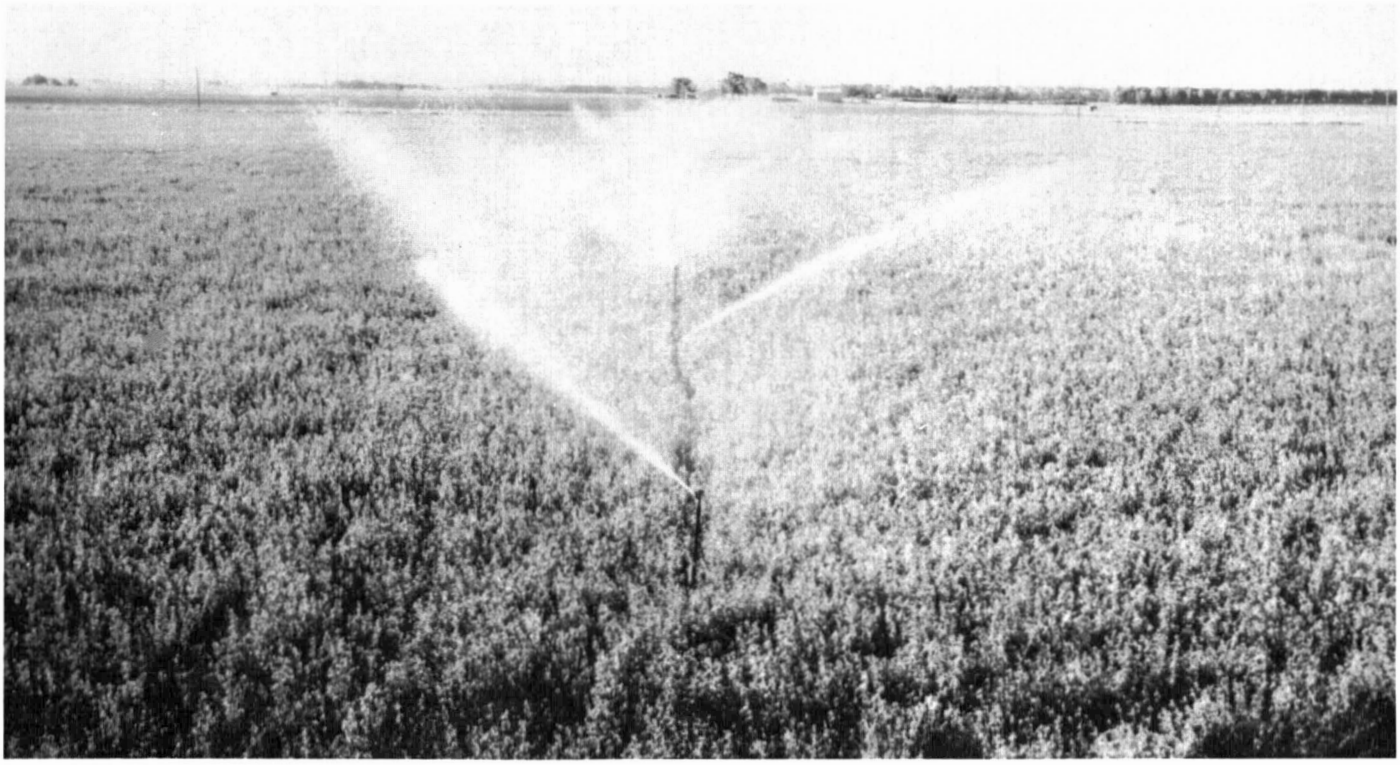
Typical landscape of Colorado and Spur clay loams.

Wheat on Hollister clay loam, 0 to 1 percent slopes. Grain elevators in background.

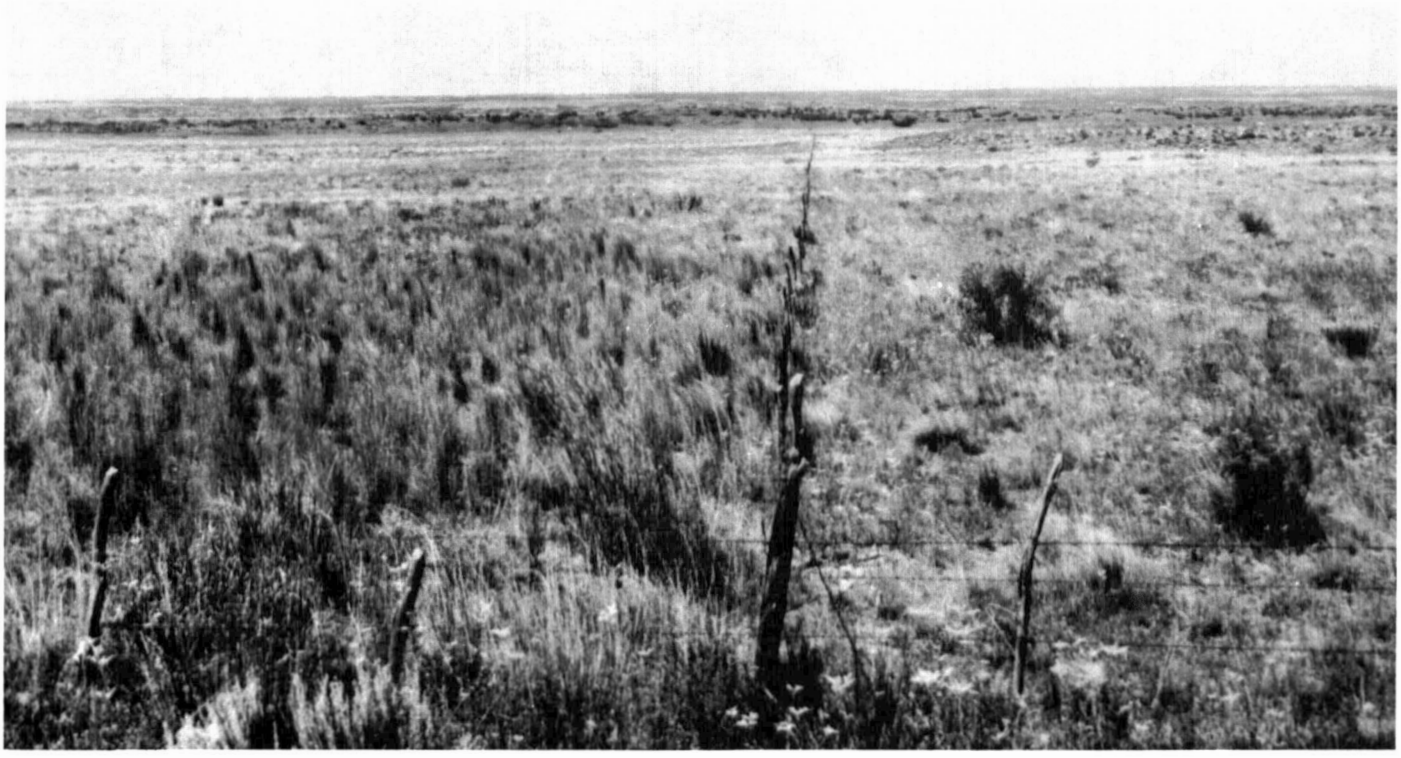


Typical landscape of Latom-Rock outcrop complex. Redberry juniper (cedar) has been partially cleared by chaining on the smoother parts.

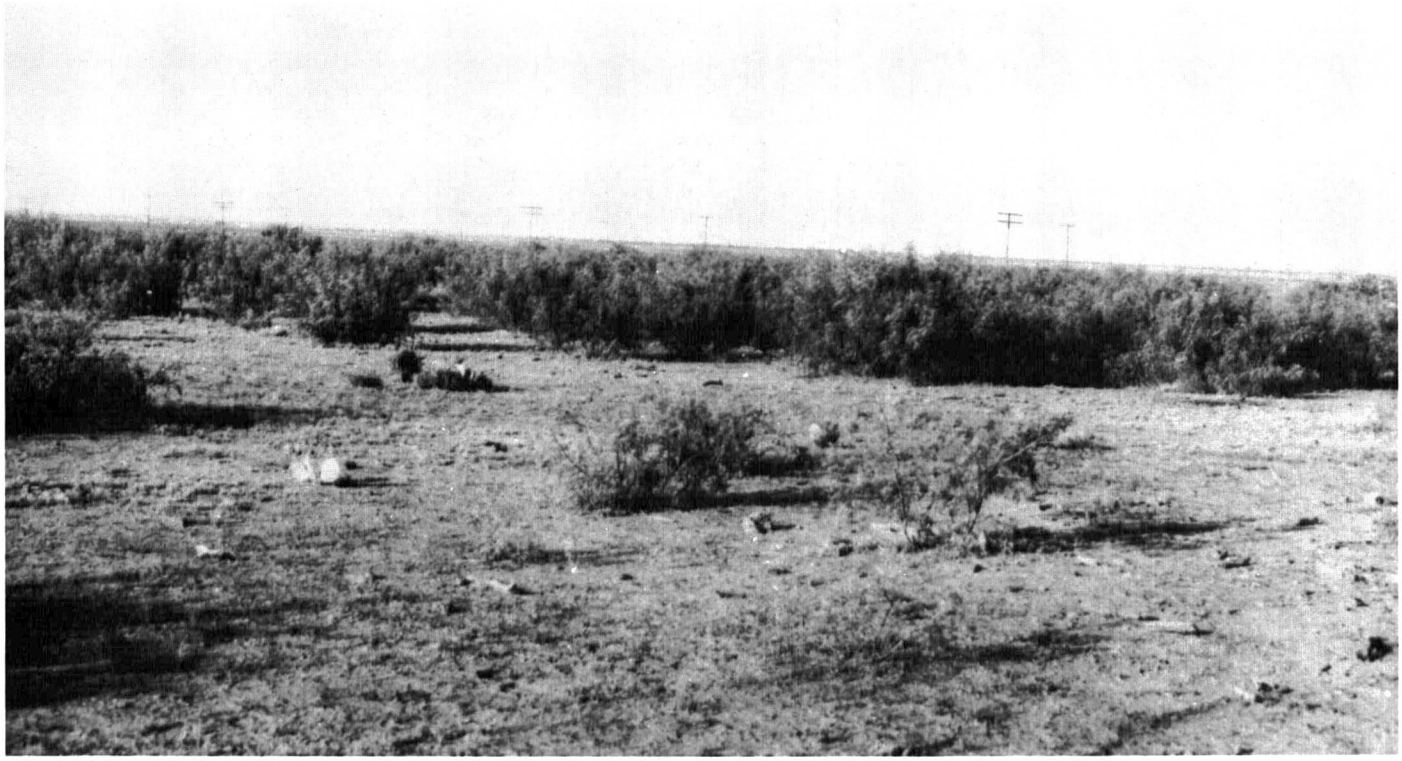
Stubble mulching wheat on Olton Loam, 0 to 1 percent slopes.



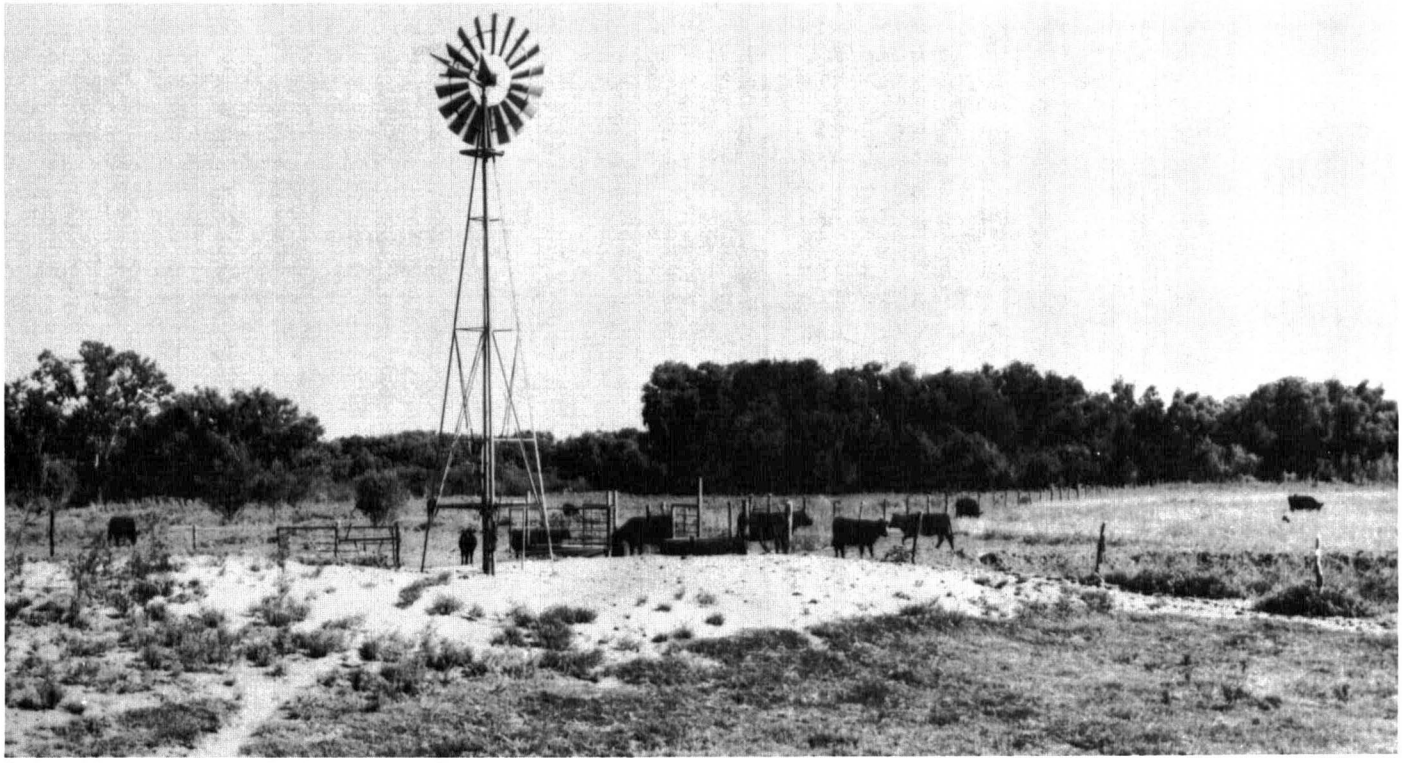
Sprinklers irrigating alfalfa on Miles loamy fine sand, 0 to 3 percent slopes.



Range on Lincoln fine sandy loam shows effect of deferred grazing on right and grazing on left.



Mesquite invades Deep Hardland range site in poor condition. Soil is Abilene clay loam, 0 to 1 percent slopes.



Well and storage for livestock water on Portales clay loam, 0 to 1 percent slopes. White sand around well was dug up during drilling.

Deep Sand range site in excellent condition. Dense stand of little bluestem in foreground is on Tivoli fine sand.

This section outlines general soil management practices that increase production or maintain a high level of production of tilled crops on the soils in Hardeman County. Erosion control, drainage, conservation of soil moisture, and maintenance of fertility are the main objectives of good management.

The type and intensity of management needed varies according to the kind of soil and kind of farming operation carried out. A primary aid in managing soil is a good cropping system. A good cropping system is one that maintains or improves the physical condition of the soil; protects the soil during critical periods, such as heavy rains or flooding, drought, and strong winds; aids in the control of weeds, insects, and plant disease; and provides an adequate economic return.

A good cropping system consists of growing crops in a sequence or rotation in which soil-improving crops balance soil-depleting crops. Soil-improving crops are those that leave large amounts of residue, such as grasses and legumes. Row crops, in general, are soil depleting.

Most soils in Hardeman County respond economically to some type of fertilization. The use of commercial fertilizers should be based on crop needs determined by soil tests. The amount and type of fertilizer needed vary according to the nature of the soil, crop to be grown, production desired, previous land use or cropping, season, and amount of available moisture.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, horticultural crops, or other crops requiring special management.

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

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the

capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Many of the soils in Hardeman County are put in a different capability unit if they are irrigated than if they are dryfarmed. Consequently, two sets of capability units are described in the following subsections. In the first, all the soils of the county are classified according to their capability under dryland farming. In the second, those soils suitable for irrigation are classified according to their capability when irrigated.

Dryland Capability Units

In this subsection the dryland capability units of Hardeman County are described, and use and management of the soils are discussed. To find the capability classification of any given mapping unit, refer to the "Guide to Mapping Units" at the back of this survey.

Capability Unit I-1 (Dryland)

This unit consists of deep, well-drained, nearly level, moderately and moderately rapidly permeable soils. They have a loam, clay loam, silt loam, or very fine sandy loam surface layer. They are easily tilled and readily penetrated by plant roots, moisture, and air. Available water capacity is moderate to high. The hazard of erosion is slight.

The soils in this unit are cultivated extensively. They are suitable for most crops grown in the county and for large-scale farming. Cotton, wheat, and grain sorghums are the main crops. Some alfalfa, forage sorghums, oats, and barley also are grown.

These soils have few limitations. Maintaining or improving the structure and fertility of the soils are the main concerns of management. Crops such as alfalfa and winter peas help maintain the productivity of the soils. Contour farming conserves moisture. Grassed waterways are needed in some places to safely dispose of excess runoff and help control erosion.

Capability Unit IIc-1 (Dryland)

This unit consists of deep, nearly level, well drained and moderately well drained soils. Permeability of these soils is very slow to slow and moderately slow, and available water capacity is high. The erosion hazard is slight. The surface layer is clay loam or loam. Lower layers impede the movement of water, air, and roots.

The soils in this unit are cultivated extensively and are well suited to large-scale farming. Wheat is the principal crop, and some sorghums and cotton also are grown.

Conserving moisture and maintaining or improving the structure and productivity of the soil are the main concerns of management. Use of diversion terraces, contour farming, and the management of crop residue to keep it on or near the surface help conserve moisture and have proved beneficial on these soils (pl. III, bottom). Perennial grasses established in waterways along the broad natural drainageways help control erosion.

Capability Unit IIc-2 (Dryland)

This unit consists of deep nearly level soils that have a loam or clay loam surface layer. They are well drained, easily tilled, and readily penetrated by plant roots, moisture, and air. The soils have a high available water capacity, and the erosion hazard is slight.

Most soils of this unit are cultivated and are well suited to large-scale farming. Wheat, cotton, and sorghums are the principal crops, and alfalfa is also grown.

These soils have few limitations. Conserving moisture and maintaining or improving soil structure and fertility are the main concerns of good management.

Alfalfa, winter peas, and guar are crops that have proved beneficial in improving the fertility and tilth of these soils. Use of diversion terraces, contour farming, and managing crop residue to keep it on or near the soil surface have also proved beneficial in conserving moisture. Grassed waterways are needed in some places to safely dispose of excess runoff water and help control erosion.

Capability Unit IIe-1 (Dryland)

This unit consists of deep, gently sloping, slowly and moderately slowly permeable soils. These well-drained soils of the uplands have a clay loam or loam surface layer and a high available water capacity. Lower layers restrict the movement of water, air, and plant roots. The water erosion hazard is moderate.

Most soils of this unit are cultivated and are well suited to large-scale farming. Wheat, sorghums, and cotton are the principal crops.

Controlling erosion, conserving moisture, and improving the structure and productivity of the soil are the main concerns of management. Effective practices include terracing, contour farming, and managing crop residue to keep it on or near the surface. Crops of winter peas, guar, cowpeas, and sweetclover are useful in improving fertility and tilth.

