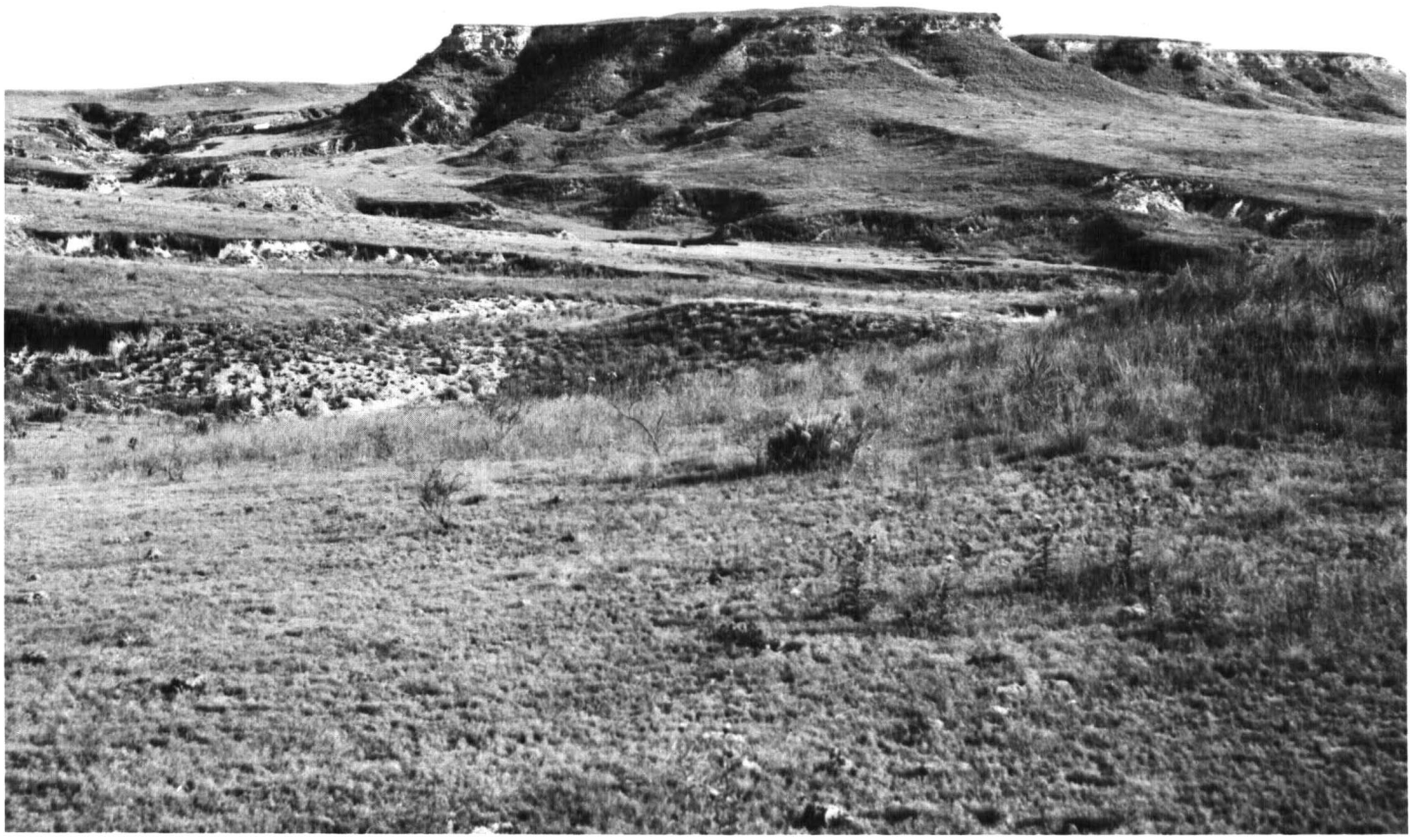
SOIL SURVEY OF

Hemphill County, Texas



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

Issued March 1974

Major fieldwork for this soil survey was done in the period 1960–65. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the 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 Hemphill County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, 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 Hemphill County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. 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. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and range site in which the soil has been placed.

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 capability groups, range sites, and wildlife sites.

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

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.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Engineering Uses of the Soils," especially in the part that gives information about soil features that affect engineering practices.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, 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 in the County and others not familiar with Hemphill County will be interested in the section, "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

Cover: **Open prairie grassland characteristic of Hemphill County, Texas. The soils are in the Berda-Potter complex.**

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Issued March 1974

SOIL SURVEY OF HEMPHILL COUNTY, TEXAS

BY JACK C. WILLIAMS, ANTHONY J. WELKER, FRANKIE F. WHEELER, AND HARRY F. McEWEN, SOIL CONSERVATION SERVICE

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

HEMPHILL COUNTY is in the eastern edge of the Texas Panhandle. It is bordered on the east by Roger Mills and Ellis Counties in Oklahoma and on the north, west, and south respectively by Lipscomb, Roberts, and Wheeler Counties in Texas (fig. 1). Hemphill County is

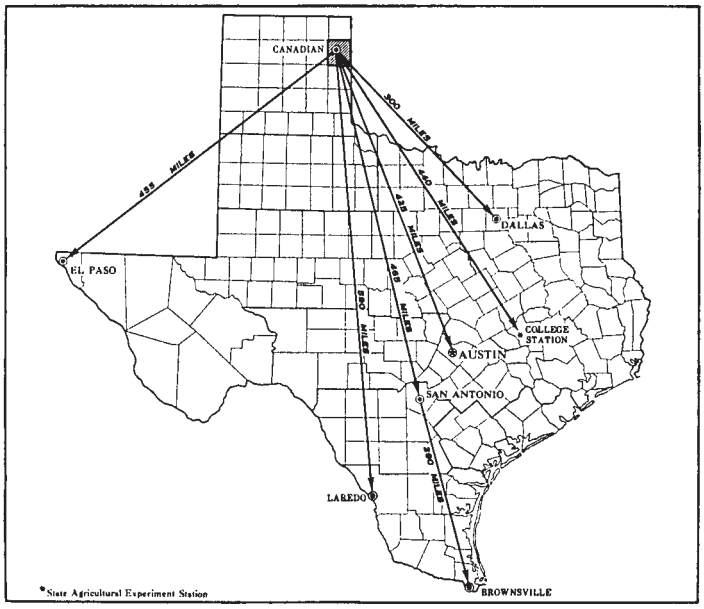

Figure 1.—**Location of Hemphill County in Texas.**

about 30 miles square, containing 594,560 acres and a population of about 3,100 people. Except for areas along some main streams, it is a complex, sloping, treeless plain.