Capability Unit IIe-2 (Dryland)

This unit consists of deep, well-drained, gently sloping, moderately and moderately slowly permeable

soils on uplands. They have a loam or clay loam surface layer. The available water capacity is high, and the water-erosion hazard is moderate.

Most soils of this unit are cultivated. Wheat, sorghums, and cotton are the principal crops.

Erosion control and moisture conservation are the chief concerns of management. Effective erosion-control practices are terracing, contour farming, and managing crop residue to keep it on or near the surface. Grassed waterways to carry runoff water from terraces help prevent erosion where outlets onto areas of native grass are not available. Crops of winter peas, cowpeas, sweetclover, and grasses are beneficial in improving the fertility and tilth of these soils.

Capability Unit IIe-4 (Dryland)

This unit consists of deep, well-drained, nearly level soils on uplands that have a fine sandy loam surface layer. They have a high available water capacity and are subject to a slight erosion hazard.

These soils are easily penetrated by plant roots, moisture, and air. Compacted layers form, however, if the soils are plowed to the same depth every year. Most of the soils in this unit are cultivated and are well suited to large-scale farming. Cotton, wheat, and sorghums are the principal crops. Guar and alfalfa also are grown.

Controlling soil blowing and maintaining or improving soil productivity and tilth are the main concerns of management. Managing crop residue to keep it on or near the soil surface helps control erosion, improve fertility, and increase water intake. Terracing and contour farming also help conserve moisture. Crops of guar, winter peas, vetch, and alfalfa help to maintain or improve the fertility and structure of the soil. Emergency tillage is sometimes needed to control soil blowing on fields that do not have adequate cover.

Capability Unit IIe-5 (Dryland)

This unit consists of deep, well-drained, moderately permeable Miles fine sandy loam, 1 to 3 percent slopes. This soil is easily tilled and readily penetrated by plant roots, moisture, and air. It has a high available water capacity. Soil blowing and water erosion are slight hazards if the soil is cultivated.

This soil is well suited to large-scale farming, and most areas are cultivated. Cotton, wheat, and sorghums are the major crops. A small acreage is used for guar.

The control of soil blowing and water erosion, conservation of moisture, and maintainance or improvement of productivity and tilth are the main concerns of management. Crops of guar and winter peas help maintain or improve the productivity of the soil. Terraces and contour farming are helpful in controlling water erosion and conserving moisture. If terraces are not used, continuous close-spaced crops that produce a large amount of residue, such as wheat, together with stubble mulch tillage, help control erosion. Emergency tillage is needed occasionally to help control soil blowing on fields that do not have adequate cover. Grassed waterways are needed to control erosion where runoff is excessive.

Capability Unit IIe-6 (Dryland)

This unit consists of deep, well-drained, moderately rapidly permeable Hardeman fine sandy loam, 0 to 1 percent slopes. This soil is easily tilled and readily penetrated by plant roots, moisture, and air. It has a moderate available water capacity, and erosion is a slight hazard.

Nearly all areas of this soil are cultivated. Cotton, guar, and wheat are the principal crops. Sorghums, alfalfa, and a few other crops also are grown. Most crops suited to the county grow well on this soil.

The principal concerns of good soil management are controlling soil blowing and maintaining or improving productivity. Crops of guar, winter peas, vetch, and alfalfa aid in maintaining or improving the fertility of the soil. Stripcropping and managing crop residue to keep it on the surface during windy seasons help to control soil blowing. Emergency tillage helps control soil blowing on fields that do not have an adequate cover of vegetation.

Capability Unit IIs-1 (Dryland)

This unit consists of deep, well-drained, very slowly permeable Tillman clay loam, 0 to 1 percent slopes. The available water capacity of this soil is high, and the hazard of erosion is slight. The clay lower layer impedes the movement of water, air, and plant roots.

This soil is well suited to large-scale farming, and most areas are cultivated. Wheat is the principal crop. Sorghums and cotton also are grown.

The principal concerns of management are conserving moisture and maintaining or improving soil productivity and tilth. Crops of winter peas, cowpeas, and sweetclover are beneficial in improving the fertility and structure of the soil. Moisture-conserving practices, such as terracing, contour farming, and keeping crop residue on or near the surface, have proved beneficial. Grassed waterways are needed in some places to help control erosion.

Capability Unit IIIe-1 (Dryland)

This unit consists of deep, well-drained, very slowly permeable Tillman clay loam, 1 to 3 percent slopes. The available water capacity of this soil is high, and the water-erosion hazard is moderate. The clay lower layers restrict the movement of water, air, and plant roots.

This soil is well suited to large-scale farming, and most areas are cultivated. Wheat is the principal crop. Sorghums and cotton also are grown.

The main concerns of good management are controlling water erosion, increasing water intake, and improving the structure and organic-matter content of the soil. Managing crop residue to keep it on or near the surface helps control erosion and increase water intake. Crops of winter peas, cowpeas, and sweetclover improve the fertility and structure of the soil. Terracing and contour farming help control water erosion and conserve moisture. Grassed waterways help protect terrace outlets.

Capability Unit IIIe-4 (Dryland)

This unit consists of moderately deep and deep, well-drained, gently sloping soils that have a fine sandy loam surface layer. They have a high available water capacity. Water erosion is a moderate hazard, and soil blowing is a slight hazard. The soils in this unit are easily penetrated by plant roots, moisture, and air. Compacted layers form, however, if the soils are plowed to the same depth every year.

Most of the soils in this unit are cultivated. Wheat, sorghums, and cotton are the main crops. Principal concerns of management are controlling erosion, conserving moisture, and improving the productivity and tilth of the soils.

Crop residue kept on or near the surface helps increase moisture penetration and control erosion. Crops of rye and vetch, winter peas, and guar are useful in improving fertility. Terracing, contour farming, and establishing grassed waterways are useful in reducing excessive runoff and controlling erosion. Emergency tillage is sometimes needed to help control soil blowing on fields that are not protected by vegetation.

Capability Unit IIIe-5 (Dryland)

This unit consists of deep, well-drained, moderately rapidly permeable Hardeman fine sandy loam, 1 to 3 percent slopes. This soil is easily tilled and readily penetrated by plant roots, moisture, and air. The available water capacity is moderate. The soil is subject to a slight soil-blowing hazard and a moderate water-erosion hazard. Deep gullies form easily if water concentrates on unprotected areas.

Most areas of this soil are cultivated. Cotton, guar, and wheat are the major crops. Sorghums and alfalfa also are grown.

The principal concerns of management are controlling erosion and maintaining or improving soil productivity and tilth. Managing crop residue to keep it on or near the surface increases moisture penetration and helps control erosion. Fertilizing and growing crops of rye and vetch, winter peas, and guar are useful in improving the fertility and structure of the soil.

Terraces, contour farming, and grassed waterways are beneficial in controlling erosion. Emergency tillage may also be needed to help control soil blowing on fields that are not protected by vegetation.

Capability Unit IIIe-6 (Dryland)

This unit consists of deep, well-drained Miles loamy fine sand, 0 to 3 percent slopes. This soil has a high available water capacity. It is moderately susceptible to soil blowing and slightly susceptible to water erosion.

This soil is suitable for large-scale farming, and most areas are cultivated. Cotton, guar, and wheat are the principal crops. Alfalfa and sorghums also are grown.

Controlling erosion and improving fertility are the main concerns of good soil management. Crop residue gives good erosion control when it is kept on the surface until time to seed the next crop. Stripcropping and cover cropping also help control soil blowing. Emergency tillage may also be needed to help control soil blowing on fields that are not protected by vegetation. Deep plowing reduces soil blowing if one-fourth to one-third of the plow slice is in the moderately fine textured lower layers. Tree windbreaks, an additional protection against soil blowing, grow well on this soil.

Applying fertilizer and growing crops of rye and vetch, alfalfa, winter peas, and guar improve the fertility and organic-matter content of the soil. Diversion terraces and grassed waterways are needed in some places to safely carry off excess runoff water.

Capability Unit IIIe-7 (Dryland)

This unit consists of gently sloping moderately permeable soils that have a clay loam surface layer. The soils in this unit have a moderate to high available water capacity and are slightly to moderately susceptible to water erosion.

Most of the soils in this unit are cultivated. Wheat is the main crop. Sorghums and cotton also are grown.

Maintaining or improving productivity and controlling erosion are the main concerns of good soil management. Terracing, contour farming, and managing crop residue to keep it on or near the surface help control erosion and reduce loss of water by runoff. Grassed waterways are needed where terraces do not have outlets onto areas of native grass. Crops of winter peas, sweetclover, or a mixture of legumes and grasses are beneficial in improving the fertility and tilth of the soil.

Capability Unit IIIw-1 (Dryland)

This unit consists of deep slightly depressed Lipan clay. This soil is seasonally wet, and water

stands on the surface following heavy rains. Planting and harvesting of crops are sometimes delayed because of ponded water or the wetness of the soil. The clay surface layer and very slowly permeable lower layers impede the movement of moisture, air, and plant roots.

Most areas of this soil are cultivated. Wheat and sorghums are the principal crops. The main concerns of management are controlling excess run-in water, adapting cropping systems to soil limitations, and maintaining or improving soil structure and productivity.

Crops of winter peas, sweetclover, or grasses are beneficial in improving the structure and fertility of the soil. Terraces or diversions on the surrounding higher lying soils reduce the amount of water that accumulates on this soil after rains. Some areas of this soil can be drained by surface ditches.

Capability Unit IVe-3 (Dryland)

This unit consists of deep, well-drained, moderately rapidly permeable Hardeman fine sandy loam, 3 to 5 percent slopes. This soil has a high available water capacity. It is easily tilled and readily penetrated by plant roots, moisture, and air. The soil is slightly subject to soil blowing and moderately subject to water erosion. Gullies form easily if water concentrates on unprotected areas.

This soil is not well suited to row crops, but most areas are cultivated. Wheat, cotton, and guar are the main crops. Sorghums and small acreages of other crops also are grown.

The main concerns of good soil management are controlling erosion, conserving moisture, and maintaining or improving soil productivity and structure. Cropping systems that include wheat or other close-spaced crops that produce a large amount of residue are well suited. Leaving crop residue on the surface increases moisture penetration and helps reduce erosion. Crops of vetch and rye or grasses are also well suited. These crops improve soil structure and fertility and help control erosion.

Emergency tillage is sometimes needed to help control soil blowing on fields that are not protected by vegetation. Tree windbreaks provide additional protection against soil blowing and grow well on this soil. Diversion terraces and grassed waterways are needed in some places.

Capability Unit IVe-4 (Dryland)

This unit consists of deep well-drained Miles loamy fine sand, 3 to 5 percent slopes. This soil has a high available water capacity and is susceptible to moderate water erosion and soil blowing.

Most areas of this soil are cultivated. Wheat, sorghums, and guar are the principal crops, but row crops are not well suited because of the erosion hazard.

Controlling erosion and maintaining or improving soil productivity and organic-matter content are the main concerns of management. Cropping systems that imclude wheat or other close-spaced crops that produce a large amount of residue are well suited to this unit. Crop residue gives good erosion control when it is kept on the surface until time to seed the next crop. Emergency tillage is sometimes needed to control soil blowing on fields that are not protected by vegetation. As an additional protection against soil blowing, tree windbreaks can be grown on this soil.

Crops of vetch and rye or grasses improve soil structure and fertility and help control erosion. Another good practice is to grow well-fertilized crops that produce large amounts of residue, and return the residue to the soil. Terraces or diversions and grassed waterways may be needed in some places to help control water erosion.

Capability Unit IVe-5 (Dryland)

This unit consists of deep nearly level to undulating soils that have a fine sandy loam or loamy fine sand surface layer. These soils have a low to moderate available water capacity. Runoff is slow, and the soils are subject to moderate to severe soil blowing.

These soils are used for range and crops. Wheat, cotton, and guar are the principal crops. Alfalfa, sorghums, barley, and rye also are grown. Row crops are not suitable unless followed by drilled cover crops or mulching to control soil blowing. Response to fertilizer is good.

Controlling soil blowing and maintaining or improving soil fertility and organic-matter content are the main concerns of management. Cropping systems that include small grains, or other crops that produce a large amount of residue, are well suited to this unit. Crop residue left on the surface gives good control of soil blowing. Crops of grasses, winter peas, or rye and vetch also improve fertility and soil structure. Emergency tillage is sometimes needed on fields that are not protected by vegetation. As an additional protection against soil blowing, tree windbreaks can be grown on these soils.

Capability Unit IVe-6 (Dryland)

This unit consists of very shallow and moderately deep, nearly level to gently sloping soils of the uplands. These soils have a clay loam to fine sandy loam surface layer and a low to high available water capacity. Water erosion is a moderate to severe hazard.

These soils are used for native range and crops. Wheat is the principal crop. Sorghum and cotton also are grown. The erosion hazard and the occurence of small areas where the soils are less than 10 inches deep over gypsum, sandstone, or limestone make these soils unsuitable for row crops.

Controlling erosion, conserving moisture, maintaining or improving soil structure and fertility, and adapting cropping systems to the soil limitations of a shallow root zone are the main concerns of management. Terracing, contour farming, and managing crop residue are beneficial. Grassed waterways protect terrace outlets in areas that are not already protected by vegetation. Crops of winter peas and sweetclover improve soil structure and fertility.

Capability Unit IVe-7 (Dryland)

This unit consists of deep well-drained Miles fine sandy loam, 3 to 5 percent slopes, eroded. This soil is subject to moderately severe erosion. Erosion is evident by rills, gullies, and a thinner surface layer. The soil is easily penetrated by plant roots, moisture, and air; however, plowing at the same depth every year causes a compacted layer to form.

Most areas of this soil were cultivated at one time but are now reseeded to grass or idle. This soil is not well suited to crops.

The principal concerns of management are controlling erosion, conserving moisture, and improving the structure and fertility of the soil. Cropping sysems that include wheat, sorghums, or other crops that produce a large amount of residue are best suited. Crop residue left on the soil surface until time to seed the next crop helps control erosion.

Crops of winter peas, guar, or grasses improve the fertility and structure of the soil. Terracing and contour farming are needed to help control water erosion and conserve moisture. Grassed waterways are needed if suitable terrace outlets are not available.

Capability Unit IVw-2 (Dryland)

This unit consists of deep, nearly level, saline soils on uplands that have a clay loam to fine sandy loam surface layer. These soils have a high available water capacity. The hazard of erosion is slight. Small saline areas, which support little vegetation, make up about 30 percent of the acreage of these soils.

These soils are underlain by clayey red beds that restrict the downward movement of water and cause a high water table. This high water table varies with rainfall and is 2 to 6 feet below the surface during most years.

Most of the soils in this unit are cultivated; however, they are not suitable for cultivation unless drainage is provided. Wheat and cotton are the principal crops. A few areas have been planted to grasses.

The main concerns of management are providing drainage where feasible and adapting cropping systems to the saline soils. If the soils in this unit are cultivated, field ditches or tile drains are needed to lower the water table and reduce salt accumulation in the root zone. Cropping systems that include grasses, wheat, or other crops that produce large amounts of residue are well suited to these soils. Keeping crop residue on the surface reduces evaporation and the accumulation of salt in the surface layer. Diversion terraces are needed in some places to divert runoff water.

Capability Unit Vw-1 (Dryland)

This unit consists of deep soils of the bottom land that have a clay or clay loam surface layer. These soils are subject to flooding by runoff water from surrounding higher lying soils or by overflow from streams.

The soils of this unit are best suited to range and wildlife. Most are in native range.

Capability Unit Vw-2 (Dryland)

This unit consists of deep, nearly level to gently undulating, rapidly permeable Lincoln soils. These soils are on low flood plains. They are frequently flooded and are subject to scouring and deposition of fresh alluvial sediments during each overflow.

The water table is within 3 to 6 feet of the surface most of the time, but these soils have a low available water capacity. Most of these soils are slightly to moderately saline. If a cover is not maintained, they are also moderately susceptible to soil blowing. These soils are best suited to range and wildlife habitat.

Capability Unit VIe-1 (Dryland)

This unit consists of moderately deep to shallow well-drained Weymouth and Vernon clay loams, 3 to 8 percent slopes. These soils have a moderate to low available water capacity and are subject to moderate to severe water erosion. Careful management of the native grasses is required to reduce runoff and control erosion.

The soils in this unit are best suited to native range. Very few acres are cultivated.

Capability Unit VIe-3 (Dryland)

This unit consists of deep, moderately rapidly permeable Hardeman fine sandy loam, 8 to 30 percent slopes, eroded. This soil has a moderate available water capacity. It is readily penetrated by plant roots, moisture, and air. Water erosion is a moderate to severe hazard.

This unit is too steep and eroded for cultivation. It is best suited to range and wildlife habitat. A good grass cover is needed to control erosion.

Capability Unit VIe-4 (Dryland)

This unit consists of deep, undulating to hummocky, moderately rapidly permeable soils of the uplands. These soils have a loamy fine sand surface layer. Some areas are severely eroded.

These soils are not suitable for cultivation, although some of the soils in this unit are cultivated. They have a moderate available water capacity, and the soil-blowing hazard is severe. Many areas that were formerly cultivated have been reseeded to grass or have been idle for several years. Both idle and cultivated areas need to be planted to grasses for control of soil blowing.

Capability Unit VIe-5 (Dryland)

This unit consists of deep, well-drained, moderately rapidly permeable Nobscot fine sand, undulating. This soil has a low available water capacity. Runoff is very slow.

Some areas of this soil were cultivated at one time, but most have been reseeded to grass or have been idle for several years. This soil is best suited to native range. Both idle and cultivated areas need to be seeded to adapted grasses for effective control of soil blowing.

Capability Unit VIs-1 (Dryland)

This unit consists of deep, gently sloping to steep, rapidly permeable Hilly gravelly land. This unit is too gravelly and steep for cultivation. It is in range.

Capability Unit VIIe-1 (Dryland)

This unit consists of deep, hummocky to duny, rapidly permeable Tivoli fine sand. This soil has a low available water capacity, has very slow runoff, and is subject to severe soil blowing. This soil is not suitable for cultivation, and most areas are in range. This soil is well suited to wildlife habitat.

Capability Unit VIIs-1 (Dryland)

This unit consists of shallow to very shallow, gently sloping to steep soils of the uplands. They are underlain by gypsum, limestone, sandstone, or clayey red beds. These soils have a low available water capacity and are subject to severe water erosion. They are not suitable for cultivation, and most are in range. Careful grazing management is needed to control erosion.

Capability Unit VIIIe-1 (Dryland)

This unit consists of gently sloping to moderately steep nearly barren Active dunes. This land type has a low available water capacity. It is subject to severe soil blowing, and the dunes are constantly shifting. Most of the dunes are bare of vegetation or have only a sparse cover. During wet seasons the dunes are partly stabilized by annual weeds and scattered clumps of grass. During the dry season the dunes again become active.

The areas of sparse vegetation that are scattered among the dunes should be protected from domestic livestock. This land type is suitable only for wildlife or recreational purposes.

Capability Unit VIIIs-1 (Dryland)

This unit consists of gently sloping to steep, nearly barren Badland that is dissected by many gullies and washes. Vegetative cover is very sparse, and most areas are bare.

This land type has practically no agricultural value. It is suitable only for wildlife habitat, recreation, or water impoundment areas. A few small areas of soil that have some value for grazing are included in the mapped areas.

Irrigated Capability Units

In the following pages the irrigated capability units of Hardeman County are described, and suggestions for the use and management of the soils are given. To find the capability classification of any given mapping unit, refer to the "Guide to Mapping Units."