Canadian, the county seat, has a population of about 2,300 and is located in the northwestern part of the county at the junction of Red Deer Creek and the Canadian River. It is served by the Atchison, Topeka, and Santa Fe Railway Company and two U.S. Highways, Numbers 60 and 83.

Ranching is the main enterprise of Hemphill County, followed by dryland farming. Wheat and grain sorghum are the principal crops. Income from oil and gas production and leasing has increased in recent years.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Hemphill 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 the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by 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. 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. Miles and Springer, 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 layer 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, Springer fine sandy loam, 1 to 3 percent slopes, is one of several phases within the 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 woodlands, 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 Hemphill County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed 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. Berda-Potter 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." Berda and Mansker loams, 3 to 6 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. Rough broken land is a land type in Hemphill 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 kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and 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 adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Hemphill 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 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 land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Hemphill County are discussed in the following pages. The texture given in the title of each soil association is that of the surface layer of the major soils. For example, in the title for association 1, the words "sandy soils" refer to texture of the surface layer.

1. *Tivoli-Springer association*

Deep, sandy soils on upland dunes and hummocks

This association consists of duned to hummocky, sandy soils on uplands. It makes up about 35 percent of the county. Tivoli soils cover about 41 percent of the association (fig. 2), Springer soils 34 percent, and less extensive soils 25 percent.

The Tivoli soils have a brown, neutral, fine sand surface layer about 8 inches thick. This layer is underlain by strong-brown, loose fine sand that extends to a depth of more than 60 inches.

The Springer soils have a brown, very friable, loamy fine sand surface layer about 8 inches thick. The next layer is brown fine sandy loam 7 inches thick. It is underlain by loamy fine sand and fine sand that extends to a depth of more than 60 inches.

Less extensive soils in this association are the Likes and Mobeetie soils that occupy some ridges and hills near the rivers; the Lincoln and Sweetwater soils that are on the bottom lands; and the Dalhart soils and some finer textured Springer soils that are in undulating areas between hummocks and dunes. Some areas of Miles soils and Active dunes also are included.

Nearly all of this association is in range. A few small areas of the Dalhart and Springer soils are cultivated.

2. *Dalhart-Dumas-Springer association*

Deep, loamy, nearly level to sloping soils on uplands

This association consists of nearly level to sloping soils on interstream divides. It covers about 26 percent of the

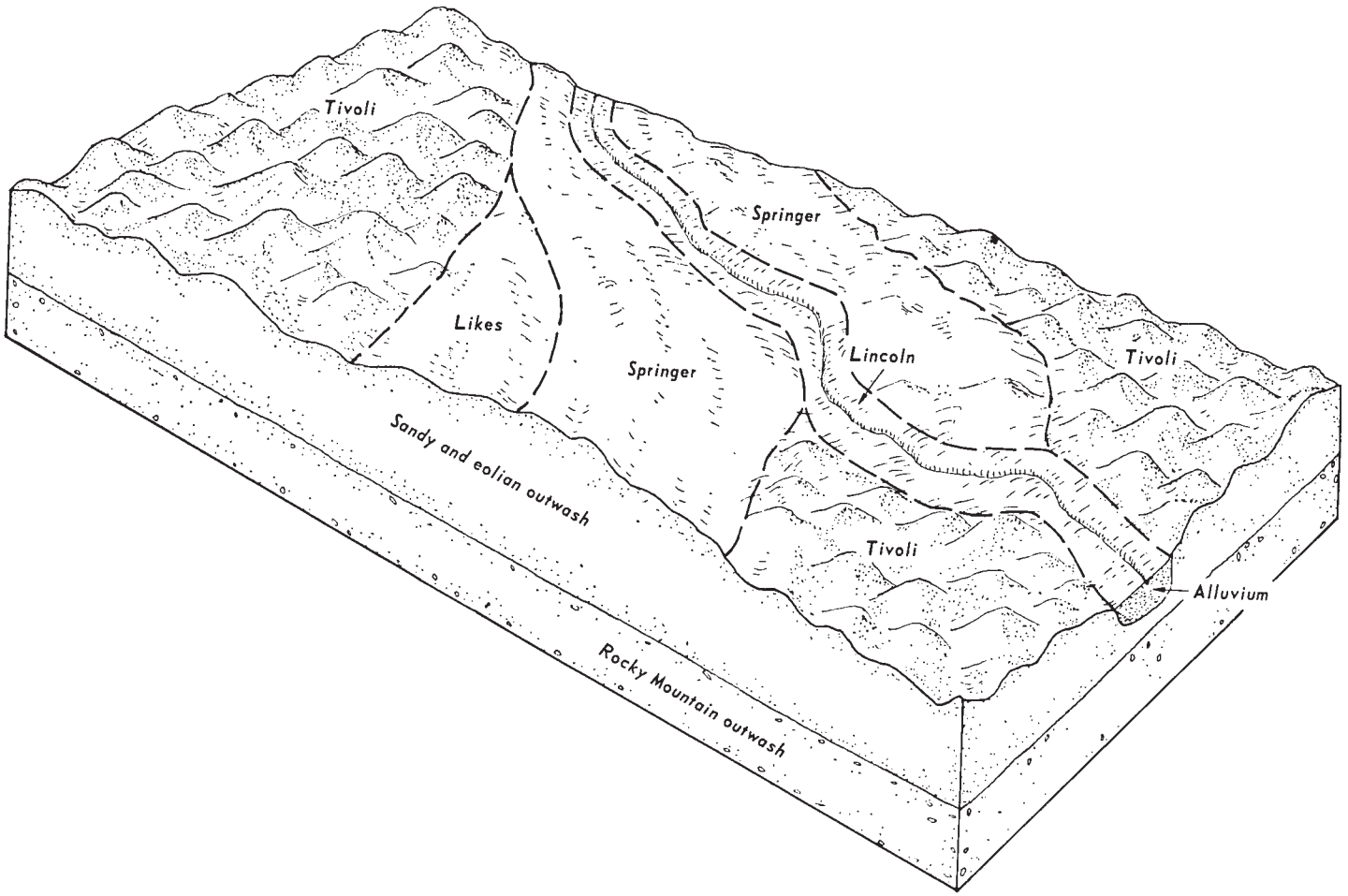

***Figure 2.*—Typical pattern of soils in the Tivoli-Springer association.**

county. Dalhart soils make up about 25 percent of the association, Dumas soils 22 percent, Springer soils 21 percent, and other soils 32 percent.