Capability Unit I-1 (Irrigated)

This unit consists of deep, well-drained to moderately well drained, nearly level, very slowly to slowly and moderately slowly permeable soils. They have a clay loam or loam surface layer and lower layers that tend to impede water, air, and root movement.

The soils of this unit have a high available water capacity. Runoff is slow to very slow, and erosion is only a slight hazard.

These soils are suitable for irrigation where water of good quality is available. If poor quality water is used, leaching of excess salts from the root zone of these soils is difficult. Cotton is the principal crop, but small acreages are used for alfalfa, wheat, and sorghums.

These soils have few limitations. Maintaining or improving soil fertility and tilth and correct water usage are the main concerns of good management.

Crops that produce large amounts of residue, such as wheat and sorghum, are well suited to this unit. Keeping crop residue on the surface as much of the time as possible helps to control erosion, improve fertility, and increase water intake. Deep-rooted legumes, such as alfalfa and sweetclover, increase the water intake rate and help maintain or improve fertility. The application of fertilizer increases

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productivity. Diversions and grassed waterways may be needed in some places to control water erosion.

A well-designed surface or sprinkler irrigation system is needed in order to apply the correct amount of irrigation water to meet soil and crop needs without waste or erosion. Land leveling may be needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch or Caucasian bluestem, western wheatgrass, switchgrass, and indiangrass, are well suited to these soils.

Capability Unit I-2 (Irrigated)

This unit consists of deep, nearly level, moderately permeable soils that have a clay loam surface layer. These soils are well drained, easily tilled, and readily penetrated by plant roots, moisture, and air. Their available water capacity is high. Runoff is slow, and the hazard of erosion is slight.

Cotton and alfalfa are the principal crops; however, most crops grown in the county grow well on these soils. The soils in this unit have few limitations. Maintaining or improving soil productivity and tilth and correct water usage are the main concerns of management.

Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited to this unit. Leaving crop residue on the surface helps to control erosion, improve fertility, and increase water intake. Crops such as alfalfa, winter peas, and sweetclover help maintain or improve the fertility and structure of the soil. Fertilizer also improves productivity. Diversions and grassed waterways may be needed in some places to control excess runoff water and prevent washing.

Both surface and sprinkler irrigation systems are suitable for this unit. A well-designed system of either type will apply the irrigation water to meet soil and crop needs without waste or erosion. Land leveling may be needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch or Caucasian bluestem, indiangrass, western wheatgrass, and switchgrass, are well suited to these soils.

Capability Unit I-4 (Irrigated)

This unit consists of deep, nearly level, well-drained, moderately and moderately rapidly permeable soils that have a loam, silt loam, or very fine sandy loam surface layer. The soils in this unit are easily tilled and readily penetrated by plant roots, moisture, and air. Available water capacity is high to moderate. The hazard of erosion is slight.

Most crops suited to the county grow well on these soils. Cotton and alfalfa are the main crops. The soils in this unit have few limitations. Correct water usage and maintaining or improving soil productivity and tilth, or soil structure, are the main concerns of good management.

Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited to this unit. Leaving crop residue on or near the surface helps to control erosion, improve fertility, and increase water intake. Alfalfa and winter peas help maintain or improve fertility, soil structure, and water intake rate. The application of fertilizer, according to a soil test, is another method of maintaining soil fertility. Diversions and grassed waterways are needed in some places to control excess runoff water and prevent erosion.

Both surface and sprinkler irrigation systems are suitable. The system used should be designed to apply the irrigation water without waste or erosion. Land leveling may be needed for uniform application if a surface system is used. Pasture grasses, such as bermudagrass, western wheatgrass, King Ranch or Caucasian bluestem, indiangrass, and switchgrass, are well suited to this unit.

Capability Unit IIe-1 (Irrigated)

This unit consists of deep, gently sloping, slowly and moderately slowly permeable soils that have a clay loam or loam surface layer. These are well-drained soils of the uplands that have a high available water capacity. Water erosion is a moderate hazard. These soils have lower layers that impede the movement of water, air, and roots. If poor quality irrigation water is used, the lower layers make it difficult to leach salt accumulations from the plant root zone.

Cotton is the principal crop. Small acreages are used for alfalfa, wheat, and sorghums. Erosion control, correct water usage, and maintenance or improvement of soil fertility and tilth are the main concerns of management. Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited to these soils.

Leaving crop residue on the surface reduces runoff and increases moisture penetration. Crops of alfalfa, winter peas, sweetclover, or grasses help maintain or improve the fertility and structure of these soils. The application of fertilizer, according to a soil test, is another method of improving fertility. Terracing, contour farming, and establishing grassed waterways to control erosion are well suited to this unit.

Surface and sprinkler irrigation systems are suitable. The system should be designed to apply the necessary irrigation water without waste or erosion. Land leveling generally is needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch bluestem, switchgrass, and western wheatgrass, are well suited to these soils.

Capability Unit IIe-2 (Irrigated)

This unit consists of deep, well-drained, gently sloping soils of the uplands. These moderately and

moderately slowly permeable soils have a loam or clay loam surface layer. The available water capacity is high, and water erosion is a moderate hazard.

The soils in this unit are suited to most crops commonly grown in the county. Cotton is the main crop. Erosion control, water management, and maintenance or improvement of soil fertility and structure are the main concerns of management.

Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited. Leaving the residue on the surface reduces runoff and increases water intake. Crops of alfalfa, winter peas, sweetclover, or grasses help maintain or improve the fertility and structure of the soils. The application of fertilizer, according to a soil test, is another method of improving soil fertility. Terracing, contour farming, and establishing grassed waterways to control erosion are practices well suited to the soils in this unit.

Surface and sprinkler irrigation systems are suitable. A well-designed system will apply the irrigation water uniformly without waste or erosion. Land leveling generally is needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch bluestem, switchgrass, and western wheatgrass, are well suited to these soils.

Capability Unit IIe-4 (Irrigated)

This unit consists of deep, well-drained, nearly level soils of the upland that have a fine sandy loam surface layer. These soils are easily penetrated by plant roots, moisture, and air; however, compacted layers form if the soils are plowed to the same depth every year. The available water capacity is high, and erosion is only a slight hazard.

Most crops suited to the county grow well on these soils. Cotton and alfalfa are the principal crops. Erosion control, correct water usage, and maintenance or improvement of soil fertility and structure are the main concerns of good management. Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited to this unit. Leaving the residue on the surface helps reduce soil blowing and increases water intake. Cover cropping, contour farming, and the use of diversion terraces help control erosion.

Crops of alfalfa, winter peas, or grasses help maintain or improve the structure and fertility of the soil. The application of fertilizer, according to a soil test, is another method of improving soil fertility. A well-designed surface or sprinkler irrigation system is needed to apply irrigation water to meet soil and crop needs without waste or erosion. Land leveling may be needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch or Caucasian bluestem, switchgrass, and indiangrass, are well suited to the soils in this unit.

Capability Unit IIe-5 (Irrigated)

This unit consists of deep, well-drained, moderately permeable Miles fine sandy loam, 1 to 3 percent slopes. This soil is easily penetrated by plant roots, moisture, and air. Compacted layers form, however, if the soil is plowed to the same depth every year. The available water capacity of this soil is high. Soil blowing and water erosion are slight hazards.

Cotton and alfalfa are the principal crops, but most crops suited to the county grow well on this soil. Erosion control, correct use of irrigation water, and maintenance or improvement of soil fertility and structure are the main concerns of management. Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited to this soil. Leaving crop residue on the surface reduces soil blowing and increases water intake. Cover cropping, terracing, and contour farming also help control erosion. Crops of alfalfa, winter peas, or grasses help maintain or improve the structure and fertility of the soil. The application of fertilizer, according to a soil test, is another method of improving fertility.

A well-designed surface or sprinkler irrigation system is needed to apply irrigation water to meet soil and crop needs without waste or erosion. Land leveling generally is needed if a surface system is used. Pasture grasses, such as bermudagrass, King Ranch bluestem, Caucasian bluestem, switchgrass, and indiangrass, are well suited to this soil.

Capability Unit IIe-6 (Irrigated)

This unit consists of deep well-drained Hardeman fine sandy loam, 0 to 1 percent slopes. This soil is easily tilled and readily penetrated by plant roots, moisture, and air. It has a moderate available water capacity. Runoff is slow, and soil blowing is a slight hazard.

Cotton and alfalfa are the main crops, but most crops suited to the county grow well on this soil. Control of soil blowing, efficient use of water, and maintenance or improvement of soil fertility and structure are the main concerns of management. Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited. Leaving residue on the surface reduces soil blowing and increases water intake. Cover cropping, contour farming, and the use of diversion terraces are beneficial in controlling erosion on this soil. Emergency tillage may be needed to help control soil blowing if the soil is left bare for extended periods.

Crops of alfalfa, winter peas, or grasses help maintain or improve the structure and fertility of the soil. The application of fertilizer, according to a soil test, is another method of improving fertility. A well-designed sprinkler irrigation system is needed to apply water for soil and crop needs

without waste or erosion. Pasture grasses suited to this soil include bermudagrass, King Ranch and Caucasian bluestem, switchgrass, and indiangrass.

Capability Unit IIe-8 (Irrigated)

This unit consists of deep, well-drained, moderately rapidly permeable Hardeman fine sandy loam, 1 to 3 percent slopes. This soil is easily tilled and readily penetrated by plant roots, moisture, and air. It has a moderate available water capacity. The soil-blowing hazard is slight, and the water-erosion hazard is moderate. Deep gullies form easily if runoff water concentrates on unprotected areas.

Cotton and alfalfa are the principal crops, but most crops suited to the county grow well. Erosion control, efficient use of water, and maintenance or improvement of soil fertility and tilth are the main concerns of management.

Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are needed. Leaving residue on the surface reduces soil blowing and water erosion. Cover cropping, use of diversion terraces, and contour farming are beneficial in controlling erosion. Emergency tillage may be needed to help control soil blowing where row crops, such as cotton and guar, are grown.

Crops of alfalfa, winter peas, guar, or grasses help maintain or improve the fertility and structure of the soil. The application of fertilizer, according to a soil test, is another method of improving fertility. A well-designed sprinkler irrigation system is needed to apply irrigation water for soil and crop needs without waste or erosion. Pasture grasses suited to this soil include bermudagrass, King Ranch and Caucasian bluestem, switchgrass, and indiangrass.

Capability Unit IIs-1 (Irrigated)

This unit consists of deep, well-drained, very slowly permeable Tillman clay loam, 0 to 1 percent slopes. This soil has a high available water capacity. Runoff is slow, and the hazard of erosion is slight. The clay lower layers impede the movement of water, air, and plant roots. If poor quality irrigation water is used, the clay makes leaching of salt accumulations from the root zone difficult.

Cotton is the main crop grown on this soil. The maintenance or improvement of soil fertility and structure, efficient use of water, and the adaptation of cropping systems to soil limitations are the main concerns of management. Cropping systems that include wheat, sorghums, or other crops that produce a large amount of residue are well suited. Leaving residue on the surface increases water intake, reduces soil losses by erosion, and improves soil structure. Diversions and grassed waterways may be needed in some places to control water erosion. Deep-rooted legumes, such as alfalfa and sweetclover, increase the water intake rate and help maintain or improve fertility. The application of fertilizer, according to a soil test, also improves fertility.

A well-designed surface irrigation system is needed to apply the irrigation water for soil and crop needs without waste or erosion. Land leveling may also be needed for even distribution of water. Pasture grasses, such as bermudagrass, King Ranch and Caucasian bluestem, western wheatgrass, switchgrass, and smooth brome, are well suited to this soil.

Capability Unit IIIe-1 (Irrigated)

This unit consists of deep, well-drained, very slowly permeable Tillman clay loam, 1 to 3 percent slopes. This soil has a high available water capacity. The water-erosion hazard is moderate. Clay lower layers impede the movement of water, air, and plant roots. If poor quality irrigation water is used, this clay makes the leaching of salt accumulations from the root zone difficult.

Cotton is the main crop grown. Erosion control, efficient use of water, maintenance or improvement of soil productivity and tilth, and the adaptation of cropping systems to soil limitations are the main concerns of good management. Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to this soil. Leaving residue on the surface reduces runoff and soil loss through erosion. Cover cropping, contour farming, and use of diversion terraces also help control erosion. Grassed waterways may be needed in some places.

Deep-rooted legumes, such as alfalfa and sweetclover, or grasses increase water intake and improve the structure and fertility of the soil. The application of fertilizer, according to a soil test, is another method of maintaining productivity.

A well-designed surface irrigation system will apply irrigation water to meet soil and crop needs without waste or erosion. Land leveling may be needed for even distribution of water. Pasture grasses, such as bermudagrass, King Ranch bluestem, Caucasian bluestem, western wheatgrass, and smooth brome, are well suited to this soil.

Capability Unit IIIe-6 (Irrigated)

This unit consists of deep well-drained Miles loamy fine sand, 0 to 3 percent slopes. This soil has a moderate susceptibility to soil blowing and a slight susceptibility to water erosion. It has a high available water capacity.

Cotton and alfalfa are the principal crops. Erosion control, efficient use of water, and maintenance or improvement of soil fertility and organic-matter content are the main concerns of good management. Cropping systems that include small grains or other crops that produce a large amount of residue are well suited to this soil. Keeping the residue on the surface until time to seed the next crop reduces soil blowing and water erosion. Deep plowing helps reduce soil blowing if one-fourth to one-third of the plow slice is into the moderately fine

textured lower layer. As an additional protection against soil blowing, tree windbreaks can be grown on this soil.

Alfalfa or grasses improve the soil and are well suited. The application of fertilizer, according to a soil test, also helps maintain or improve fertility. A well-designed sprinkler irrigation system will apply irrigation water to meet soil and crop needs without waste or erosion. Surface irrigation systems are not suitable for this soil. Pasture grasses suited to this soil include bermudagrass, switchgrass, and indiangrass.

Capability Unit IIIe-7 (Irrigated)

This unit consists of gently sloping moderately permeable soils that have a clay loam surface layer. These soils have a moderate to high available water capacity. The water-erosion hazard is slight to moderate.

Cotton is the main crop. Small acreages are used for alfalfa and wheat. Controlling erosion, efficient use of water, maintaining or improving soil fertility and tilth, and adapting cropping systems to soil limitations are the main concerns of management.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to these soils. Leaving crop residue on or near the surface helps to reduce runoff and soil erosion. Terracing and contour farming also reduce loss of water by runoff and help control erosion. Grassed waterways to carry runoff water from terraces are needed where terraces do not have outlets onto areas of native grass. Crops of alfalfa, winter peas, or grasses help maintain or improve the fertility and tilth of these soils. The application of fertilizer, according to a soil test, is also needed to improve fertility.

A well-designed surface or sprinkler irrigation system is needed to apply water for soil and crop requirements without waste or erosion. Land leveling generally is needed if a surface system is used. Pasture grasses well suited to these soils include bermudagrass, indiangrass, switchgrass, and King Ranch or Caucasian bluestem.

Capability Unit IVe-3 (Irrigated)

This unit consists of deep, well-drained Sprinkler loamy fine sand, undulating. This soil has a moderate available water capacity. Runoff is slow, and the hazard of soil blowing is moderate to high.

Cotton and alfalfa are the main crops. This soil is not suitable for row crops unless they are followed by cover crops or mulching to control soil blowing. Controlling soil blowing, maintaining or improving soil fertility and organic-matter content, and efficient use of water are the main concerns of management.

Cropping systems that include small grains or other crops that produce a large amount of residue are needed. The residue gives good erosion control when kept on the surface until time to seed the next crop. Emergency tillage may be needed on fields without adequate vegetative cover.

Crops of alfalfa or grasses help improve soil fertility. The application of fertilizer, according to a soil test, is needed for economical crop production and to increase the quantity of plant growth for protective cover against soil blowing. As an additional protection against soil blowing, tree windbreaks can be grown. They grow well on this soil.

A well-designed sprinkler irrigation system is needed for timely application of water to meet soil and crop needs without waste. Surface irrigation systems are not suitable for this soil. Pasture grasses, such as bermudagrass, indiangrass, and switchgrass, are well suited to this soil.

Capability Unit IVe-5 (Irrigated)

This unit consists of shallow slowly permeable Vernon clay loam, 1 to 3 percent slopes. This soil has a low available water capacity. Runoff is rapid, and water erosion is a moderate hazard.

Cotton is the main crop. Small acreages are used for wheat. Erosion control, efficient use of water, maintaining or improving soil fertility and structure, and adapting cropping systems to the soil limitations are the main concerns of management.

Cropping systems that include small grains, grasses, or other close-spaced crops that produce a large amount of residue are needed on this soil. Leaving residue on the surface increases water intake and reduces runoff and water erosion.

Terracing and contour farming help control water erosion. Grassed waterways are needed to carry runoff water from terraces that do not have outlets onto areas of native grass.

Crops of alfalfa or close-spaced grasses are needed to help control water erosion and maintain or improve soil structure and fertility. The application of fertilizer, according to a soil test, is needed for economical production and for increasing the quantity of plant growth for soil protection.

A well-designed sprinkler irrigation system is needed for timely application of irrigation water to meet soil and crop needs without waste or erosion. Pasture grasses suited to this soil included bermudagrass, King Ranch and Caucasian bluestem, switchgrass, and indiangrass.

Predicted Yields

Predicted average acre yields of dryfarmed wheat, grain sorghum, and cotton grown under a high level of management are shown in table 2. These yields are based on information from research, interviews with personnel of the Texas Agricultural Experiment Station, and interviews with farmers and others who have knowledge of yields. Soils that are not suitable for cultivation are not included in the table.

Crops other than those listed in the table are grown in Hardeman County, but they are grown in small acreages and reliable estimates of yields can not be made.

Yield predictions for irrigated crops are not given because irrigation is relatively recent in this county and is of limited extent; reliable yield data are not available. Generally, crop yields are at least doubled on soils that are irrigated with sufficient water of good quality. In dry years, the yields may be three or four times greater on irrigated soils than on dryfarmed soils.

A high level of management for dryland soils in this county consists of:

1. Planting improved and adapted crop varieties.
2. Using proper seeding rates, optimum planting dates, and efficient harvesting methods.
3. Controlling weeds, insects, and diseases sufficiently to insure normal plant growth.
4. Applying fertilizer as indicated by a soil test.
5. Growing only cover crops on the most sandy soils.
6. Using terraces and contour farming where appropriate.
7. Using crop residue to prevent erosion, increase water infiltration, and enhance seedling emergence.

Irrigation

Irrigation is relatively recent in Hardeman County. There were only a few irrigation wells in the county before 1954. Since then about 280 wells have been drilled, and approximately 15,000 acres are irrigated at least part of the time.

Many of the soils are suitable for irrigation, but irrigation water is not available everywhere. Irrigated areas are scattered over the county. Well depths range from 75 to 150 feet, and production ranges from about 200 to 800 gallons per minute. The majority of wells produce about 400 gallons per minute.

The quality of the irrigation water ranges from good to poor. Water analysis for 29 wells showed a range of from 832 to 3,648 parts per million total salts. In other terms, this is a range of about 1 to 5 tons of salts per acre-foot of water. A complete water analysis is needed to determine the suitability of water for irrigation use. The suitability depends on the kinds and amount of salt in the water, the kind of soil to be irrigated, and the salt tolerance of the crops to be grown.