The Dalhart soils have a dark-brown, friable, fine sandy loam surface layer about 8 inches thick. The next layer is dark-brown, friable sandy clay loam 12 inches thick. The underlying material is fine sandy loam that extends to a depth of more than 60 inches.

The Dumas soils have a dark-brown, friable, loam surface layer about 6 inches thick. The next layer is clay loam about 44 inches thick. The underlying material is calcareous silt loam that extends to a depth of more than 60 inches.

This Springer soil has a brown, very friable, fine sandy loam surface layer about 12 inches thick. The next layer is friable, brown fine sandy loam that is underlain by reddish-yellow loamy fine sand.

Less extensive areas of the nearly level Pullman, Richfield, and Randall soils occupy high plains. The Mansker and Quanah soils are gently sloping and are in convex areas. The Potter, Berda, Bippus, and Mobeetie soils are in, or associated with, the stream valleys and drainageways that dissect undulating areas. The Miles soils and a coarser textured Springer soil are in stream valleys. The Spur, Guadalupe, and Lincoln soils are on bottom lands.

This association is in crops and range. Most of the crops grown in the county are grown in this association. The smoother areas are used for crops; the steeper areas along dissecting streams are in range.

3. *Mobeetie-Berda-Potter association*

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

This association consists of gently sloping to steep soils along the major rivers and creeks. The mainly rolling landscape is dissected by deeply entrenched intermittent streams. Active geologic erosion is evident along these natural drains.

This association occupies about 26 percent of the county. Mobeetie soils make up about 26 percent of the association, Berda soils 22 percent, Potter soils 22 percent, and other soils 30 percent.

The Mobeetie soils have a brown, calcareous, fine sandy loam surface layer about 6 inches thick that is underlain by pale-brown, calcareous fine sandy loam. Caliche pebbles are scattered throughout the soil profile. These

soils occupy foot slopes below the Potter, Mansker, and Berda soils and the caprock escarpments.

The Berda soils have a grayish-brown, calcareous, loam surface layer about 14 inches thick. The lower layers are calcareous, brown clay loam and loam. A few caliche pebbles are scattered throughout the soil profile. These soils are on foot slopes below areas of Potter soils and caprock escarpments, and in other less sloping areas they occur with the Mansker soils.

The calcareous Potter soils have a grayish-brown, friable, loam surface layer about 5 inches thick. This is underlain by powdery, weakly cemented, and slightly platy to platy caliche layers several feet thick. These soils are on ridges and along the resistant caprock.

Other soils and land types in this association are Rough broken land, which occupies steep areas on the sides of valleys and along canyons near the edge of a caprock; the Mansker and Richfield soils on ridges and in convex areas; and the concave Bippus soils in drainageways above the Spur, Guadalupe, and Lincoln soils that occupy bottom lands. The Likes, Enterprise, Springer, and Tipton soils are in stream valleys.

Most of this association is in large ranches and is used for range. A few small fields on the broader ridges and and in the valleys grow supplemental feed for livestock.

4. Lincoln-Sweetwater association

Sandy and loamy soils on bottom lands

This association consists of nearly level to undulating soils on bottom lands. Most areas flood occasionally to frequently and have a water table at varying depths.

This association occupies about 8 percent of the county. Lincoln soils make up about 50 percent of this association (fig. 3), creek and river channels 25 percent, Sweetwater soils 20 percent, and minor soils 5 percent.

The calcareous Lincoln soils have a brown, loose, loamy fine sand surface layer that is underlain by stratified sandy material.

The shifting creek and river channels consist of mixed sands and gravel deposited in braided patterns.

The Sweetwater soils have a dark-gray, calcareous, silty clay loam surface layer about 14 inches thick. The next layer is a grayish-brown, calcareous clay loam about 10 inches thick. The underlying material is very pale brown loamy fine sand that is commonly stratified and saturated with water. These nearly level soils are on bottom lands that seldom overflow, but water resulting from underground seepage stands on the surface in places.

Minor soils in this association are the Spur and Guadalupe, which occupy small areas mostly in the upper

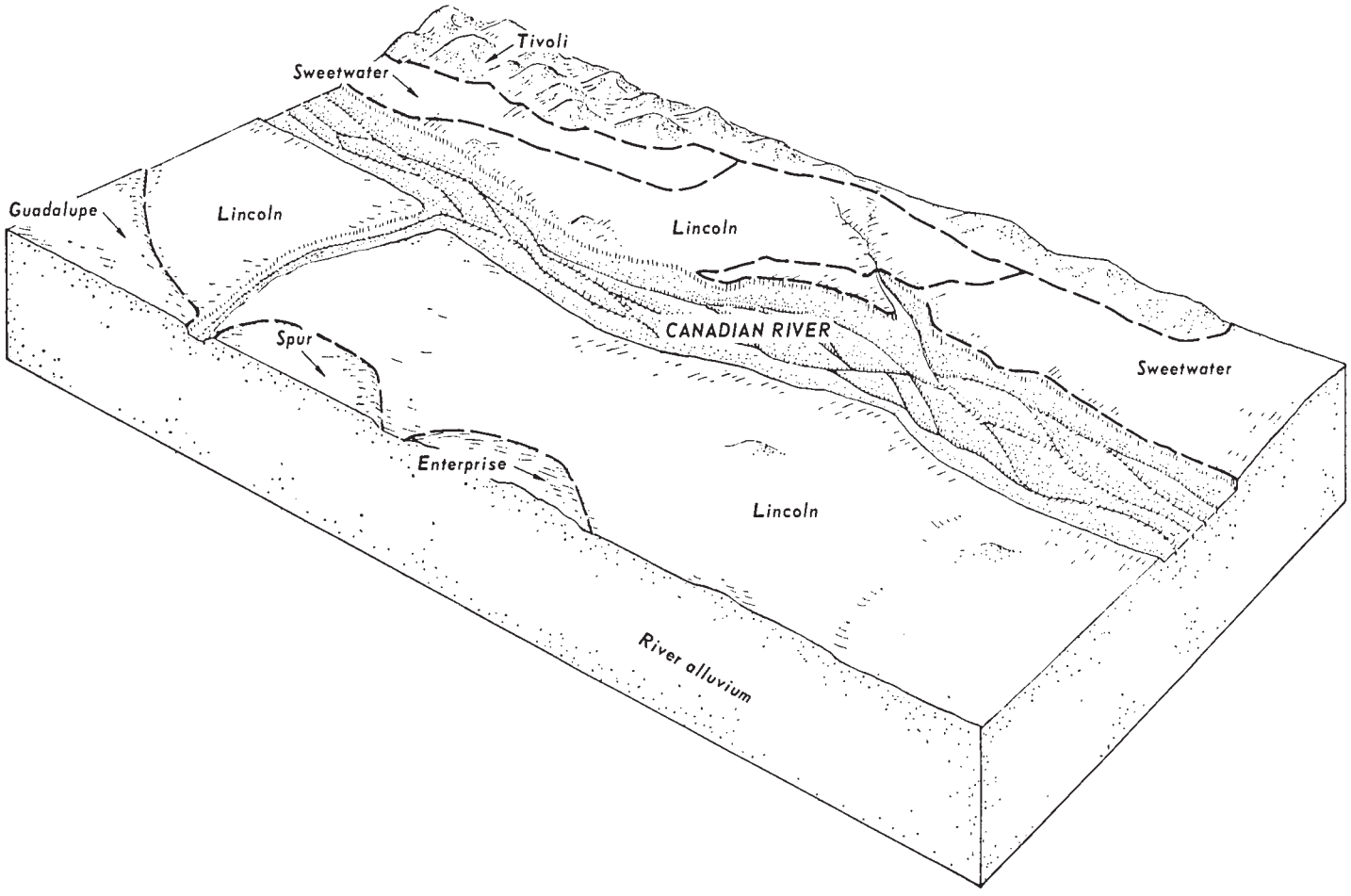

Figure 3.—Typical pattern of soils in the Lincoln-Sweetwater association.

part of drainage tributaries; the Enterprise soils on uplands that join the outer edges of flood plains; and the Likes and Tivoli soils on low ridges or dunes on bottom lands.

This association is mostly in native grass range and hay meadows. Only a few small areas of the Spur and Guadalupe soils are cultivated.

5. *Enterprise-Tipton association*

Deep, loamy, nearly level to sloping soils on high terraces

This association consists of nearly level to sloping terraces along rivers. These terraces are 50 to 200 feet above the river channels.

This association occupies about 3 percent of the county. Enterprise soils make up about 46 percent of the association (fig. 4), Tipton soils 37 percent, and other soils 17 percent.

The Enterprise soils have a brown, calcareous, very fine sandy loam surface layer about 8 inches thick. Lower layers are light-brown, calcareous very fine sandy loam that extends to a depth of more than 60 inches. In most areas Enterprise soils lie below the Tipton soils.

The Tipton soils have a dark grayish-brown, granular, silty clay loam surface layer about 19 inches thick. The next layer is dark-brown silty clay loam 19 inches thick. The next layer is 12 inches of grayish-brown silty clay loam. The underlying material is yellowish-brown, calcareous silty clay loam that extends to a depth of more than 64 inches. These nearly level and gently sloping soils are on terraces.

Other soils in this association are the Likes, Berda, Mobeetie, Tivoli, and Springer. These are sloping soils that lie below areas of Tipton soils. The Bippus, Spur, Guadalupe, and Lincoln soils are in valleys and are dissected by streams.

Most areas of the Tipton soils in this association are cultivated. The nearly level to gently sloping areas of Enterprise soils also are tilled; the steeper areas are in range.

6. *Miles-Patricia association*

Deep, sandy, nearly level to sloping soils on uplands

This association occupies nearly level to sloping uplands that are characterized by undulating topography interrupted by a few low dunes and ridges and some minor drainageways.

This association covers about 2 percent of the county. Miles soils make up about 77 percent of the acreage (fig. 5), Patricia soils 13 percent, and other soils 10 percent.

The Miles soils have a brown, loamy fine sand surface layer 8 inches thick. This is underlain by a friable, brown sandy clay loam layer about 10 inches thick. The next layer is reddish-brown sandy clay loam, 30 inches thick, which overlies brown sandy clay loam that extends below a depth of 60 inches.

The Patricia soils have a grayish-brown, fine sand surface layer about 5 inches thick. The next layer is pale-brown fine sand 12 inches thick. It is underlain by yellowish-red to reddish-yellow sandy clay loam and loamy fine sand.