Two kinds of irrigation systems are used in the county, sprinkler (pl. IV, top) and surface. Surface systems can be either row or border. Border and row irrigation systems are best suited to nearly level, moderately fine textured and medium-textured soils. Underground pipes help to conserve irrigation water and to distribute it evenly. Their use is increasing in the county.

Sprinkler irrigation systems are best suited to sandy soils. These systems are generally used on gently sloping and sloping soils because less land forming is required with sprinkler irrigation.

The same crops can be grown under both irrigation and dryland farming. More intensive use of high-residue crops, legumes, fertilizers, and residue is made possible through the use of irrigation. Technicians of the Soil Conservation Service can assist in designing suitable irrigation systems and planning cropping systems.

TABLE 2.--PREDICTED AVERAGE ACRE YIELDS OF PRINCIPAL CROPS

[Absence of yield indicates that the crop is not suited to, or is not commonly grown on, the soil]

Soil	Wheat	Grain sorghum	Cotton (lint)
	Bu.	Bu.	Lbs.
Abilene clay loam, 0 to 1 percent slopes	22	35	300
Abilene clay loam, 1 to 3 percent slopes	20	30	275
Abilene clay loam, saline, 0 to 1 percent slopes	15	----	155
Acme-Cottonwood complex	12	18	140
Acuff loam, 0 to 1 percent slopes	21	25	250
Acuff loam, 1 to 3 percent slopes	17	20	200
Altus fine sandy loam, 0 to 1 percent slopes	21	28	250
Altus fine sandy loam, saline, 0 to 1 percent slopes	17	----	165
Cobb fine sandy loam, 1 to 3 percent slopes	16	24	220
Colorado clay loam	25	34	340
Colorado silt loam	25	35	350
Cosh fine sandy loam, 1 to 3 percent slopes	12	17	---
Cosh-Latom complex	9	13	---
Hardeman fine sandy loam, 0 to 1 percent slopes	20	28	280
Hardeman fine sandy loam, 1 to 3 percent slopes	18	25	240
Hardeman fine sandy loam, 3 to 5 percent slopes	15	----	---
Hollister clay loam, 0 to 1 percent slopes	22	28	275
Hollister clay loam, 1 to 3 percent slopes	20	25	250
Lincoln fine sandy loam	15	----	---
Lipan clay	16	----	---
Mangum clay loam	22	----	---
Mansker clay loam, 1 to 3 percent slopes	12	17	140
Miles fine sandy loam, 0 to 1 percent slopes	21	28	250
Miles fine sandy loam, 1 to 3 percent slopes	19	25	225
Miles fine sandy loam, 3 to 5 percent slopes	15	21	200
Miles fine sandy loam, 3 to 5 percent slopes, eroded	12	18	---
Miles loamy fine sand, 0 to 3 percent slopes	18	26	240
Miles loamy fine sand, 3 to 5 percent slopes	14	----	---
Olton clay loam, 0 to 1 percent slopes	22	30	300
Olton clay loam, 1 to 3 percent slopes	20	25	250
Olton loam, 0 to 1 percent slopes	22	30	300
Olton loam, 1 to 3 percent slopes	20	25	250
Portales clay loam, 0 to 1 percent slopes	22	28	245
Quanah clay loam, 1 to 3 percent slopes	16	20	175
Springer loamy fine sand, undulating	16	18	220
Spur clay loam	26	35	350
Tillman clay loam, 0 to 1 percent slopes	16	20	175
Tillman clay loam, 1 to 3 percent slopes	14	18	160
Tipton loam	26	36	365
Vernon clay loam, 1 to 3 percent slopes	10	15	---
Weymouth clay loam, 1 to 3 percent slopes	12	19	150
Yahola very fine sandy loam	27	37	360

USE OF THE SOILS FOR RANGE[2/]

Native grassland and cropland used for grazing are discussed in this subsection, and range sites and condition classes are explained. Each range site in the county is briefly described, and the annual yield of herbage for the site is given. Potential or climax vegetation, the stabilized plant community which continues to reproduce itself as long as the environment does not change, is described for each site, and plant species are named.

Native rangeland covers approximately 171,347 acres in Hardeman County, or about 38 percent of the total agricultural land. At the time of the survey there were 48 ranch units in operation. Most of these are cow-calf enterprises. Many ranchers supplement their operations with winter stockers or carryover calves. Most ranches include some cropland. This cropland is used to grow supplemental forage that is either grazed or stored as silage or hay. Where water is available, irrigated pastures supply the supplemental forage. The chief crops grown for supplemental forage are small grains, sorghums, and johnsongrass.

Grassland varies throughout the county from rough brokenland to sandyland. Native grass cover ranges from short grasses on hardland to mid grasses on mixedland and sandy loam and taller grasses on sandyland.

The native rangeland has been heavily grazed for several generations. As a result, the hardland is covered mostly by buffalograss and bluegrama. The mixedland now produces buffalograss, blue grama, and three-awns. Mesquite is rapidly invading both of these sites. Bluestem still grows on the sands, but the vegetation is dominantly dropseed, three-awn, sand sagebrush, and shin oak. Inaccessibility has protected some of the rough breaks. Vegetation in these areas is similar to that grown before the introduction of livestock.

Range Sites and Condition Classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. The soils that will produce about the same kind and amount of forage, if the ranges are in similar condition, make up a range site.

Range sites differ significantly from each other in their ability to produce vegetation. This difference requires separate grazing use, or management, in order to maintain or improve the present vegetation. If cultivated crops are not grown, the most productive group of forage plants on a range site is generally the original combination of plants or climax vegetation. On many areas the present potential of the range is considerably less than the original potential. Erosion and continuous overgrazing are the main causes of this loss in productivity.

The plants on any given range site are grouped, according to their response to grazing, as decreasers, increasers, and invaders. Decreasers are plants in the potential plant community that tend to die out if heavily grazed. They are generally the most productive and palatable perennial grasses. Increasers are plants in the potential community that become more abundant as the decreasers decline, and then start to die out if heavy grazing continues. They are normally smaller, less productive, and less palatable to livestock than decreasers. Invaders are plants that were kept out of the original stand by the competition for moisture, nutrients, and light in the potential plant community. They invade the stand and grow along with the increasers after the climax vegetation has been reduced by grazing. Generally invaders have little grazing value and consist of poor quality grasses, annual weeds, and shrubs.

Four range condition classes are used to indicate the degree of departure from the native or climax vegetation brought about by grazing or other use. The classes show the present condition of the native vegetation on a range site in relation to the potential 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 original stand. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is less than 25.

Potential forage production depends on the range site. Current forage production depends upon the range condition and moisture that the plants get during their growing season.

Good range management requires knowledge of the soils and determination of the range condition. On range that is kept in good or excellent condition, the vegetation provides optimum forage yields, helps conserve water, and protects the soil from erosion.

Descriptions of the Range Sites

There are 13 range sites in Hardeman County. In the range site descriptions, the soils, composition of the potential plant community, and principal invaders are discussed. The annual herbage yield shown is the range of production from dry years to wet years. The soils in each range site can be determined by referring to the "Guide to Mapping Units" at the back of this survey. Range sites are given for each member of a soil complex. Active dunes, Badland, and Rock outcrop are of little or no value as range and have not been placed in range sites.

Valley Range Site

Soils of this range site are nearly level to slightly concave. They generally occur on second

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2/ By JOE B. NORRIS, range conservationist, Soil Conservation Service.

bottoms or in a wide part of a drainageway of the kind that narrows only to widen further down its course. Soils of this site occur in association with soils of the Deep Hardland and Shallow Redland sites, and are also adjacent to the Bottomland site.

The soils are clay loams that crust if they are not protected by vegetation. Some may be frequently flooded and remain under water for a few hours to several days. Small potholes, or depressed areas, occur throughout some areas. Permeability ranges from moderate to very slow.

The potential plant community includes side-oats grama, vine-mesquite, western wheatgrass, blue grama, and Canada wildrye. These species make up about 70 percent of the total forage. Other plant species on this site are buffalograss, texas wintergrass, silver bluestem, tobosa, meadow dropseed, Texas bluegrass, white tridens, hackberry, and elm. Where the site deteriorates following continuous heavy grazing, side-oats grama, vine-mesquite, and western wheatgrass are grazed out and buffalograss and Texas wintergrass increase. If overgrazing continues, invaders dominate. Typical invaders are mesquite, condalia, pricklypear, hairy tridens, sand dropseed, and numerous annual weeds.

The vegetation of the Valley Range site resembles that of the Deep Hardland site. The valley site receives more moisture, however, and this encourages greater and more stable yields. Even where the range is most deteriorated, remnants of the more desirable grasses remain under protection of brush and serve as a source of seed when range improvement is practiced to help restore the site to its potential plant community.

Where the site is in excellent condition, the potential yield of herbage, in pounds per acre air-dry weight, ranges from 1,600 in dry years to 2,400 in wet years.

Bottomland Range Site

Soils of this range site are on lowlands along major rivers, creeks, intermittent streams, and small draws. These soils are subject to overflow and also receive runoff from higher lying soils. Although some of the soils are flooded frequently, they are under water for only short periods. Any damage to vegetation is ordinarily from sedimentation rather than from wetness.

The soils are deep and fertile. Permeability ranges from moderate to moderately rapid. This is one of the better range sites because it receives additional moisture from runoff and overflow.

Composition of the climax vegetation varies from place to place depending on the origin of the alluvial deposits. About 70 percent is big bluestem, sand bluestem, little bluestem, indiangrass, switchgrass, Canada wildrye, and side-oats grama. About 30 percent is western wheatgrass, vine-mesquite, silver bluestem, blue grama, and buffalograss. A few woody plants, chiefly elm, hackberry, and cottonwood, occur in the climax vegetation on some of the bottom lands.

If the climax vegetation is not maintained, the site is invaded by noxious plants that develop from seed washed in from outlying areas. These invaders, ordinarily annuals common in cultivated fields, are sunflower, cocklebur, buffalo-bur, hairy caltrop, common broomweed, crotons, thistles, and sandbur. Other common invaders are mesquite, sand dropseed, three-awns, Texas grama, hairy tridens, inland saltgrass in saline areas, and perennial forbs.

This site is capable of producing a large amount of herbage if it is not overwashed by clayey sediments. When this site is in excellent condition, the potential annual herbage yield, in pounds per acre air-dry weight, ranges from 2,200 in dry years to 3,950 in wet years.

Sandy Bottomland Range Site

The soils of this range site are nearly level to gently undulating and are on flood plains. They are rapidly permeable, are medium to coarse textured, and have an effective root zone more than 20 inches deep. Some areas are subject to frequent flooding and deposition of sediment. If unprotected by plant cover, the soils are subject to scouring and soil blowing.

The vegetation is mid and tall grasses. Indiangrass, switchgrass, and sand bluestem dominated the site in its original condition. Other climax species are side-oats grama, little bluestem, Canada wildrye, Texas bluegrass, and sandreed. About 70 percent of the original vegetation was made up of these species. A few woody plants, such as sand plum, cottonwood and willow trees, sand sagebrush, and skunkbush, occurred in the climax vegetation.

Any deterioration of the vegetation caused by overgrazing results in a rapid encroachment of such increasers as vine-mesquite, alkali sacaton, three-awns, sand dropseed, and blue grama. Deferred grazing (pl. IV, bottom) can be used to good advantage to re-establish stands of bluestem.

Further degeneration in the vegetation results in an invasion of gummy lovegrass, annual three-awns, tumble lovegrass, low-growing paspalums, inland saltgrass, and numerous annuals. Other woody invaders are yucca, saltcedar, and groundsels. Once the climax vegetation is grazed out, this highly productive site declines immediately.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 2,200 in dry years to 3,850 in wet years.

Clay Flats Range Site

Treadway clay, overflow, is the only mapping unit in this range site. This soil is mainly in the flood plains of creeks. It consists of clayey alluvium washed from surrounding higher lying soils.

The site is characterized by small, scrubby, sparse stands of mesquite and heavy stands of tobosa.

Large center-stemmed mesquite grow on some overflow areas. In places tobosa makes up as much as 40 percent of the potential plant community. It increases to as much as 90 percent following prolonged heavy grazing. The unpalatability of tobosa causes livestock to make continuous heavy use of the remaining species.

The climax grasses on this site are blue grama, side-oats grama, western wheatgrass, white tridens, vine-mesquite, tobosa, and buffalograss. Alkali sacaton grows in saline areas. Plants that invade the site after the range deteriorates are mesquite, pricklypear, cholla cactus, lotebush, and annuals. Inland saltgrass invades the saline areas.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 900 in dry years to 2,650 in wet years.

Deep Hardland Range Site

Soils of this range site are nearly level to gently sloping and occur on upland plains. Soils of this site are readily accessible to livestock and are favored for grazing.

These soils are loam and clay loam to clay in texture and more than 20 inches deep. They are moderately to very slowly permeable to water and roots and have a high available water capacity. In many places the intake of water is reduced by surface crusting and compaction caused by livestock trampling. If these soils are not protected by vegetation, water erosion is a concern.

The potential plant community on this site consists of mid and short grasses. Blue grama made up about 70 percent of the original vegetation. Other species that grow in limited amounts are western wheatgrass, vine-mesquite, white tridens, side-oats grama, buffalograss, silver bluestem, and meadow dropseed.

Continuous overgrazing causes an immediate decrease in side-oats grama followed by a decrease in blue grama. Buffalograss and tobosa then increase. Further deterioration of the range results in invasion by perennial three-awn, hairy tridens, sand dropseed, Texas grama, tumblegrass, pricklypear, mesquite (pl. V, top), and numerous annuals. In poorer condition and during years in which there is a wet spring, invading annuals occupy bare areas. The most common of these annuals are Texas filaree, evax, various plantains, bladderpod, plains greenthread, bitterweed, common broomweed, and little barley. The common invading perennial forbs on this site are western ragweed, silverleaf nightshade, and Dakota verbena.

This site is capable of only moderate forage production. A large amount of litter and cover is needed to reduce surface crusting and to prevent erosion. Once the range is in poor condition, recovery is very slow because seeds of desirable species are absent, the soils are crusted, and the site is heavily infested by mesquite, lotebush, and pricklypear. This site is commonly reseeded to establish more productive vegetation. Such practices as cross fencing and dispersing livestock watering facilities (pl. V, bottom) to rotate grazing and rest pasture have been successful in restoring the original vegetation.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,650 in dry years to 2,750 in wet years.

Mixedland Range Site

Soils of this range site are nearly level to gently sloping and occur on uplands. They are deep loamy soils. Permeability is moderate, and the available water capacity is moderate to high.

About 70 percent of the vegetation on this site consists of side-oats grama, blue grama, little bluestem, Arizona cottontop, and plains bristlegrass. Canada wildrye, switchgrass, and western wheatgrass grow along the larger drains. Little bluestem grows only in isolated areas that have more moisture. Approximately 30 percent of the potential plant community consists of buffalograss, hairy grama, sand dropseed, and silver bluestem. Meadow dropseed grows along drains.

Any deterioration in the site condition results in an immediate decrease in side-oats grama, followed by an increase in blue grama and buffalograss. If continuously overgrazed, the range vegetation soon consists almost entirely of buffalograss and numerous invading forbs. Blue grama grows only in protected areas. The chief invading grasses are red grama, Texas grama, six-weeks grama, tumble windmillgrass, hooded windmillgrass, gummy lovegrass, little barley, tumblegrass, and hairy tridens. Woody invaders are mesquite, catclaw acacia, pricklypear, lotebush, tasajillo, redberry juniper, and yucca.

This site is capable of moderate forage production if it is in good or excellent condition. If the amount of plant cover and litter is not adequate, the site deteriorates rapidly because of soil blowing and water erosion. Recovery is slow due to the shortage of desirable plant seeds and crusting of the soil. Brush control and seeding grass hasten recovery on this site.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,750 in dry years to 2,950 in wet years.

Sandy Loam Range Site

Soils of this range site are nearly level to steep and occur on upland plains. These are highly productive soils capable of supporting a wide variety of vegetation. They are fine sandy loams that utilize rainfall effectively. If unprotected by plant cover, they compact easily and surface crusts form.

This midgrass site produces side-oats grama, little bluestem, Arizona cottontop, and plains bristlegrass. Small amounts of vine-mesquite, sand lovegrass, and Texas wintergrass normally grow in areas that have more favorable moisture. These species make up about 70 percent of the potential plant community.

About 25 percent of the vegetation is buffalograss, blue grama, sand dropseed, perennial three-awn, hairy grama, and silver bluestem. Woody species, that comprise no more than 5 percent of the original vegetation, are sand sagebrush, shin oak, agarito, skunkbush, and mimosa. Invaders are mesquite, pricklypear, and annual weeds. Mesquite is a serious problem on heavily grazed ranges.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,950 in dry years to 3,300 in wet years.

Sandyland Range Site

Soils of this range site are smooth and nearly level to undulating or hummocky. The soils are deep, coarse textured, and moderately to moderately rapidly permeable. They have a moderate to high available water capacity. If not protected, they are highly susceptible to soil blowing. Properly managed, this site will produce a good stand of tall and mid grasses.

About 75 percent of the climax plant community is sand bluestem, switchgrass, indiangrass, little bluestem, Canada wildrye, sand lovegrass, side-oats grama, and Texas bluegrass. About 25 percent is silver bluestem, sand dropseed, hairy grama, blue grama, and perennial three-awn. A few woody plants, such as sand plum and sand sagebrush, grow in some areas.

Any deterioration in this site results in a rapid increase of small soapweed, shin oak, skunkbush, and annual weeds. Invading grasses include annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, tumble lovegrass, and low-growing paspalums. The chief invading forbs are common ragweed, wax goldenweed, tumble ringwing, annual wildbuckwheat, rosering gaillardia, prairie sunflower, woollywhite, beebalm, pricklepoppy, curlycup gumweed, Riddell groundsel, and stillingia.

This site is capable of high forage production if it is maintained in good or excellent condition. Since there are few grasses of intermediate grazing value, production drops rapidly once the original vegetation is overgrazed. Recovery is rapid, however, if brush is controlled and grazing deferred, because there is usually a source of seed, and live root buds are present.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,850 in dry years to 3,500 in wet years.

Deep Sand Range Site

Soils of this range site are undulating to hummocky or duny and occur on uplands. The soils adjacent to the Red River are extremely hummocky. Generally soils of this site are intermingled with the soils of the Sandyland site.

These soils are deep, rapidly to moderately rapidly permeable fine sand. If unprotected by vegetation, they are highly susceptible to soil blowing. The site deteriorates rapidly under continued heavy grazing but responds favorably to good management. Big sandreed grows well, but side-oats grama is less adapted and has poor to fair vigor on this site. Blowouts, areas where the topsoil has been blown away, occur throughout the site, especially in formerly cultivated fields.

About 75 percent of the vegetation is tall grass, such as sand bluestem, indiangrass, little bluestem, switchgrass, sand lovegrass, and giant dropseed. The important mid grasses that make up the rest are side-oats grama, silver bluestem, hairy grama, Texas wintergrass, sand dropseed, and perennial three-awn. Woody plants on this site are sand plum, sand sagebrush, bumelia, and skunkbush. Invader vegetation is similar to that on the Sandyland site.

When this site is in excellent condition (pl. VI), the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,850 in dry years to 3,750 in wet years.

Gravelly Range Site

The only mapping unit in this site is gently sloping to steep Hilly gravelly land. Gravel is interspersed throughout the soil profile and favorably affects moisture content and aeration. A wide variety of plants makes up the potential plant community. Ranchers consider this site to be good for winter grazing because it produces large amounts of black grama. The stems of black grama remain green throughout the winter, even though this is considered a summer-growing grass.

Dominant grasses on this site include side-oats grama, blue grama, little bluestem, black grama, Arizona cottontop, hairy grama, buffalograss, silver bluestem, and Texas wintergrass. Small amounts of sand bluestem, indiangrass, and switchgrass also grow in some areas. Invading species are Texas grama, sand muhly, hairy tridens, fall witchgrass, mesquite, catclaw, pricklypear, and numerous annual weeds.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,200 in dry years to 1,950 in wet years.

Shallow Redland Range Site

Soils of this range site are gently sloping to moderately steep and occur on uplands in association

with soils of the Deep Hardland site. In the southern part of the county they are mixed with soils of the Very Shallow and Gypland range sites and with Badland.

These soils are clay loams that are moderately to slowly permeable. They have a moderate to low available water capacity. A good plant cover is needed to reduce evaporation and to control water erosion.

The potential plant community consists of mostly mid and short grasses. Side-oats grama is the dominant species. It makes up about 65 percent of the plant community. Other important mid grasses are blue grama, vine-mesquite, and little bluestem. Sand bluestem and indiangrass grow in some areas that face north and east. In these areas the moisture conditions are more favorable because the soils contain some gravel or stones or are influenced by some other factor.

The short grasses that make up about 35 percent of the vegetation include hairy grama, silver bluestem, buffalograss, perennial three-awn, and tobosa.

Forbs in the original vegetation were groundplum milkvetch, dalea, prairieclover, scurfpea, heath aster, Engelmandaisy, dotted gayfeather, penstemon, sagewort, and gaura. These forbs are important indicators in determining trends in the condition of the range. Desert shrubs, such as acacia, mimosa, vine ephedra, agarito, and skunkbush, grow sparsely on this site.

The chief woody invaders are mesquite, grassland croton, pricklypear, lotebush, and small soapweed. If there is a nearby source of seed, redberry juniper also invades this site. Common invading perennial grasses are hairy tridens, sand dropseed, Texas grama, red grama, and tumblegrass. The chief invading forbs are broom snakeweed, false-broomweed on soils that contain gypsum, plains actinea, gray goldaster, wavyleaf thistle, hoary blackfoot, threadleaf groundsel, and Texas stillingia. Other common invading forbs are common broomweed, bitterweed, oneseed croton, Texas filaree, evax, plantain, plains greenthread, and bladderpod.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 1,350 in dry years to 2,200 in wet years.

Very Shallow Range Site

This site consists of undulating to steep soils and includes some knolls or relatively steep escarpments. These soils are very shallow and contain many limestone or sandstone rocks on the surface and throughout the profile. If unprotected by vegetation, the sloping soils are highly susceptible to water erosion.

Vegetation is normally sparse. This site is generally in a higher condition class than adjacent sites and, in most places, has a variety of vegetation. In places side-oats grama is dominant. Other important species on this site are blue grama, Arizona cottontop, and little bluestem. On the northern slopes, and in places where moisture content is more favorable, sand bluestem, indiangrass, vine-mesquite, plains bristlegrass, and other decreasers grow. These species make up 70 percent of the potential plant community.

About 30 percent of the vegetation is made up of hairy grama, black grama, buffalograss, silver bluestem, sand dropseed, perennial three-awn, and slim or rough tridens.

Invaders include hairy tridens, Texas grama, red grama, sand muhly, tumblegrass, mesquite, pricklypear, lotebush, yucca, and annual weeds. Redberry juniper grows in places.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 450 in dry years to 900 in wet years.

Gypland Range Site

Only Cottonwood soils are in this range site. These soils are high in gypsum. The distinctive characteristic of this site is the effect the varying amount of gypsum has on the vegetation. The Cottonwood soils are clay loam in texture and are about 6 inches deep over thick beds of gypsum and calcium carbonate. Characteristic grasses are side-oats grama, little bluestem, and sand bluestem. In places where the soil is less than 4 inches deep, vegetation is sparse and side-oats grama and hairy grama are dominant.

The climax vegetation of this site is made up of blue grama, indiangrass, switchgrass, vine-mesquite, plains bristlegrass, Arizona cottontop, hairy grama, buffalograss, slim or rough tridens, black grama, silver bluestem, sand dropseed, and perennial three-awn. Also characteristic of the site are dotted gayfeather, black dalea, feather dalea, and false-broomweed.

The principal invaders are mesquite, redberry, juniper, yucca, catclaw, Texas grama, hairy tridens, and numerous annual weeds.

When this site is in excellent condition, the total annual herbage yield, in pounds per acre air-dry weight, ranges from 550 in dry years to 1,200 in wet years.

Many farmers and ranchers in Hardeman County are discovering that under good management raising wildlife can be a profitable use of soils. The demand for places to hunt and fish is increasing each year. About 38 percent of the county is in rangeland. Much of this range is sandy or rough country that is well suited to wildlife. About 55 percent of the county is cultivated, and most of this acreage would be suitable for wildlife if properly managed.

Buffalo, deer, antelope, turkey, prairie chicken, and quail were originally abundant in the county. Early hunters exterminated the buffalo. With the introduction of livestock, overgrazing, fencing, and cultivation, most of the deer, antelope, turkey, and prairie chicken disappeared. Many quail, doves, various songbirds, small animals, and predators are still in the county. A few deer remain in the rough breaks in the southern part of the county. The lakes, streams, ponds, and grain fields attract many ducks and some geese during their migration. Fish production in the county is limited to permanent streams, such as Groesbeck Creek and Wanderers Creek, to artificial impoundments, such as Lake Pauline, and to the many farm and ranch ponds.

Wildlife Sites

The soils of Hardeman County have been placed in five wildlife sites. These sites are based on groups of soil associations. The soil associations are shown on the general soil map at the back of this survey and are described in the section "General Soil Map." Although many of the same wildlife species are present in most of the sites, each site differs from the others in topography, proportional pattern of soils, productivity, kinds and amount of vegetation, and treatment needed to maintain or improve the site for desired wildlife habitat. The five wildlife sites are discussed in the following paragraphs.

Wildlife Site 1

This site consists mainly of the Tivoli-Hardeman soil association. It is made up of deep, nearly level to undulating, duned and steep soils that are coarse textured and moderately coarse textured. The site also includes narrow areas of soils of the bottom lands that are in the flood plains of creeks and rivers. Native vegetation is mainly mid and tall grasses, such as side-oats grama, little bluestem, sand bluestem, indiangrass, switchgrass, and sand dropseed. Woody plants include hackberry, bumelia, sand plum, skunkbush, sand sagebrush, and shin oak. This site provides excellent food, cover, and water for wildlife.

The principal animals on this site are rabbit, coyote, skunk, bobcat, opossum, badger, and racoon. Birds inhabiting the site are quail, dove, duck, geese, and songbirds.

Wildlife Site 2

This site consists of the Springer-Miles soil association. It is made up of deep, nearly level to undulating and hummocky soils that are coarse textured. Most of the acreage is cultivated. Native vegetation is mainly side-oats grama, little bluestem, sand bluestem, switchgrass, lovegrass, sand dropseed, and perennial three-awn. Woody plants include shin oak, sand sagebrush, and skunkbush. This site provides good food and cover for wildlife.

Rabbit, coyote, skunk, and bobcat inhabit this site. Quail, dove, and songbirds are the principal birds.

Wildlife Site 3

This site is made up of the Miles-Acuff-Olton and the Cobb-Cosh soil associations. It consists of moderately coarse textured to medium-textured and moderately fine textured, nearly level to gently sloping soils on uplands. Most of the acreage is cultivated. Scattered areas of rangeland are intermixed with the cropland. Native vegetation is primarily blue grama, side-oats grama, buffalograss, sand dropseed, hairy tridens, silver bluestem, and three-awns. Mesquite, yucca, catclaw, and lotebush are the main woody plants. Food is plentiful on this site during the summer months, but it is sometimes limited during the winter. Sufficient cover is not always available; however, this is a fair site for wildlife when properly managed.

Rabbit, coyote, and skunk are the main animals on this site, and dove, duck, and songbirds are the principal birds.

Wildlife Site 4

This site consists mainly of the Hollister-Abilene, Tillman-Vernon-Weymouth, and Quanah-Talpa soil associations. It consists of very shallow to deep, nearly level to steep soils on uplands and in narrow bands on bottom lands along creeks and intermittent drains. The soils are mostly cultivated, and scattered areas of rangeland are intermixed with the cropland. The rangeland is on steeper slopes and consists of shallow or stony soils. The native vegetation is mainly buffalograss, blue grama, side-oats grama, tobosa, and silver bluestem. Woody plants are mesquite, lotebush, and pricklypear. Sufficient cover for wildlife is not always available on this site. Food is in good supply during some periods but is limited during dry seasons.

Animals on this site are mainly rabbit, coyote, skunk, and opossum. Dove, quail, duck, and songbirds are the principal birds.

Wildlife Site 5

This site consists of the Badland-Vernon-Cottonwood soil association. It is made up mainly of very shallow and shallow soils and Badland in the rough breaks. This site also includes areas of sandy to clayey soils of the bottom lands that are adjacent to rivers and the larger creeks.

Most of the soils have only a sparse cover of grass except those along the bottom lands and some of the stony areas. Nearly all of this site is in range. Grasses are mainly side-oats grama, blue grama, little bluestem, buffalograss, and tobosa. Woody plants are principally redberry juniper, mesquite, and lotebush. The rough terrain and woody vegetation provide excellent cover for wildlife in most places, but the food supply is sometimes short.

The principal animals that inhabit this site are deer, coyote, bobcat, rabbit, opossum, skunk, and racoon. Birds on the site include quail, dove, duck, geese, and songbirds.

Kinds of Wildlife in the County

The species of wildlife of greatest interest to farmers and ranchers in Hardeman County are quail, dove, duck, geese, deer, and fish. Careful management is needed to maintain the population of these species. The general management required for each species is discussed in the following paragraphs.

Quail.--Quail require a year-round supply of food, cover, and water. If any of these are missing, the population decreases rapidly. Food sources are seeds from weeds, grasses, legumes, small grains, and sorghum crops. Insects are also an important source of food during the summer months. Low-growing shrubs or brush are needed to provide cover for escape from predators, for shade, and for dusting and loafing. Overgrown fence rows and field borders provide cover, food, and protected trails for the birds to move from place to place. Several species of shrubs are adapted to each soil in the county. Shrubs can be planted where there is a shortage of cover. On soils suitable for cultivation, crops such as millet, sesame, or field peas can be grown for food. This is especially important if native food is scarce. Food plants should be planted close to good cover plants.

Dove.--Mourning dove nest in Hardeman County, and northern doves move southward through the county during fall and winter. A good food supply is essential for attracting doves to an area. Dove feed on about the same plant seeds as quail. Native grass and weed seed, small grains, and grain sorghums are the major food plants. Doves feed on waste grain in harvested fields. Soils suitable for cultivation can be planted to any one or a mixture of these plants. An abundant food supply will attract doves during the hunting season and winter.

Ducks and Geese.--Water areas in the county are heavily utilized by migrating ducks and geese for feeding and roosting. These birds range into the surrounding cultivated fields for food. Both ducks and geese feed on waste grain. Geese also feed heavily on winter weeds and young wheat in the fields. Ducks feed on seed from plants, such as barnyardgrass and smartweed, that grow around pond margins, stream banks, and playa lakes.

Deer.--Only a few deer are left in the county. They are mainly in site 5 in the southern part of the county. Woody vegetation along streams is essential for deer habitat. For food, deer prefer legumes, weeds, vines, some grasses and leaves, twigs, buds, and fruits of various shrubs. They also feed heavily on winter grain or winter legumes. Planting these crops on soils of the bottom land or on other suitable soils near water and cover is the best way to develop habitat for deer.

Fish.--Fish production in the county is limited to the many farm and ranch ponds, permanent streams, such as Groesbeck Creek and Wanderers Creek, and Lake Pauline. Farm and range ponds are excellent for the production of fish if the pond water is properly managed. The surface of the pond should be at least a quarter acre in size. Fish adapted to the water in the county include largemouth bass, channel catfish, and bream. The objectives of management are to provide a large amount of food for the bream, which in turn furnish food for the bass and catfish. The elimination of aquatic plants, which harbor too many small bream and cause the pond to become overstocked, also is important. To achieve these objectives, the pond must be properly constructed. Shallow areas that encourage the growth of aquatic plants should be eliminated. Fertilizer applied to a properly constructed pond stimulates the growth of microscopic plants and animals that shade the bottom of the pond and limit the growth of plants. Production of fish in fertilized ponds is often more than double the production in unfertilized ponds. Other desirable practices are fencing to protect ponds from livestock and fishing regularly to prevent overpopulation.

Each species of wildlife has definite requirements for food, cover, and water. If any one or a combination of these requirements is absent, the wildlife population diminishes or disappears. The soils in each wildlife site are capable of producing certain food and cover plants to meet the needs of wildlife. Information on developing wildlife habitats and managing fish ponds can be obtained from technicians of the Soil Conservation Service, from the Texas Agricultural Extension Service, and from the Texas Parks and Wildlife Department.

WINDBREAKS

Tree windbreaks are valuable in reducing the wind velocity on farms and ranches. They are used to protect soils, crops, and farmsteads from damaging wind and blowing dust. They serve as snow fences in winter. They provide shelter for livestock and are a source of food and cover for birds and other wildlife. Windbreaks also add beauty to the farm or ranch.

The first windbreak plantings in the county were made in 1936. During the next few years about 1000 acres of windbreaks were planted. Plantings were in a patchwork pattern from east to west and from north to south, mainly along land survey lines or field borders. Few windbreak plantings have been made in the last ten years, and some of the old established field windbreaks have been removed.

If water for irrigation is available, trees can be established on most soils in the county. Trees and shrubs well suited to windbreaks are Siberian elm, redcedar, Arizona cypress, shortleaf and loblolly pines, cottonwood, sycamore, Russian-olive, Osage-orange, catalpa, and desertwillow. Generally, a three-row windbreak is most practical. It should include at least one row of tall trees and one row of evergreens. The trees should be planted in a two-directional pattern at right angles to give greater protection from the prevailing south and west winds. After the trees have been planted, they must be cultivated and cared for like any growing crop. They must be protected from fire and from trampling and grazing by livestock.

Information on the layout and planting of windbreaks can be obtained from local offices of the Soil Conservation Service and the county agricultural agent. These offices can also supply information on where seedlings of good quality can be obtained.

ENGINEERING USES OF THE SOILS[3/]

In engineering, soils are used primarily as building material or to support structures of various kinds including roads, airports, building foundations, pipelines, drainage systems, structures for water storage or erosion control, and sewage disposal systems. Engineers are interested in the properties of a soil that determine its suitability or limitations for a specified construction use. Properties of soils that are most important in engineering are permeability, shear strength, compaction and shrink-swell characteristics, water-holding capacity, grain-size distribution, plasticity, and soil reaction. Site considerations, such as drainage, topography, depth to bedrock, and depth to water table, are also important.

Information concerning these and related soil properties is given in tables 3 and 4. The estimates and interpretations of soil properties in these tables can be used to--

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils that will help in planning drainage systems, farm ponds, irrigation systems, waterways, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines and cables, and to assist in planning detailed investigations of the selected locations.
4. Locate probable sources of topsoil, sand, gravel, rock, or fill material.
5. Correlate performance of engineering structures with soil mapping units and develop information useful in designing and maintaining the structures.
6. Estimate the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction in a particular area.

The engineering interpretations in this subsection can be useful for many purposes, but it should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works. Special care should be taken in gathering and evaluating soil data for projects involving heavy loads or where the excavations are to greater depths than are covered here. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some terms used by soil scientists may be unfamiliar to engineers. Other words have different meanings in soil science from their engineering definition. Many terms used in this section are defined in the Glossary at the back of this survey.

Engineering Classification Systems

The U.S. Department of Agriculture (USDA) classifies soils according to texture, color, and structure. This system is useful as the initial step in making engineering classifications of soils. Other properties important in engineering can be estimated or can be determined by tests.

3/ By WELDON L. BIRDWELL, area engineer, Soil Conservation Service.

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or this reason it is necessary to follow carefully the instructions for referring to other series that appear in means less than.]

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
Abilene:					
AbA, AbB	More than 60 inches to soft shale.	0-14	Clay loam	CL	A-6
		14-44	Silty clay	CL	A-6 or A-7
		44-64	Clay loam	CL	A-6
AcA 1/	48 to 80 inches to soft shale.	0-6	Clay loam	CL	A-6
		6-32	Silty clay	CL	A-6
		32-56	Silty clay loam	CL	A-6 or A-7
		56-70	Red-bed clay or shale.	CH	A-7
*Acme: Ad	10 to 20 inches to soft gypsite.	0-15	Clay loam	CL	A-6
		15-36	White gypsite weakly cemented.	-------	----------
For Cottonwood part of Ad, see Cottonwood series.					
Active dunes: Ae	More than 80 inches-	0-60	Fine sand	SP-SM	A-3
Acuff: AfA, AfB	More than 80 inches-	0-7	Loam	SC	A-6
		7-44	Sandy clay loam	SC or CL	A-6
		44-64	Sandy clay loam	SC	A-6
Altus:					
AlA	More than 80 inches.	0-9	Fine sandy loam	SM	A-4
		9-62	Sandy clay loam	SC or CL	A-6
AtA 1/	48 to 80 inches to soft shale.	0-9	Fine sandy loam	SM	A-4
		9-78	Sandy clay loam	SC or CL	A-6
		78	Red-bed clay or shale.	CH	A-7
Badland: Ba. Properties are too variable to rate.					
Cobb: CbB	20 to 48 inches to sandstone.	0-7	Fine sandy loam	SM	A-4
		7-44	Sandy clay loam	SC or CL	A-6
		44-60	Sandstone, weakly cemented.	--------	----------

See footnotes at end of table.

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for the first column of this table. Absence of data means that properties were not estimated. Symbol <

Percentage passing sieve--			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	Inches per inch of soil	pH	
100	100	70-85	0.63-2.0	0.15-0.19	6.6-8.4	Moderate.
95-100	95-100	90-95	0.2-0.63	0.14-0.18	7.9-8.4	Moderate.
------	90-100	70-85	0.2-0.63	0.12-0.16	7.9-8.4	Moderate.
100	100	70-85	0.63-2.0	0.15-0.18	7.4-7.8	Moderate.
100	100	90-95	0.2-0.63	0.15-0.18	7.4-7.8	Moderate.
100	100	90-95	0.2-0.63	0.15-0.18	7.9-8.4	Moderate.
------	------	-----	<0.06	0.12-0.16	7.9-8.4	High.
95-100	90-100	60-75	0.63-2.0	0.14-0.18	7.9-8.4	Low.
------	------	-----	--------	---------	7.9-8.4	
100	95-100	5-10	6.30-20.0	0.04-0.07	6.6-7.4	Low.
100	100	35-50	0.63-2.00	0.13-0.16	6.6-7.8	Low.
100	100	40-55	0.63-2.00	0.14-0.17	7.4-7.8	Low.
90-95	80-90	35-50	0.63-2.00	0.13-0.16	7.9-8.4	Low.
100	100	40-50	0.63-2.0	0.10-0.14	6.6-7.8	Low.
95-100	95-100	40-55	0.63-2.0	0.13-0.16	6.6-8.4	Low.
100	100	40-50	0.63-2.0	0.10-0.14	7.9-8.4	Low.
100	95-100	40-55	0.63-2.0	0.10-0.14	7.9-8.4	Low.
------	------	------	<0.06	---------	7.9-8.4	High.
100	98-100	40-50	2.0-6.3	0.10-0.13	6.6-7.3	Low.
100	100	40-55	0.63-2.0	0.12-0.15	6.6-7.3	Low.
------	------	-----	--------	---------	6.6-7.3	Low.