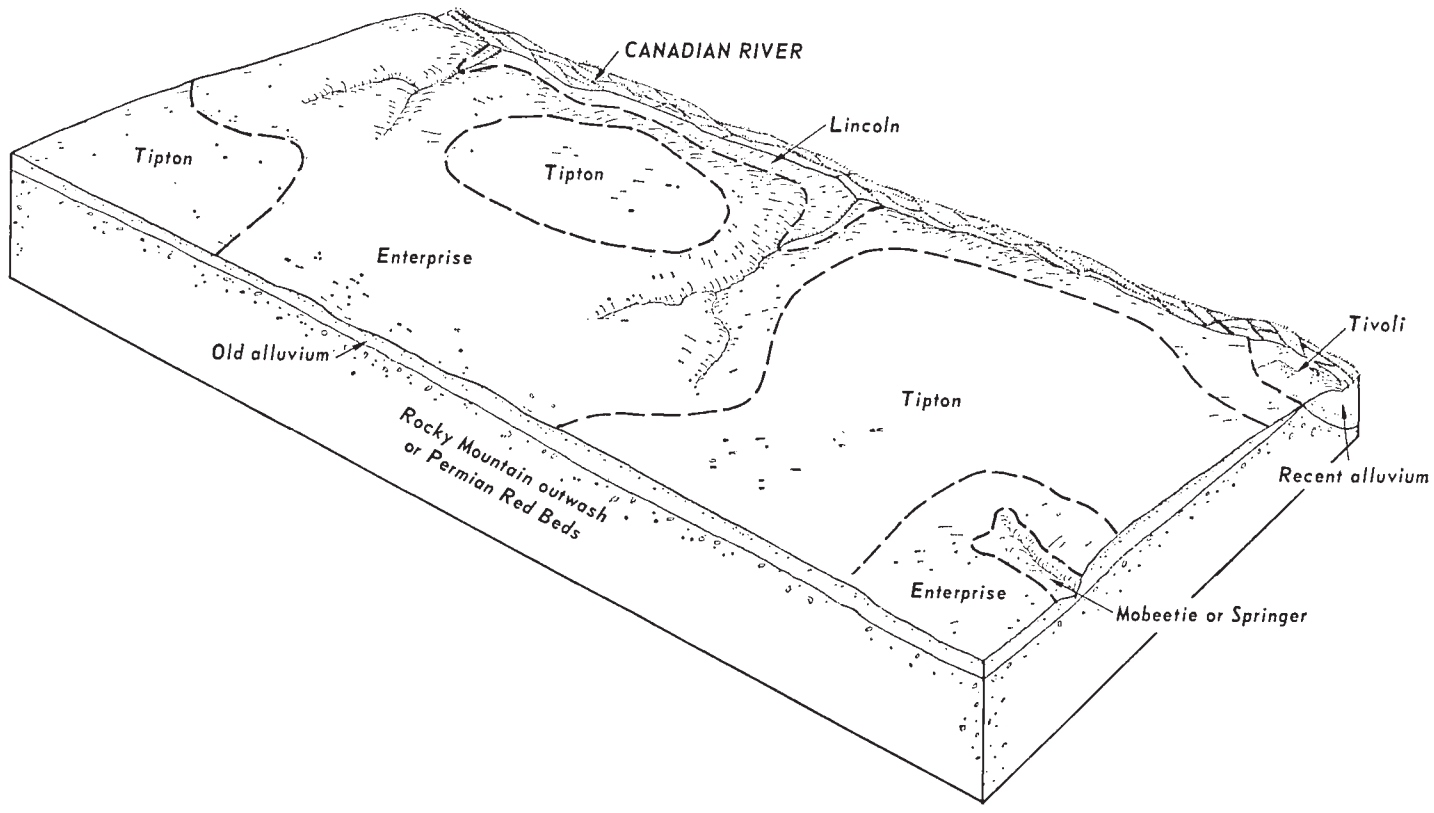

Figure 4.—Typical pattern of soils in the Enterprise-Tipton association.

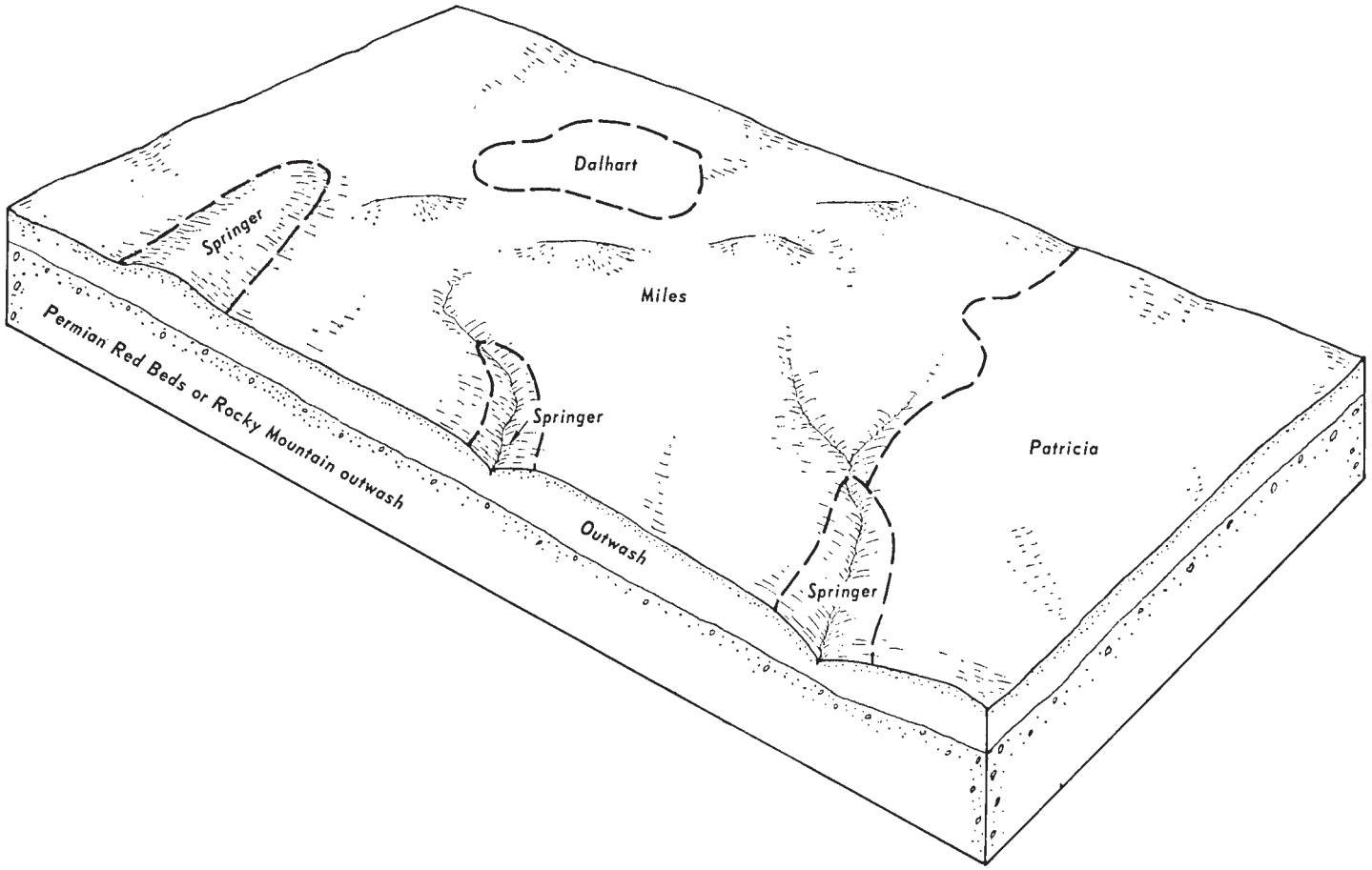

Figure 5.—**Typical pattern of soils in the Miles-Patricia association.**

Other soils in this association are Springer soils that are in undulating and hummocky areas and on the sides of some drainageways; a few small dunes of Tivoli soils close to some of the drainageways; and Dalhart and Mobeetie soils on low ridges.

This association is in crops and range.

Descriptions of the Soils

This section describes the soil series and mapping units in Hemphill County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil.