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Soil series and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
*Colorado:					
Cd, Ce----------	More than 80 inches.	0-24	Clay loam----------	CL	A-6
		24-39	Sandy clay loam-----	SC or CL	A-6
For Spur part of Cd, see Spur series.		39-64	Clay loam----------	CL	A-6
Cf----------	More than 80 inches.	0-12	Silt loam----------	ML or ML-CL	A-4
		12-40	Sandy clay loam-----	SC or CL	A-6
		40-80	Clay loam----------	CL	A-6
*Cosh: ChB, Cl----------	12 to 20 inches to sandstone.	0-6	Fine sandy loam-----	SM	A-4
		6-16	Sandy clay loam-----	SC or CL	A-6
For Latom part of Cl, see Latom series.		16-36	Sandstone, weakly cemented.	--------	----------
*Cottonwood: Ct----------	3 to 10 inches to soft gypsite.	0-6	Clay loam----------	CL	A-6
		6-48	Soft chalky gypsite-	---------	----------
For Vernon part of Ct, see Vernon series.					
Hardeman: HaA, HaB, HaC, HaE2.	More than 80 inches.	0-64	Fine sandy loam-----	SM or SM-SC	A-4
Hilly gravelly land: Hg---	More than 80 inches.	0-10	Gravelly sandy loam.	---------	----------
		10-60	Stratified sands and gravel.	---------	----------
Hollister: HoA, HoB-------	60 to 75 inches to soft shale.	0-12	Clay loam and silty clay loam.	CL	A-6
		12-60	Clay----------	CH	A-7
		60-70	Clay----------	CL or CH	A-7
*Latom: La----------	4 to 10 inches to sandstone.	0-7	Fine sandy loam-----	SM	A-4
		7-12	Sandstone, strongly cemented.	--------	----------
For Rock outcrop part of La, see Rock outcrop.					
Lincoln: Lc, Ln [2/] ---------	More than 80 inches.	0-10	Fine sandy loam and loamy fine sand.	SM	A-4 or A-2
		10-60	Fine sand, stratified.	SM or SP-SM	A-2
Lipan: Lp----------	More than 80 inches.	0-64	Clay----------	CH	A-7
Mangum: Ma----------	More than 80 inches.	0-8	Clay loam----------	CL	A-6
		8-60	Clay----------	CH	A-7

See footnotes at end of table.

PROPERTIES OF THE SOILS--Continued

Percentage passing sieve--			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	Inches per inch of soil	pH	
100	100	70-80	0.63-2.0	0.16-0.18	7.9-8.4	Low.
100	100	40-55	0.63-2.0	0.15-0.18	7.9-8.4	Low.
100	100	70-80	0.63-2.0	0.16-0.18	7.9-8.4	Low.
100	100	70-90	0.63-2.0	0.16-0.18	7.4-8.4	Low.
100	100	40-55	0.63-2.0	0.16-0.18	7.9-8.4	Low.
100	100	70-80	0.63-2.0	0.16-0.18	7.9-8.4	Low.
100	100	40-50	2.0-6.3	0.10-0.13	6.6-7.8	Low.
100	100	40-55	0.63-2.0	0.12-0.15	6.6-7.8	Low.
------	------	-----	---------	---------	6.6-7.8	Low.
100	100	70-80	0.63-2.0	0.11-0.14	7.9-8.4	Low.
------	------	-----	--------	---------	7.9-8.4	
100	100	40-50	2.0-6.3	0.10-0.13	7.4-8.4	Low.
------	------	-----	6.3-20.0	0.05-0.08	6.6-7.3	Low.
------	------	-----	--------	---------	-------	Low.
100	100	90-99	0.06-0.20	0.14-0.18	7.4-8.4	High.
100	98-100	90-98	0.06-0.20	0.15-0.19	7.9-8.4	High.
100	95-100	90-98	0.06-0.20	0.12-0.16	7.9-8.4	High.
90-100	85-95	40-50	2.0-6.3	0.10-0.14	6.6-8.4	Low.
------	-----	-----	--------	---------	7.9-8.4	Low.
100	100	30-50	2.0-6.3	0.10-0.13	7.9-8.4	Low.
100	90-95	10-20	6.3-20.0	0.05-0.09	7.9-8.4	Low.
100	95-100	90-100	<0.06	0.12-0.16	7.4-8.4	High.
100	100	70-80	<0.06	0.14-0.18	7.9-8.4	Moderate.
100	100	90-95	--------	0.14-0.18	7.9-8.4	High.

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
Mansker: McB	More than 80 inches	0-16	Clay loam	CL	A-6
		16-60	Clay loam	CL	A-6
Miles:					
MfA, MfB, MfC, MfC2	More than 80 inches	0-7	Fine sandy loam	SM	A-2 or A-4
		7-54	Sandy clay loam	SC or CL	A-4 or A-6
		54-72	Fine sandy loam	SM	A-4
MlB, MlC	More than 80 inches	0-16	Loamy fine sand	SM	A-2
		16-62	Sandy clay loam	SC or CL	A-4
Nobscot: No	More than 80 inches	0-24	Fine sand	SM or SP-SM	A-2 or A-3
		24-38	Sandy loam	SM	A-2
		38-54	Loamy fine sand	SM	A-2
		54-60	Fine sand	SM or SP-SM	A-2 or A-3
Olton:					
OcA, OcB	More than 60 inches to soft shale.	0-15	Clay loam	CL	A-6
		15-27	Silty clay loam	CL	A-6
		27-38	Silty clay loam	CL	A-6
		38-62	Clay loam	CL	A-6
OlA, OlB	More than 60 inches to soft shale.	0-6	Loam	ML or ML-CL	A-4
		6-27	Clay loam and silty clay loam.	CL	A-6
		27-38	Silty clay loam	CL	A-6
		38-62	Clay loam	CL	A-6
Portales: PoA	More than 80 inches	0-50	Clay loam	CL	A-6
		50-60	Sandy clay loam	SC or CL	A-6
*Quanah: QcB, Qt For Talpa part of Qt, see Talpa series.	More than 60 inches to soft shale.	0-34	Clay loam and silty clay loam.	CL	A-6
		34-46	Silty clay loam	CL	A-6
		46-72	Silty clay loam	CL	A-6
Rock outcrop	--------	-----	Sandstone.		
Springer: SgB, SgD, Sp3	More than 80 inches	0-18	Loamy fine sand	SM	A-2
		18-48	Fine sandy loam	SM	A-2 or A-4
		48-62	Loamy fine sand	SM	A-2
Spur: Sr	More than 80 inches	0-84	Clay loam	CL	A-6

See footnotes at end of table.

PROPERTIES OF THE SOILS--Continued

Percentage passing sieve--			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	Inches per inch of soil	pH	
95-100	90-95	65-80	0.63-2.0	0.13-0.17	7.9-8.4	Low.
90-95	85-90	60-75	0.63-2.0	0.12-0.16	7.9-8.4	Low.
95-100	95-100	30-50	2.0-6.3	0.11-0.15	6.6-7.8	Low.
95-100	95-100	40-55	0.63-2.0	0.13-0.17	6.6-8.4	Low.
95-100	90-100	35-50	0.63-2.0	0.12-0.16	7.9-8.4	Low.
100	100	15-25	2.0-6.3	0.07-0.11	6.6-7.3	Low.
100	100	40-55	0.63-2.0	0.13-0.17	6.6-7.3	Low.
100	100	5-15	6.3-20.0	0.05-0.09	6.1-6.5	Low.
100	100	15-25	2.0-6.3	0.07-0.11	6.1-6.5	Low.
100	100	15-25	2.0-6.3	0.06-0.10	6.1-6.5	Low.
100	100	5-15	2.0-6.3	0.05-0.08	6.1-6.5	Low.
100	100	70-80	0.2-0.63	0.15-0.20	6.6-7.8	Low.
100	100	80-90	0.2-0.63	0.15-0.20	6.6-8.4	Moderate.
100	95-100	80-90	0.2-0.63	0.15-0.18	7.9-8.4	Moderate.
95-100	95-100	70-80	0.2-0.63	0.10-0.15	7.9-8.4	Low.
100	100	60-75	0.2-0.63	0.15-0.18	6.6-7.3	Low.
100	100	70-80	0.2-0.63	0.15-0.20	6.6-7.3	Moderate.
100	100	80-90	0.2-0.63	0.15-0.18	7.3-8.4	Moderate.
90-95	85-95	60-70	0.2-0.63	0.10-0.15	7.9-8.4	Low.
95-100	95-100	70-80	0.63-2.0	0.13-0.17	7.9-8.4	Low.
95-100	95-100	40-55	0.63-2.0	0.12-0.15	7.9-8.4	Low.
95-100	95-100	85-95	0.63-2.0	0.15-0.18	7.9-8.4	Low.
95-100	90-95	75-95	0.63-2.0	0.13-0.16	7.9-8.4	Low.
100	95-100	85-95	0.63-2.0	0.15-0.18	7.9-8.4	Low.
100	100	15-25	2.0-6.3	0.06-0.10	6.1-7.3	Low.
100	100	30-45	2.0-6.3	0.10-0.13	6.1-7.3	Low.
100	100	15-25	2.0-6.3	0.06-0.10	6.6-7.3	Low.
100	100	70-80	0.63-2.0	0.14-0.18	7.9-8.4	Low.

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
* Talpa: Ta, Tc For Vernon part of Tc, see Vernon series.	4 to 10 inches to limestone.	0-6 6-12	Clay loam Indurated, fractured, dolomitic limestone.	CL	A-6
Tillman: TmA, TmB	38 to 72 inches to soft shale.	0-9 9-62 62-72	Clay loam and silty clay loam. Clay Red-bed clay.	CL CL or CH	A-6 A-7
Tipton: Tp	More than 80 inches	0-17 17-39 39-62	Loam Clay loam Clay loam	ML or CL CL CL	A-4 or A-6 A-6 A-6
Tivoli: Tv	More than 80 inches	0-60	Fine sand	SM or SP-SM	A-2 or A-3
Treadway: Tw	More than 60 inches to soft shale.	0-58	Clay	CH	A-7
* Vernon:					
VeB	Less than 20 inches to soft shale.	0-6 6-16 16-48	Clay loam Clay Red-bed clay or shale.	CL CH CH	A-6 A-7 A-7
Vr For Badland part of Vr, see Badland.	Less than 20 inches to soft shale.	0-16 16	Clay and clay loam Red-bed clay or shale.	CH --------	A-7 ----------
* Weymouth: WeB, WvD For Vernon part of WvD, see Vernon series.	More than 60 inches to soft shale.	0-18 18-42 42-60	Clay loam Clay loam Clay loam	CL CL CL	A-6 A-6 A-6
Yahola: Ya	More than 80 inches	0-60	Very fine sandy loam-	SM or ML	A-4

1/ Soil is saline.

PROPERTIES OF THE SOILS--Continued

Percentage passing sieve--			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	Inches per inch of soil	pH	
80-90	70-80	60-80	0.63-2.0	0.12-0.16	7.9-8.4	Low.
100	100	70-80	0.2-0.63	0.15-0.18	7.4-7.8	Moderate.
95-100	95-100	75-95	0.06-0.2	0.15-0.18	7.4-8.4	High.
100	100	60-75	0.63-2.0	0.14-0.18	6.6-7.3	Low.
100	100	70-80	0.63-2.0	0.15-0.18	6.6-7.8	Low.
100	95-100	65-80	0.63-2.0	0.15-0.18	7.9-8.4	Low.
100	95-100	5-15	6.3-20.0	0.04-0.08	6.6-8.4	Low.
100	100	75-95	<0.06	0.15-0.18	7.9-8.4	High.
95-100	90-100	70-80	0.06-0.2	0.15-0.18	7.9-8.4	Moderate.
95-100	90-100	75-95	0.06-0.2	0.15-0.18	7.9-8.4	High.
95-100	95-100	75-95	0.06-0.2	---	7.9-8.4	High.
100	100	75-95	0.06-0.2	0.15-0.18	7.9-8.4	High.
---	---	---	---	---	7.9-8.4	
95-100	95-100	70-80	0.63-2.0	0.15-0.18	7.9-8.4	Low.
85-90	80-85	55-65	0.63-2.0	0.13-0.16	7.9-8.4	Low.
95-100	90-95	65-75	0.63-2.0	0.14-0.17	7.9-8.4	Low.
100	100	45-60	2.0-6.3	---	7.9-8.4	Low.

2/ In some areas the Ln mapping unit is saline.

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or reason it is necessary to follow carefully the instructions for

Soil series and map symbols	Suitability as source of--		Degree of limitations and soil features affecting--			
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Abilene: AbA, AbB--------	Fair: clay loam texture; 6 to 20 inches in thickness.	Fair: fair traffic supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic supporting capacity; moderate shrink-swell potential.	Moderate: fair bearing capacity; moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight-------
AcA----------	Poor: slight to very strong salinity.	Fair: fair traffic supporting capacity; moderate shrink-swell potential.	Severe: wetness.	Severe: wetness.	Severe: moderately slow permeability.	Slight-------
*Acme: Ad--------- For Cottonwood part of Ad, see Cottonwood series.	Fair: clay loam texture; 6 to 20 inches in thickness.	Poor: 10 to 20 inches of material.	Severe: 10 to 20 inches to soft gypsite bedrock.	Severe: 10 to 20 inches to soft gypsite bedrock.	Severe: 10 to 20 inches to soft gypsite bedrock.	Severe: 10 to 20 inches to permeable bedrock.
Active dunes: Ae.	Poor: fine sand texture.	Good----------	Moderate: slopes.	Moderate: slopes.	Severe: inadequate filtration.	Severe: rapid permeability.
Acuff: AfA, AfB.	Good----------	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Altus: AlA----------	Good----------	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
AtA----------	Poor: slight to very strong salinity.	Fair: fair traffic supporting capacity.	Severe: wetness.	Severe: wetness.	Severe: very slow permeability of underlying material.	Moderate: moderate permeability.
Badland: Ba. Properties too variable to rate.						

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this referring to other series that appear in the first column of this table]

Degree of limitations and soil features affecting--Con.		Soil features affecting--			Corrosivity class and contributing soil features	
Farm Ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Reservoir area	Embankments					
Moderate: moderately slow permeability.	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: texture--	Low.
None to slight--	Moderate: medium compressibility.	High water table; slight to very strong salinity.	High water table; slight to very strong salinity.	Slight to very strong salinity.	High: texture; conductivity.	Moderate: sodium salts.
Severe: 10 to 20 inches to permeable bedrock.	Severe: 10 to 20 inches of material.	10 to 20 inches to gypsite.	10 to 20 inches to gypsite.	10 to 20 inches to gypsite.	High: conductivity.	Low.
Severe: rapid permeability.	Severe: poor stability; poor resistance to piping and erosion.	High intake rate; low available water capacity; dune topography.	Dune topography; severe hazard of soil blowing.	Severe hazard of soil blowing.	Low----------	Low.
Moderate: moderate permeability.	Slight---------	All features favorable.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Moderate: moderate permeability.	Slight---------	All features favorable.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Slight---------	Moderate: fair resistance to piping and erosion.	High water table; slight to very strong salinity.	High water table; slight to very strong salinity.	Slight to very strong salinity.	High: conductivity.	Moderate; sodium salts.

Soil series and map symbols	Suitability as source of--		Degree of limitations and soil features affecting--			
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Cobb: CbB-------	Fair: 6 to 20 inches of material.	Fair: fair traffic supporting capacity; 20 to 48 inches of material.	Moderate: fair traffic supporting capacity; bedrock at 36 to 48 inches. Severe: bedrock at 20 to 36 inches.	Moderate: fair bearing capacity; bedrock at 36 to 48 inches. Severe: bedrock at 20 to 36 inches.	Severe: bedrock at 20 to 48 inches.	Severe: bedrock at 20 to 48 inches.
*Colorado: Cd, Ce, Cf. For Spur part of Cd, see Spur series.	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair bearing capacity; flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Moderate: moderate permeability.
*Cosh: ChB, Cl--- For Latom part of Cl, see Latom series.	Fair: 6 to 20 inches of material.	Poor: 12 to 20 inches of material.	Severe: 12 to 20 inches to bedrock.	Severe: 12 to 20 inches to bedrock.	Severe: 12 to 20 inches to bedrock.	Severe: 12 to 20 inches to bedrock.
*Cottonwood: Ct-- For Vernon part of Ct, see Vernon series.	Poor: 3 to 10 inches of material.	Poor: 3 to 10 inches of material.	Severe: 3 to 10 inches to soft gypsite bedrock.	Severe: 3 to 10 inches to soft gypsite bedrock.	Severe: 3 to 10 inches to soft gypsite bedrock.	Severe: 3 to 10 inches to permeable bedrock.
Hardeman: HaA, HaB, HaC, HaE2.	Good----------	Good----------	Slight: 0 to 6 percent slopes. Moderate: 6 to 15 percent slopes. Severe: 15 to 30 percent slopes.	Slight: 0 to 6 percent slopes. Moderate: 6 to 15 percent slopes. Severe: 15 to 30 percent slopes.	Slight: 0 to 5 percent slopes. Moderate: 5 to 10 percent slopes. Severe: 10 to 30 percent slopes.	Severe: moderately rapid permeability.
Hilly gravelly land: Hg.	Poor: more than 50 percent gravel.	Good----------	Slight: 0 to 6 percent slopes. Moderate: 6 to 15 percent slopes. Severe: 15 to 50 percent slopes.	Slight: 0 to 6 percent slopes. Moderate: 6 to 15 percent slopes. Severe: 15 to 50 percent slopes.	Severe: inadequate filtration; 10 to 50 percent slopes.	Severe: rapid permeability; 7 to 50 percent slopes.

Degree of limitations and soil features affecting--Con.		Soil features affecting--			Corrosivity class and contributing soil features	
Farm Ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Reservoir area	Embankments					
Moderate: bedrock at 36 to 48 inches. Severe: bedrock at 20 to 36 inches.	Moderate: 20 to 48 inches of material.	Bedrock at 20 to 48 inches.	Bedrock at 20 to 48 inches.	Bedrock at 20 to 48 inches.	Moderate: texture.	Low.
Moderate: moderate permeability.	Moderate: medium compressibility; fair resistance to piping and erosion.	Flood hazard---	Flood hazard---	Flood hazard--	Moderate: texture.	Low.
Severe: 12 to 20 inches to bedrock.	Severe: 12 to 20 inches of material.	12 to 20 inches to bedrock.	12 to 20 inches to bedrock.	12 to 20 inches to bedrock.	Moderate: texture.	Low.
Severe: 3 to 10 inches to permeable bedrock.	Severe: 3 to 10 inches of material.	3 to 10 inches to gypsite.	3 to 10 inches to gypsite.	3 to 10 inches to gypsite.	High: conductivity.	Low.
Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Slopes---------	Slopes---------	Erosive-------	Low----------	Low.
Severe: rapid permeability.	Severe: rapid permeability.	Gravelly; slopes.	Hilly topography.	Gravelly; hilly topography.	Low----------	Low.

Soil series and map symbols	Suitability as source of--		Degree of limitations and soil features affecting--			
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Hollister: HoA, HoB.	Fair: clay loam texture; 6 to 20 inches thick.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor bearing capacity.	Severe: slow permeability.	Slight-------
*Latom: La---------- Properties not interpreted for Rock outcrop part of La.	Poor: 4 to 10 inches thick.	Poor: 4 to 10 inches of material.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.
Lincoln: Lc, Ln----	Poor: sandy texture.	Good----------	Moderate: flood once in 5 to 20 years. Severe: flood more than once in 5 years.	Severe: flood hazard.	Severe: flood hazard; inadequate filtration.	Severe: rapid permeability.
Lipan: Lp----------	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor bearing capacity.	Severe: very slow permeability.	Slight-------
Mangum: Ma---------	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity; flood hazard.	Severe: high shrink-swell potential; poor bearing capacity; flood hazard.	Severe: very slow permeability; flood hazard.	Slight-------
Mansker: McB-------	Fair: clay loam texture; 6 to 20 inches of material.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Slight---------	Moderate: moderate permeability.
Miles: MfA, MfB, MfC, MfC2.	Fair: 6 to 20 inches of material.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Slight---------	Moderate: moderate permeability.
MlB, MlC----------	Poor: loamy fine sand texture.	Good----------	Slight---------	Slight---------	Slight--------	Moderate: moderate permeability.

Degree of limitations and soil features affecting--Con.		Soil features affecting--			Corrosivity class and contributing soil features	
Farm Ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Reservoir area	Embankments					
Slight----------	Moderate: high compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: texture---	Low.
Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	4 to 10 inches to bedrock.	4 to 10 inches to bedrock.	4 to 10 inches to bedrock.	Low----------	Low.
Severe: rapid permeability.	Severe: poor resistance to piping and erosion.	High water table; slight to strong salinity.	Severe hazard of soil blowing. Sand texture.	Highly erosive-	High: conductivity.	Moderate: sodium salts.
Slight----------	Moderate: high compressibility.	Slow intake rate.	Depressional topography.	All features favorable.	High: texture---	Low.
Slight----------	Moderate: high compressibility.	Slow intake rate; flood hazard.	Flood hazard---	All features favorable.	High: texture---	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	10 to 20 inches to caliche.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Moderate: moderate permeability.	Moderate: medium compressibility; fair stability.	Slopes---------	All features favorable.	All features favorable.	Moderate: texture.	Low.
Moderate: moderate permeability.	Moderate: fair stability.	Rapid intake rate.	Moderate hazard of soil blowing.	Moderate hazard of soil blowing.	Moderate: texture.	Low.

Soil series and map symbols	Suitability as source of--		Degree of limitations and soil features affecting--			
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Nobscot: No-----	Poor: fine sand texture.	Good----------	Slight---------	Slight---------	Slight--------	Severe: moderately rapid permeability.
Olton: OcA, OcB, OlA, OlB.	Fair: 6 to 20 inches of material.	Fair: moderate shrink-swell potential; fair traffic supporting capacity.	Moderate: moderate shrink-swell potential; fair traffic supporting capacity.	Moderate: moderate shrink-swell potential; fair bearing capacity.	Severe: moderately slow permeability.	Slight--------
Portales: PoA---	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Slight--------	Moderate: moderate permeability.
*Quanah: QcB, Qt- For Talpa part of Qt, see Talpa series.	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Rock outcrop. Properties too variable to rate.						
Springer: SgB, SgD, Sp3.	Poor: loamy fine sand texture.	Good----------	Slight: 0 to 6 percent slopes. Moderate: 6 to 8 percent slopes.	Slight: 0 to 6 percent slopes. Moderate: 6 to 8 percent slopes.	Slight--------	Severe: moderately rapid permeability.
Spur: Sr-------	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity; flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Moderate: moderate permeability.
*Talpa: Ta, Tc-- For Vernon part of Tc, see Vernon series.	Poor: 4 to 10 inches of material.	Poor: 4 to 10 inches of material.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.

Degree of limitations and soil features affecting--Con.		Soil features affecting--			Corrosivity class and contributing soil features	
Farm Ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Reservoir area	Embankments					
Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Severe hazard of soil blowing; undulating topography.	Severe hazard of soil blowing.	Low----------	Low.
Moderate: moderately slow permeability.	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: texture-	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Severe hazard of soil blowing; undulating; hummocky topography.	Severe hazard of soil blowing.	Low----------	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	Flood hazard---	Flood hazard----	Flood hazard---	Moderate: texture.	Low.
Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches of material.	4 to 10 inches to bedrock.	4 to 10 inches to bedrock.	4 to 10 inches to bedrock.	Moderate: texture.	Low.

Soil series and map symbols	Suitability as source of--		Degree of limitations and soil features affecting--			
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Tillman: TmA, TmB.	Fair: 6 to 20 inches of material.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor bearing capacity.	Severe: slow permeability.	Slight---------
Tipton: Tp------	Good----------	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Slight---------	Moderate: moderate permeability.
Tivoli: Tv------	Poor: fine sand texture.	Good----------	Moderate: slopes.	Moderate: slopes.	Severe: inadequate filtration.	Severe: rapid permeability.
Treadway: Tw----	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity; flood hazard.	Severe: high shrink-swell potential; poor bearing capacity; flood hazard.	Severe: flood hazard very slow permeability.	Slight---------
Vernon: VeB, Vr. Properties not interpreted for Badland part of Vr.	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poor bearing capacity.	Severe: slow permeability.	Slight: 0 to 2 percent slopes. Moderate: 2 to 7 percent slopes. Severe: slopes of more than 7 percent.
*Weymouth: WeB, WvD. For Vernon part of WvD, see Vernon series.	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Moderate: fair bearing capacity.	Slight: 0 to 5 percent slopes. Moderate: 5 to 8 percent slopes.	Moderate: moderate permeability; 2 to 7 percent slopes.
Yahola: Ya-----	Good----------	Good----------	Moderate: flood hazard.	Severe: flood hazard.	Moderate: flood hazard.	Severe: moderately rapid permeability.

Degree of limitations and soil features affecting--Con.		Soil features affecting--			Corrosivity class and contributing soil features	
Farm Ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Reservoir area	Embankments					
Slight----------	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: texture--	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	Moderate: texture.	Low.
Severe: rapid permeability.	Severe: poor resistance to piping and erosion; poor stability.	High intake rate; low available water capacity; dune topography.	Dune topography; severe hazard of soil blowing.	Severe hazard of soil blowing.	Low----------	Low.
Slight---------	Moderate: high compressibility; fair stability.	Flood hazard---	Flood hazard----	Flood hazard---	High: texture--	Low.
Slight---------	Moderate: high compressibility; poor stability.	Less than 20 inches to shale; slow intake rate.	Less than 20 inches to shale.	Less than 20 inches to shale.	High: texture--	Low.
Moderate: moderate permeability.	Moderate: medium compressibility.	Slopes--------	All features favorable.	All features favorable.	Moderate: texture.	Low.
Severe: moderately rapid permeability.	Moderate: fair stability; poor resistance to piping and erosion.	Flood hazard--	Flood hazard----	Flood hazard--	Low----------	Low.

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Two engineering systems are generally used to classify soils. These are the Unified system (9) developed by the Department of Defense, and the AASHO system adopted by the American Association of State Highway Officials (1).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. The soil materials are identified as coarse grained, which are gravel (G) and sand (S); fine grained, which are silt (M) and clay (C); and highly organic (Pt). Clean sands are identified by the symbols SW or SP; sands with fines of silt and clay, by the symbols SM and SC; silts and clays that have a low liquid limit, by the symbols ML and CL; and silts and clays that have a high liquid limit, by the symbols MH and CH.

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups on the basis of grain-size distribution, liquid limit, and plasticity index. The group A-1 is gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme is group A-7 that consists of clay soils that have low strength when wet and make the poorest subgrade. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest.

Estimated Engineering Properties of the Soils

Table 3 gives some estimated soil properties that are important in engineering. These estimates are based on tests made by the Texas Highway Department and the Bureau of Public Roads on samples of soils from counties having soils similar to those in Hardeman County, and on information gained through field experience. Mechanical analyses were not made of soil samples from Hardeman County.

The textural terms used to describe the soil material in the main horizons are those used by the U.S. Department of Agriculture. The properties described are for a typical profile, generally of each soil series. Some variation from these values should be anticipated.

The column that shows depth to bedrock gives the type of consolidated material and the depth at which it generally occurs.

Permeability refers only to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. Estimates of permeability are made by comparing soils of Hardeman County with soils of known permeability. The normal range of permeability for each soil is given in the table.

Available water capacity is that amount of capillary water in the soil available for plant growth after all free water has drained away.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Salinity limits the use of three soils in Hardeman County. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its corrosivity. Salinity is determined from the electrical conductivity of a saturated soil extract as expressed in millimhos per centimeter at a temperature of 25 degrees centigrade. The saline soils in this county and their range of salinity are: Abilene clay loam, saline, 0 to 1 percent slopes, less than 4 to more than 16 millimhos per centimeter; Altus fine sandy loam, saline, 0 to 1 percent slopes, less than 4 to more than 16 millimhos per centimeter; and Lincoln soils, less than 4 to 15 millimhos per centimeter.

Shrink-swell potential is an indication of the volume change to be expected in a soil with a change in moisture content. In general, soils that have high shrink-swell potential present hazards to the maintenance of engineering structures constructed in, on, or with such materials.

Engineering Interpretations

Table 4 gives the suitability of soil material for specific uses and describes the characteristics of each soil that affect each use. Some of the hazards and problems related to construction and maintenance also are given. The soil features shown for a given soil are based on estimated properties shown in table 3. Variations in the soil profile may affect the use of the soil.

Topsoil, ordinarily rich in organic matter, is used to topdress lawns, parks, gardens, roadbanks, and earthen dams. Ratings in table 4 indicate the suitability of each soil for this use. Soils are rated poor or fair as a source of topsoil when the soils are heavy, sticky, difficult to handle or work, eroded, saline, or low in organic-matter content.

Road subgrade is soil material excavated and used as borrow for highway subgrade. Suitability ratings for subgrade material are based on the performance of similar material used for this purpose in the past. In general, the most desirable soil material is well-graded sand. The least desirable are clays or organic materials. The major soil features considered in evaluating the soils for subgrade are shear strength, compressibility, workability, shrink-swell potential, bearing capacity, and compaction characteristics. Other considerations are stability, erosiveness, depth to water table, moisture content, and the presence of stones or boulders. Ratings of the suitability for use as subgrade are based on the estimated engineering properties of the soils given in table 3.

Highway location is influenced by those features and qualities of the soil that affect the overall performance of the soil for the location of highways. The entire profile of undisturbed soil without artificial drainage is evaluated. It is assumed,

however, that the surface layer, because of its higher organic-matter content, will be removed in construction.

Foundations for low buildings are affected primarily by the bearing capacity, shrink-swell potential, and shear strength of the soil. Interpretations are for buildings of less than three stories. Specific values of bearing strength are not assigned.

Septic tank filter fields and sewage lagoons are affected by such soil features as permeability, ground water levels, flooding hazards, land slopes, depth to rock or other impervious materials, and creviced material that may cause pollution of water supplies.

Suitability for reservoir areas depends primarily on the seepage rate of the soil. Highly plastic soils, such as Abilene clay loam, have low seepage. Coarse-textured soils, such as Tivoli fine sand, do not contain any binding or sealing material and have a high seepage rate.

Embankments for farm ponds are affected by soil stability, compaction characteristics, susceptibility to piping, shrink-swell potential, compacted permeability, compressibility, erosiveness, and gypsum content. Both the subsoil and substratum are evaluated, where they have different properties and are sufficiently thick to constitute a source of borrow material.

Dikes and levees are relatively low in height. Potential hazards are slight, and most of the soils in Hardeman County are suitable for this use.

Sprinkler irrigation can be used on all soils. It is the best method for coarse-textured, shallow, or rolling soils. Fine-textured and medium-textured soils that are nearly level, have uniform slopes, and are 20 inches or more deep can be irrigated by surface methods.

Terraces and diversions constructed from coarse-textured soils are difficult to maintain. Soil blowing and water erosion are serious hazards in maintaining terrace ridges and channels. Both level and graded terraces and diversions are constructed in the county.

Waterways on soils of Hardeman County have to be carefully stabilized. On highly erodible soils, accumulations of windblown material in waterways create a difficult maintenance problem.

Soil features affecting agricultural drainage are permeability, depth to clay or hard layers that slow or stop downward water movement, and depth to water table. In general, agricultural drainage is not a problem in Hardeman County. However, the following soils do have drainage problems: Abilene clay loam, saline; Altus fine sandy loam, saline; Lincoln fine sandy loam; Lincoln soils; and Lipan clay. Abilene, Altus, and Lincoln soils have a fluctuating water table 2 to 6 feet below the surface. Lipan clay is in depressions without outlets.

Ratings of corrosivity are for steel and concrete pipelines. Steel pipe should have a protective coating to retard corrosion when placed in any soil in the county.

FORMATION AND CLASSIFICATION OF THE SOILS

This section discusses the factors of soil formation and briefly describes important processes in the development of soil horizons. In addition, the current system of classifying soils is discussed and each soil series represented in the county is placed in the major categories of that system.

Factors of Soil Formation

Soil is the product of the interaction of the five major factors of soil formation. These factors are climate, living organisms (especially vegetation), parent material, topography, and time.

Climate

The warm-temperate subtropical climate in Hardeman County has promoted moderately rapid soil development. The climate is uniform throughout the county, although its effect is modified locally by runoff, and the differences between the soils generally are not due to climate.

Living Organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

Vegetation, primarily grasses, has affected soil formation in Hardeman County more than living organisms. The grass vegetation produced soils that generally are medium in organic-matter content. Some of the young, sandy, and shallow soils are low in organic matter.

Parent Material

Parent material is the unconsolidated mass from which a soil is formed. It determines the chemical and mineralogical composition of the soil.

The soils in Hardeman County developed in four kinds of parent material: residium derived from Permian shale, sandstone, limestone, and gypsum; sandy to clayey outwash or old alluvium; recent alluvium; and recent eolian materials.

Hardeman County is underlain by the Permian Formation, consisting mainly of rocks of the Double Mountain group (3). These Permian materials consist of sediments laid down in an ancient sea and are exposed over a large part of the southern and central parts of the county.

In the northern and east-central parts of the county, a mantle of outwash materials was deposited over the Permian red beds during the Pliocene to Pleistocene period (6). These outwash deposits vary from a few feet to about 50 feet in thickness and range from clayey to silty and sandy in texture.

The eolian materials are mostly along the Prairie Dog Town Fork of the Red River. These materials were blown from the broad sandy river channels and were deposited in a relatively narrow band parallel to the river. The coarser textured sands were deposited nearest the river. The finer sands were carried farther from the river. All soils that formed in these eolian materials are deep, but they are not well developed and lack distinct horizons.

Soils that formed in recent alluvium are on the flood plains of streams.

Topography

Topography, or relief, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. The topography of Hardeman County ranges from nearly level to steep.

Nearly level to gently sloping Tillman soils are deeper and have more distinct horizons than gently sloping to sloping Vernon and Weymouth soils on hilltops and ridges. They are different because the soils in lower positions receive additional water, have less runoff, and are subject to less erosion.

On steep soils, if the parent material is sandstone or other rock, geological erosion occurs almost as fast as the soil material is formed. An example is the very shallow Latom soils. These soils have been forming as long as the generally less sloping Cobb and Cosh soils but are much shallower.

Time

A long time is required for the formation of distinct horizons. The differences in length of time that parent material has been in place are generally reflected in the degree of development of the soil profile.

The soils in Hardeman County range from young to old. The young soils have very little horizon development, and the old soils have well-expressed soil horizons. Tivoli soils are an example of young soils that have little horizon development. Except for a slight accumulation of organic matter and darkening of the surface layer, Tivoli soils retain most of the characteristics of their fine sand parent material. Miles soils are an example of older soils that have well-developed soil horizons. They have distinct A and B horizons that bear little resemblance to the original parent material.

Formation of Soil Horizons

Three main processes were involved in the formation of horizons in the soils of Hardeman County: (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, and (3) formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active.

Accumulation of organic matter in the upper layer to form an A1 horizon has been important. The soils of Hardeman County range from medium to low in organic-matter content.

Some leaching of carbonates and bases has occurred in nearly all of the soils. Leaching of bases in soils usually precedes translocation of silicate clay minerals. Most of the soils of the county are moderately leached, and this has contributed to the development of horizons. Calcium carbonates have been leached from the upper horizons of most of the soils. The amount of rainfall, however, has not been great enough to leach all the carbonates from the soil. Many of the soils have a layer in which calcium carbonates have accumulated.

In several soils, the downward translocation of clay minerals has contributed to horizon development. Abilene, Acuff, Olton, and Miles soils have translocated silicate clays accumulated in the Bt horizons. The Bt horizons of these soils contain appreciably more silicate clay than the A horizons. These soils were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clays took place. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of Hardeman County.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us in understanding their behavior and their response to manipulation. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and rangeland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and later revised (5). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study, and readers who are interested in developments in this system should read the latest literature available (4, 8).

In table 5, each soil series in Hardeman County is placed in its family, subgroup, and order of the current classification system.

Placement of some soil series in the current system may change as more precise information becomes available.

TABLE 5.--CLASSIFICATION OF SOIL SERIES

Series	Family	Subgroup	Order
Abilene	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Acme	Loamy, mixed, thermic, shallow	Torriorthentic Haplustolls	Mollisols.
Acuff 1/	Fine-loamy, mixed, thermic	Aridic Paleustolls	Mollisols.
Altus	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Cobb	Fine-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Colorado	Fine-loamy, mixed, calcareous, thermic.	Typic Ustifluvents	Entisols.
Cosh	Loamy, mixed, thermic, shallow	Typic Rhodustalfs	Alfisols.
Cottonwood	Fine-carbonatic, thermic, shallow	Ustic Torriorthents	Entisols.
Hardeman	Coarse-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Hollister	Fine, mixed, thermic	Pachic Paleustolls	Mollisols.
Latom	Loamy, mixed, calcareous, thermic	Lithic Ustic Torriorthents	Entisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Lipan	Fine, montmorillonitic, thermic	Entic Pellusterts	Vertisols.
Mangum	Fine, mixed, calcareous, thermic	Vertic Ustifluvents	Entisols.
Mansker 1/	Fine-carbonatic, thermic	Aridic Calciustolls	Mollisols.
Miles	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Nobscot	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Olton 1/	Fine, mixed, thermic	Aridic Paleustolls	Mollisols.
Portales 1/	Fine-carbonatic, thermic	Aridic Calciustolls	Mollisols.
Quanah	Fine-silty, mixed, thermic	Typic Calciustolls	Mollisols.
Springer	Coarse-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Spur 2/	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.
Talpa	Loamy, mixed, thermic	Lithic Haplustolls	Mollisols.
Tillman 2/	Fine, mixed, thermic	Typic Paleustolls	Mollisols.
Tipton	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.
Treadway	Fine, mixed, thermic	Ustertic Camborthids	Aridisols.
Vernon 3/	Fine, mixed, thermic	Typic Ustochrepts	Inceptisols.
Weymouth	Fine-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Yahola	Coarse-loamy, mixed, calcareous, thermic.	Typic Ustifluvents	Entisols.