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

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

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

Active Dunes

Active dunes (Ad) is a miscellaneous land type consisting of active sand dunes that are constantly shifting and

[1] Italic numbers in parentheses refer to Literature Cited, page 53.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Active dunes	2,336	0.4	Miles loamy fine sand, 3 to 6 percent slopes	5,784	1.0
Berda and Mansker loams, 3 to 6 percent slopes	15,065	2.5	Mobeetie fine sandy loam, 1 to 3 percent slopes	451	.1
Berda-Potter complex	36,920	6.2	Mobeetie fine sandy loam, 3 to 5 percent slopes	6,095	1.0
Bippus clay loam, 1 to 3 percent slopes	3,702	.6	Mobeetie-Likes complex	4,135	.7
Bippus clay loam, 3 to 5 percent slopes	2,739	.5	Mobeetie-Potter complex	72,927	12.3
Bippus fine sandy loam, 1 to 3 percent slopes	2,284	.4	Patricia fine sand, 0 to 3 percent slopes	1,875	.3
Bippus fine sandy loam, 3 to 5 percent slopes	985	.2	Potter soils	7,683	1.3
Dalhart fine sandy loam, 0 to 1 percent slopes	639	.1	Pullman clay loam, 0 to 1 percent slopes	624	.1
Dalhart fine sandy loam, 1 to 3 percent slopes	23,395	4.0	Quanah clay loam, 1 to 3 percent slopes	1,925	.3
Dalhart fine sandy loam, 3 to 5 percent slopes	11,146	1.9	Randall clay	103	(1)
Dalhart fine sandy loam, 5 to 8 percent slopes	3,217	.5	Richfield clay loam, 0 to 1 percent slopes	445	.1
Dalhart soils, 2 to 6 percent slopes, eroded	739	.1	Richfield clay loam, 1 to 3 percent slopes	6,173	1.0
Dumas loam, 0 to 1 percent slopes	1,086	.2	Rough broken land	11,511	1.9
Dumas loam, 1 to 3 percent slopes	20,962	3.5	Springer fine sandy loam, 1 to 3 percent slopes	28,555	4.8
Dumas loam, 3 to 5 percent slopes	12,502	2.1	Springer fine sandy loam, 3 to 5 percent slopes	13,068	2.2
Enterprise very fine sandy loam, 0 to 1 percent slopes	1,537	.3	Springer fine sandy loam, 5 to 8 percent slopes	28,223	4.7
Enterprise very fine sandy loam, 1 to 3 percent slopes	1,796	.3	Springer loamy fine sand, undulating	7,133	1.2
Enterprise very fine sandy loam, 3 to 5 percent slopes	2,473	.4	Springer loamy fine sand, hummocky	69,359	11.7
Enterprise very fine sandy loam, 5 to 8 percent slopes	3,511	.6	Spur clay loam	2,895	.5
Guadalupe fine sandy loam	1,742	.3	Spur clay loam, broken	2,452	.4
Likes loamy fine sand	4,761	.8	Sweetwater soils	9,364	1.6
Likes soils	8,704	1.5	Tipton silt loam, 0 to 1 percent slopes	654	.1
Lincoln soils	25,188	4.2	Tipton silt loam, 1 to 3 percent slopes	960	.2
Mansker loam, 1 to 3 percent slopes	1,360	.2	Tipton silty clay loam, 0 to 1 percent slopes	3,521	.6
Miles loamy fine sand, 0 to 3 percent slopes	7,904	1.3	Tipton silty clay loam, 1 to 3 percent slopes	1,925	.3
			Tivoli fine sand	93,771	15.8
			Water area	16,256	2.7
			Total acres in county	594,560	100.0

[1] Less than 0.1 percent.

changing form with each strong wind. These dunes are made up of neutral sand, dominantly quartzite particles, that extends to a depth of 10 feet or more. The individual dunes within areas of this mapping unit vary from about 20 to 75 feet in height and cover from one-half acre to more than 1,000 acres each. No distinct soil has formed, and only a few isolated plants grow in these areas. Most of these dunes are along the Canadian River.

This land type is almost devoid of vegetation. It provides no grazing, but is used by livestock for shelter against winter winds. It also can be used for recreation or esthetic purposes. Capability unit VIIIe–1; range site not assigned.

Berda Series

The Berda series consists of gently sloping to strongly sloping, calcareous soils on uplands. These soils formed in calcareous local alluvium that is in some places mixed with remnants of outcrops consisting of white caliche or very pale brown, soft sandstone.

In a representative profile, the surface layer is grayish-brown loam about 14 inches thick. The next layer is brown clay loam about 20 inches thick. The underlying material, to a depth of more than 62 inches, is loam that is light brown in the upper part and pink in the lower part.

The Berda soils are well drained and moderately permeable. The available water capacity is high. These soils are mostly in range, but a few areas are cultivated.

Representative profile of Berda loam in an area of Berda and Mansker loams, 3 to 6 percent slopes, 60 feet south of a county road, from a point on the county road 3.5 miles west of the junction of U. S. Highway 83 with Farm Road 277. This junction is 5 miles north of the Wheeler County line.

A1—0 to 14 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, coarse, granular structure; hard, friable, slightly sticky; calcium carbonate pebbles on surface and throughout the horizon; calcareous; moderately alkaline; gradual, smooth boundary.

B2—14 to 34 inches, brown (7.5YR 5/3) clay loam, brown (7.5YR 4/3) when moist; moderate, medium, subangular blocky structure; very hard, firm, slightly sticky; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—34 to 50 inches, light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky; 10 percent calcium carbonate in a mixture of hard and soft masses as large as 0.75 inch in diameter; calcareous; moderately alkaline; gradual, wavy boundary.

C2—50 to 62 inches, pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) when moist; hard, friable, slightly sticky; 5 percent calcium carbonate, by volume; calcareous; moderately alkaline.

The A horizon ranges from 8 to 14 inches in thickness and from grayish brown to brown in color. The B horizon ranges from 15 to 28 inches in thickness and from brown to light brown in color.

Berda and Mansker loams, 3 to 6 percent slopes (BmC).—These gently sloping to sloping soils are on uplands. Some areas of this mapping unit contain Berda loam, some areas Mansker loam, and other areas both soils. About 60 percent of this mapping unit is Berda loam that occurs on hillsides and at lower elevations. Slopes are mostly 4 to 6 percent. Mansker loam makes up

about 25 percent of the unit and is on ridges and in convex areas.