1/ The soils mapped in Hardeman County are more humid than is typical for the series. The named series is in an aridic subgroup.

2/ The soils mapped in Hardeman County are outside of the range for the series because they have mollic epipedons more than 20 inches thick.

3/ The soil mapped in Hardeman County is outside the range of the series because it is less than 20 inches thick.

TABLE 6.--TEMPERATURE

[Data from the weather

Month	Temperature							Average heating degree days 3/	Average number of days with 2/--			
	Average daily maximum	Average daily minimum	Average monthly	Record high	Year of occurrence	Record low	Year of occurrence		Maximum temperature of--		Minimum temperature of--	
									90° F. or above	32° F. or below	32° F. or below	0° F. or below
	°F.	°F.	°F.	°F.		°F.						
January---	52.5	25.8	39.2	86	1950	-4	1962	869	0	3	26	1
February--	57.0	30.1	43.6	91	1962	-5	1951	631	(4/)	2	19	0
March-----	65.8	36.7	51.3	100	1946	2	1948	477	1	1	12	0
April-----	76.2	48.2	62.2	104	1959	21	1936	167	5	0	2	0
May-------	84.1	58.3	71.2	108	1939	30	1960	25	11	0	(4/)	0
June------	93.3	67.6	80.5	113	1953	43	1947	3	20	0	0	0
July------	97.9	71.2	84.6	114	5/1944	50	1952	0	27	0	0	0
August----	98.3	70.5	84.4	119	1936	52	1962	0	28	0	0	0
September-	89.3	62.2	75.8	110	1952	40	5/1963	9	18	0	0	0
October---	78.8	51.3	65.1	101	5/1938	24	1957	116	5	0	1	0
November--	64.3	36.5	50.4	90	5/1945	8	1959	475	0	(4/)	11	0
December--	55.1	29.0	42.1	88	5/1955	2	1950	733	0	2	23	0
Year---	76.1	49.0	62.5	119	1936	-5	1951	3,505	115	8	94	1

1/ Data are mainly for the 30-year period, 1934-63.

2/ Average period of record is 10 years.

3/ Average period of record is 10 years. The number of heating degree-days for a given day is the base temperature of 65° F., less the mean temperature for that day. The total number of heating degree-days for a month is the sum of all the daily values.

AND PRECIPITATION[1/]

bureau station at Quanah]

Precipitation												
Driest year (1956)	Wettest year (1941)	Average total	Greatest daily	Year of occurrence	Snow, sleet			Average number of days with precipitation of--			One year in 10 will have--	
					Average monthly	Greatest monthly	Year of occurrence	0.10 inch or more	0.50 inch or more	1.00 inch or more	Less than--	More than--
In.	In.	In.	In.		In.	In.					In.	In.
0.15	1.04	0.77	1.27	1946	2.2	9.7	1949	2	0	0	0.04	1.76
.77	2.33	.93	1.80	1938	2.4	11.0	1945	2	(4/)	(4/)	.02	2.33
.03	.91	1.35	2.16	1939	.9	12.0	1942	3	1	(4/)	.02	2.41
.36	4.22	2.50	6.60	1942	.4	10.0	1938	3	1	1	.28	4.22
3.27	11.97	4.14	5.59	1941	0	0	----	6	3	1	.67	7.95
.99	9.07	3.23	4.25	1939	0	0	----	5	3	2	.44	5.82
1.22	1.50	1.89	2.62	1950	0	0	----	4	2	1	.21	4.43
.59	4.26	1.83	2.62	1940	0	0	----	2	1	(4/)	.19	4.22
.20	6.60	2.94	4.43	1942	0	0	----	3	2	1	.12	6.72
2.49	10.32	2.64	3.62	1955	0	0	----	4	2	2	.08	6.38
.22	.48	1.18	2.07	1963	.2	3.6	1957	2	1	1	0	2.85
1.74	.90	.97	1.59	1947	1.6	18.0	1942	2	1	(4/)	.02	2.47
12.03	53.60	24.37	6.60	1942	7.7	18.0	1942	38	17	9	15.87	30.19

4/ Less than one-half.

5/ Also on earlier dates, months, or years.

This section provides information about the climate, physiography, relief, drainage, and industries of Hardeman County.

Climate [4/]

Hardeman County has a warm-temperate subtropical climate with dry winters and low summer humidity. The county lies in a transitional zone between the permanently humid region of East Texas and the dry steppe climate of the High Plains. A summary of temperature and precipitation data from the Quanah station is given in table 6, on pages 78-79.

Annual rainfall averages between 24 and 25 inches, but the distribution is extremely erratic. It varies over a wide range from month to month and from year to year. Thundershowers are more likely than steady rains. They are unreliable and occur in scattered areas. Total annual rainfall varies from less than half to more than double the yearly average. Dry spells, when no precipitation occurs for 30 days or more, have occurred in all months except April, May, and June. Maximum average monthly rainfall occurs in May because thunderstorm activity reaches its peak during this month.

Snow is uncommon and frequently melts as it falls, although snow is occasionally heavy. For example, 18.0 inches of snow fell during December 1942, while no measurable snow fell during this month in 19 of the 30 years from 1934 to 1963.

Hardeman County lies in the path of cold air masses that push down from the north late in fall, in winter, and early in spring. These "northers" cause abrupt changes in temperature. The area is subject to a wide range of temperatures from day to day, and sometimes from hour to hour, but winters are relatively mild. Summers are hot, and daily maximums often are more than 100° F. The highest summer temperatures are usually accompanied by low humidity.

The prevailing wind direction is southerly during all months except January and February, when the "northers" are frequent. Average wind velocity varies little from month to month. Strongest winds are associated with severe thunderstorms.

Hailstorms may occur anytime from about March through October, but they are more frequent late in spring and early in summer when thunderstorms are common. Normally, the area affected by an individual hailstorm is small, and the degree of destruction varies. Severe windstorms follow about the same seasonal pattern as hailstorms.

Sunshine is abundant the year round. Cloudiness is most frequent during winter and early in spring. Average annual humidity is about 76 percent at 6:00 a.m. and about 49 percent at both noon and 6:00 p.m. Average annual evaporation from lakes is estimated at 66 inches. About two-thirds of this evaporation occurs in the warm season, May through October.

The average date of the last temperature of 32 degrees or lower in the spring is March 31st, and the average date of the first freeze in the fall is November 7. The average length of the freeze-free period based on 32° F. is 221 days, and the average period based on 28° F. is 242 days.

Physiography, Relief, and Drainage

Hardeman County is on the divide between the Prairie Dog Town Fork of the Red River and the Pease River. The county slopes gradually from west to east, and drainage is dominantly eastward through Groesbeck Creek and Wanderers Creek. Comparatively little water drains directly into Prairie Dog Town Fork or the Pease River.

The elevation of the county ranges from about 1,250 feet where the Pease River crosses the east county line, to 1,855 feet at a high point on the sand ridge in the northwestern part of the county, about 3 miles southwest of Hooleyann Church.

The overall topography of the county consists of: (1) a strip of rough land, 3 to 5 miles wide, on the south side of the county along the Pease River; (2) a broad, central, east-west belt of comparatively smooth country; and (3) a high broad sand ridge, 2 to 5 miles wide, along the north side of the county, paralleling Prairie Dog Town Fork of the Red River. The central belt of smooth country slopes eastward and is cut into three minor plains by two north-south escarpments or belts of sloping country.

In most places well water is obtained at depths ranging from 50 to 150 feet. The supply is sufficient for domestic and livestock use. Some areas have enough for irrigation. The supply of well water is generally obtained at less depth and is more abundant in the eastern part of the county, especially around the lower edges of areas of sandy soils. Both branches of Groesbeck Creek are permanent streams. Wanderers Creek is a permanent stream east of the seeps and springs about 2 miles southwest of Chillicothe, Texas. Lake Pauline is the largest body of water in the county. It is a private reservoir and recreational area.

Industries

Industries in the county include five cotton gins. Two are at Quanah, two are at Chillicothe, and one is at Goodlett. A gypsum mill is located at Acme, which is a few miles west of Quanah. A cotton compress, cottonseed oil mill, creamery, and meat-packing plant are located at Quanah. An oilfield has been developed about half way between Quanah and Chillicothe. A few oil wells are in other parts of the county.

4/ Prepared by ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

LITERATURE CITED

(1) American Association of State Highway Officials.
1961. Standard Specifications for Highway Materials and Methods of Sampling and Testing. Ed. 8, 2 v., illus.

(2) Baldwin, Mark, Kellogg, Charles E., and Thorp, James.
1938. Soil Classification. U.S. Dept. Agr. Ybk.: pp. 979-1001, illus.

(3) Sellards, E.H., Adkins, W.S., and Plummer, F.B.
1932. Geology of Texas. v. 1, Stratigraphy. Univ. of Tex. Bul. 3232, 1007 pp., illus.

(4) Simonson, Roy W.
1962. Soil Classification in the United States. Sci. 137: 1027-1034.

(5) Thorp, James, and Smith, Guy D.
1949. Higher Categories of Soil Classification: Order, Suborder, and Great Soil Group. Soil Sci., 67: 117-126.

(6) Udden, J.A., Baker, C.L, and Bose, Emil.
1916. Review of the Geology of Texas. Univ. of Tex. Bul. 44, 164 pp., illus.

(7) United States Department of Agriculture.
1951. Soil Survey Manual. U.S. Dept. Agr. Handbook 18, 503 pp., illus.

(8) _____
1960. Soil Classification, A Comprehensive System, 7th Approximation. 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(9) United States Department of Defense.
1968. Unified Soil Classification System for Roads, Airfields, Embankments, and Foundations. MIL-STD-619B, 30 pp., illus.

GLOSSARY

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is poor.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The amount of water a soil can hold and make available to plants. It is the numerical difference between the percentage of water at field capacity and the percentage of water at the time the plants wilt. The rate is expressed as inches of water per inch of soil depth.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the southwestern states. The material may consist of soft thin layers in the soil or of hard thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent 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 presssure 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 and brittle; little affected by moistening.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Erosion pavement. A layer of gravel or stones on the ground surface that remains after the fine particles are removed by wind or water. Desert pavements result from exposure to dry winds.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gravel. Coarse, rounded, or angular fragments, not prominently flattened, that range in size from 2 millimeters to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accmulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are--

Border.--Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.--Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.--Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.--Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.--Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.--Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.--Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.--Irrigation water, released at high points, flows onto the field without controlled distribution.

Loam. Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate, such as crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In other words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Saline and alkali classes. These classes express relative content of salts or alkali as follows:

Class 0.--Soils free of excess salt or alkali. Practically no crops are inhibited by or show evidence of injury from excess of salts or alkali.

Class 1.--Soils slightly affected by salt or alkali. The growth of sensitive crops is inhibited but that of salt-tolerant crops may not be.

Class 2.--Soils moderately affected by salt or alkali. Crop growth is inhibited and no crop does well.

Class 3.--Soils strongly affected by salt or alkali. Only a few kinds of plants survive.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--

platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

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."

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 47.
Engineering use of the soils, tables 3 and 4, pages 56 through 73.

Map symbol	Mapping Unit	Page	Capability Unit Dryland Symbol	Dryland Page	Capability Unit Irrigated Symbol	Irrigated Page	Range Site Name	Range Site Page
AbA	Abilene clay loam, 0 to 1 percent slopes---	9	IIc-1	36	I-1	41	Deep Hardland	50
AbB	Abilene clay loam, 1 to 3 percent slopes---	9	IIe-1	36	IIe-1	42	Deep Hardland	50
AcA	Abilene clay loam, saline, 0 to 1 percent slopes----------	9	IVw-2	40	(1/)	--	Deep Hardland	50
Ad	Acme-Cottonwood complex----------	9						
	Acme soil----------	--	IVe-6	39	(1/)	--	Deep Hardland	50
	Cottonwood soil----------	--	IVe-6	39	(1/)	--	Gypland	52
Ae	Active dunes----------	10	VIIIe-1	41	(1/)	--	----------	--
AfA	Acuff loam, 0 to 1 percent slopes----------	10	IIc-2	36	I-4	42	Mixedland	50
AfB	Acuff loam, 1 to 3 percent slopes----------	11	IIe-2	36	IIe-2	42	Mixedland	50
AlA	Altus fine sandy loam, 0 to 1 percent slopes----------	11	IIe-4	37	IIe-4	43	Sandy Loam	50
AtA	Altus fine sandy loam, saline, 0 to 1 percent slopes----------	11	IVw-2	40	(1/)	--	Sandy Loam	50
Ba	Badland----------	12	VIIIs-1	41	(1/)	--	----------	--
CbB	Cobb fine sandy loam, 1 to 3 percent slopes----------	12	IIIe-4	38	(1/)	--	Sandy Loam	50
Cd	Colorado and Spur clay loams----------	13	Vw-1	40	(1/)	--	Valley	48
Ce	Colorado clay loam----------	13	I-1	36	I-2	42	Valley	48
Cf	Colorado silt loam----------	13	I-1	36	I-4	42	Bottomland	49
ChB	Cosh fine sandy loam, 1 to 3 percent slopes----------	14	IVe-6	39	(1/)	--	Sandy Loam	50
Cl	Cosh-Latom complex----------	14						
	Cosh soil----------	--	IVe-6	39	(1/)	--	Sandy Loam	50
	Latom soil----------	--	IVe-6	39	(1/)	--	Very Shallow.	52
Ct	Cottonwood-Vernon complex----------	15						
	Cottonwood soil----------	--	VIIs-1	41	(1/)	--	Gypland	52
	Vernon soil----------	--	VIIs-1	41	(1/)	--	Shallow Redland	51
HaA	Hardeman fine sandy loam, 0 to 1 percent slopes----------	15	IIe-6	37	IIe-6	43	Sandy Loam	50
HaB	Hardeman fine sandy loam, 1 to 3 percent slopes----------	16	IIIe-5	38	IIe-8	44	Sandy Loam	50
HaC	Hardeman fine sandy loam, 3 to 5 percent slopes----------	16	IVe-3	39	(1/)	--	Sandy Loam	50
HaE2	Hardeman fine sandy loam, 8 to 30 percent slopes, eroded----------	16	VIe-3	40	(1/)	--	Sandy Loam	50
Hg	Hilly gravelly land----------	16	VIs-1	41	(1/)	--	Gravelly	51
HoA	Hollister clay loam, 0 to 1 percent slopes----------	17	IIc-1	36	I-1	41	Deep Hardland	50
HoB	Hollister clay loam, 1 to 3 percent slopes----------	17	IIe-1	36	IIe-1	42	Deep Hardland	50
La	Latom-Rock outcrop complex----------	18						
	Latom soil----------	--	VIIs-1	41	(1/)	--	Very Shallow	52
	Rock outcrop----------	--	VIIs-1	41	(1/)	--	----------	--
Lc	Lincoln soils----------	18	Vw-2	40	(1/)	--	Sandy Bottomland	49
Ln	Lincoln fine sandy loam----------	19	IVe-5	39	(1/)	--	Sandy Bottomland	49
Lp	Lipan clay----------	19	IIIw-1	38	(1/)	--	Deep Hardland	50
Ma	Mangum clay loam----------	20	IIc-1	36	I-1	41	Valley	48
McB	Mansker clay loam, 1 to 3 percent slopes---	20	IIIe-7	38	IIIe-7	45	Deep Hardland	50

See footnote at end of table.

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GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping Unit	Page	Capability Unit Dryland Symbol	Dryland Page	Capability Unit Irrigated Symbol	Irrigated Page	Range Site Name	Range Site Page
MfA	Miles fine sandy loam, 0 to 1 percent slopes	22	IIe-4	37	IIe-4	43	Sandy Loam	50
MfB	Miles fine sandy loam, 1 to 3 percent slopes	22	IIe-5	37	IIe-5	43	Sandy Loam	50
MfC	Miles fine sandy loam, 3 to 5 percent slopes	22	IIIe-4	38	(1/)	--	Sandy Loam	50
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded	22	IVe-7	40	(1/)	--	Sandy Loam	50
MlB	Miles loamy fine sand, 0 to 3 percent slopes	23	IIIe-6	38	IIIe-6	44	Sandyland	51
MlC	Miles loamy fine sand, 3 to 5 percent slopes	23	IVe-4	39	(1/)	--	Sandyland	51
No	Nobscot fine sand, undulating	24	VIe-5	41	(1/)	--	Deep Sand	50
OcA	Olton clay loam, 0 to 1 percent slopes	24	IIc-1	36	I-1	41	Deep Hardland	50
OcB	Olton clay loam, 1 to 3 percent slopes	25	IIe-1	36	IIe-1	42	Deep Hardland	50
OlA	Olton loam, 0 to 1 percent slopes	25	IIc-1	36	I-1	41	Deep Hardland	50
OlB	Olton loam, 1 to 3 percent slopes	25	IIe-1	36	IIe-1	42	Deep Hardland	50
PoA	Portales clay loam, 0 to 1 percent slopes	26	IIc-2	36	I-2	42	Deep Hardland	50
QcB	Quanah clay loam, 1 to 3 percent slopes	27	IIe-2	36	IIe-2	42	Deep Hardland	50
Qt	Quanah-Talpa complex	27						
	Quanah soil	--	IVe-6	39	(1/)	--	Deep Hardland	50
	Talpa soil	--	IVe-6	39	(1/)	--	Very Shallow	52
SgB	Springer loamy fine sand, undulating	27	IVe-5	39	IVe-3	45	Sandyland	51
SgD	Springer loamy fine sand, hummocky	28	VIe-4	41	(1/)	--	Sandyland	51
Sp3	Springer soils, severely eroded	28	VIe-4	41	(1/)	--	Sandyland	51
Sr	Spur clay loam	28	I-1	36	I-2	42	Valley	48
Ta	Talpa soils	29	VIIs-1	41	(1/)	--	Very Shallow	52
Tc	Talpa-Vernon complex	29						
	Talpa soil	--	VIIs-1	41	(1/)	--	Very Shallow	52
	Vernon soil	--	VIIs-1	41	(1/)	--	Shallow Redland	51
TmA	Tillman clay loam, 0 to 1 percent slopes	30	IIs-1	37	IIs-1	44	Deep Hardland	50
TmB	Tillman clay loam, 1 to 3 percent slopes	30	IIIe-1	37	IIIe-1	44	Deep Hardland	50
Tp	Tipton loam	31	I-1	36	I-4	42	Mixedland	50
Tv	Tivoli fine sand	31	VIIe-1	41	(1/)	--	Deep Sand	51
Tw	Treadway clay, overflow	31	Vw-1	40	(1/)	--	Clay Flats	49
VeB	Vernon clay loam, 1 to 3 percent slopes	32	IVe-6	39	IVe-5	45	Shallow Redland	51
Vr	Vernon-Badland complex	32						
	Vernon soil	--	VIIs-1	41	(1/)	--	Shallow Redland	51
	Badland	--	VIIs-1	41	(1/)	--	----------	--
WeB	Weymouth clay loam, 1 to 3 percent slopes	33	IIIe-7	38	IIIe-7	45	Shallow Redland	51
WvD	Weymouth and Vernon clay loams, 3 to 8 percent slopes	33	VIe-1	40	(1/)	--	Shallow Redland	51
Ya	Yahola very fine sandy loam	34	I-1	36	I-4	42	Bottomland	49

1/ Generally not irrigated or not suitable for irrigation.

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