The Berda loam in this unit has the profile described as representative for the Berda series. The Mansker loam has the profile described as representative for the Mansker series.

About 15 percent of this mapping unit is small areas of other soils, such as Potter soils on ridges, a few areas of Richfield clay loam and Bippus clay loam on lower slopes and in concave areas, and a few areas of Mobeetie fine sandy loam adjacent to areas of moderately coarse textured soils.

These soils are used mostly for range, but some areas are cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IVe–2; Hardland Slopes range site.

Berda-Potter complex (Bp).—This mapping unit is a complex of gently sloping to strongly sloping soils on uplands. The areas lie along and below the caprock escarpments that occur in the dissected topography of the High Plains and along the drainageways that drain the central part of the county.

This unit is mapped as a complex because the soils are so closely associated that it is not practical to map them separately at the scale used. Each area contains both Berda and Potter soils, although the percentage of each varies from area to area. About 70 percent of this mapping unit is Berda loam. Potter soils make up about 20 percent, and a small acreage of a land type and other soils make up 10 percent.

The Berda loam is on hillsides, ridges, and foot slopes. Slopes range from 3 to 12 percent. It has a friable, calcareous, grayish-brown loam surface layer about 14 inches thick. The next layer is a calcareous, brown clay loam about 20 inches thick. The underlying material is light-brown loam that grades to pink. It extends to a depth of more than 62 inches. It is about 10 percent soft masses of calcium carbonate in the upper part, and about 5 percent in the lower part.

The Potter loam is strongly sloping and is in convex areas and ridges. Slopes range from 5 to 15 percent. This Potter loam has the profile described as representative for the Potter series.

Inclusions are Rough broken land, a land type that consists of small mesas and escarpments, and small areas of Mansker, Mobeetie, Bippus, Spur, Guadalupe, and Lincoln soils.

Most of this mapping unit is in range (fig. 6). Capability unit VIe–2; Hardland Slopes range site.

Bippus Series

The Bippus series consists of deep, loamy soils on uplands. These soils formed in calcareous, loamy alluvium. They are concave and lie on lower footslopes where they receive extra runoff. Slopes range from 1 to 5 percent.

In a representative profile, the surface layer is dark grayish-brown clay loam about 24 inches thick. The next layer is light-brown clay loam about 28 inches thick. The underlying material, extending to a depth of more than 60 inches, is light-brown clay loam.

The Bippus soils are well drained. Permeability is moderate, and available water capacity is high. These soils are in range and crops.

Representative profile of Bippus clay loam, 1 to 3 percent slopes, 50 feet north of a county road, from a point 0.1 mile east of the Needmore Creek bridge. This site is 11.5 miles southeast of Canadian. From the intersection of U. S. Highway 60 and Farm Road 2388, the location is southeast, 6 miles past the end of Farm Road 2388.

A11—0 to 9 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, very friable, slightly sticky; common worm casts; neutral; gradual, smooth boundary.

A12—9 to 24 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky; common worm casts; neutral; gradual, smooth boundary.

B2—24 to 40 inches, light-brown (7.5YR 6/3) clay loam, brown (7.5YR 4/4) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky structure; hard, friable, slightly sticky; common worm casts; few films and threads of calcium carbonate; many fine root channels; calcareous; moderately alkaline; gradual, smooth boundary.

B3—40 to 52 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard, friable, slightly sticky; few worm casts; common threads and films, soft masses, and weakly cemented concretions of calcium carbonate that make up 5 percent, by volume, of the horizon; calcareous; moderately alkaline; diffuse, wavy boundary.

C—52 to 60 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; massive; hard, friable, slightly sticky; few threads, films, and pebbles of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 20 to 30 inches in thickness and from clay loam to fine sandy loam in texture. The B2 horizon ranges from 12 to 18 inches in thickness, from granular to subangular blocky structure, and from pale brown to light brown in color. The calcium carbonate content of the B3 horizon is 2 to 12 percent.

Bippus clay loam, 1 to 3 percent slopes (BrB).—This smooth, gently sloping soil lies in slightly concave areas that average about 30 acres in size. Most areas are narrow and elongated and border small drains or occupy fan-shaped tracts at the mouths of small drainageways.

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

Included with this soil in mapping are small areas of Richfield clay loam, Berda loam, and Bippus clay loam, 3 to 5 percent slopes.

About half the acreage of this Bippus clay loam, 1 to 3 percent slopes, is cultivated. It is slightly susceptible to soil blowing and water erosion. Most areas receive runoff water from higher lying areas. Capability unit IIIe–2; Deep Hardland range site.

Bippus clay loam, 3 to 5 percent slopes (BrC).—This gently sloping soil is on smooth uplands. The areas are long and narrow, are concave, and average about 35 acres in size. This soil is commonly bordered on the lower side by areas of gently sloping Bippus soils or by Spur soils. It is ordinarily bordered on the upper side by Berda or Mansker soils.

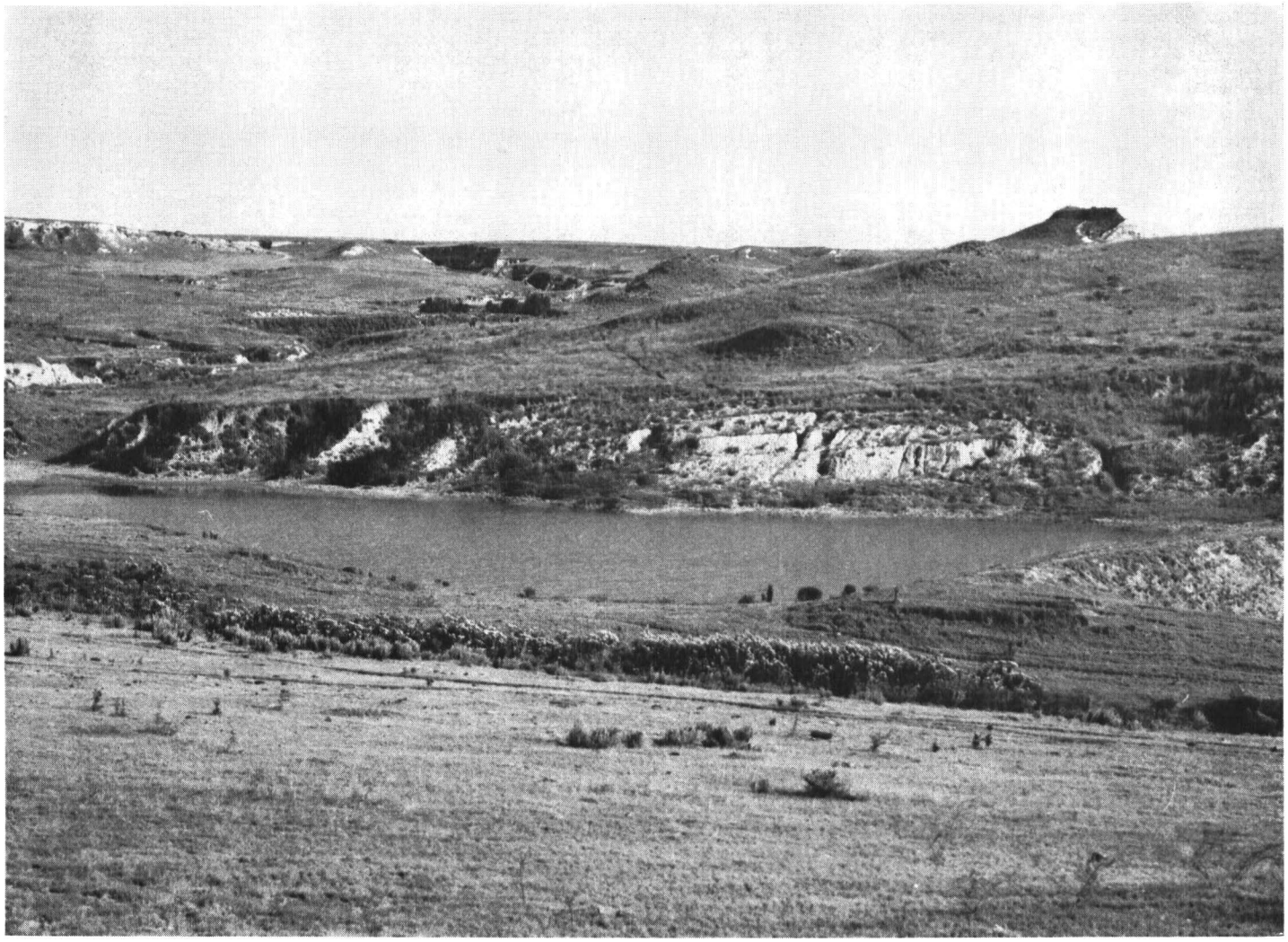

Figure 6.—**Livestock water area in Berda-Potter complex.**

The surface layer is dark grayish-brown, noncalcareous clay loam about 22 inches thick. The next layer is friable, light-brown, calcareous clay loam about 23 inches thick. The underlying material is light-brown, calcareous clay loam that extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Berda loam, Mansker loam, Bippus clay loam, 1 to 3 percent slopes, and a few areas of Bippus fine sandy loam.

This Bippus clay loam, 3 to 5 percent slopes, is used mostly for range, but some areas are cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Most areas of this soil receive runoff from higher lying areas. Capability unit IVe–10; Deep Hardland range site.

Bippus fine sandy loam, 1 to 3 percent slopes (BuB).—This gently sloping soil lies on smooth uplands. The areas are slightly concave and range from a few acres to 100 or more acres in size. The average area is about 20 acres in size. At lower elevations, this soil occupies elongated areas bordering drains.

The surface layer is a neutral, dark grayish-brown fine sandy loam about 24 inches thick. The next layer is friable, calcareous, light-brown clay loam about 26 inches thick. The underlying material is a light-brown, calcareous clay loam that extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Bippus clay loam, Spur clay loam, Guadalupe fine sandy loam, and Bippus fine sandy loam, 3 to 5 percent slopes.

About half the acreage of this Bippus fine sandy loam, 1 to 3 percent slopes, is cultivated, and half is in range. Water erosion is a slight hazard, and soil blowing is a moderate hazard. Most areas of this soil receive runoff from higher lying areas. Capability unit IIIe–4; Sandy Loam range site.

Bippus fine sandy loam, 3 to 5 percent slopes (BuC).—This gently sloping soil occupies long, narrow, smoothly concave areas in drainageways. These areas range from 10 to 60 acres in size and average about 18 acres.

The surface layer is neutral, dark grayish-brown fine sandy loam about 21 inches thick. The next layer is

friable, calcareous, light-brown clay loam about 29 inches thick. The underlying material is a calcareous, light-brown clay loam that extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Mobeetie fine sandy loam, Bippus clay loam, and Bippus fine sandy loam, 1 to 3 percent slopes.

This Bippus fine sandy loam, 3 to 5 percent slopes, is used mostly for range, but some areas are cultivated. It is subject to a moderate hazard of soil blowing and water erosion. Most areas receive runoff from higher lying areas. Capability unit IVe–4; Sandy Loam range site.

Dalhart Series

The Dalhart series consists of nearly level to sloping soils of the uplands that formed in loamy deposits.

In a representative profile, the surface layer is dark-brown fine sandy loam about 8 inches thick. The next layer is dark-brown sandy clay loam in the upper 12 inches and brown fine sandy loam in the lower 19 inches. The underlying material, reaching to a depth of 60 inches or more, is yellowish-brown fine sandy loam.

The Dalhart soils are well drained, and their permeability is moderate. The available water capacity is moderate. These soils are used for crops and range.

Representative profile of Dalhart fine sandy loam, 1 to 3 percent slopes, 50 feet east of U. S. Highway 83, from a point 4.25 miles south of its junction with U. S. Highway 60 and Texas Highway 33. This point is 11 miles south of Canadian, Tex.

Ap—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable, nonsticky; few fine pores; few worm casts; neutral; abrupt, smooth boundary.

B2t—8 to 20 inches, dark-brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky; few fine pores; few worm casts; neutral; gradual, smooth boundary.

B3—20 to 39 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; hard, friable, nonsticky; few worm casts; mildly alkaline; gradual, smooth boundary.

C—39 to 60 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, very friable, nonsticky; mildly alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from dark grayish brown to brown in color. The Bt horizon ranges from 11 to 45 inches in thickness and from sandy clay loam to clay loam in texture. Depth to the C horizon ranges from 35 to 60 inches.

Dalhart fine sandy loam, 0 to 1 percent slopes (DaA).—This nearly level soil is on the upland interstream divides. The areas of this soil are irregularly oval and in most places are surrounded by more sloping Dalhart fine sandy loam. Areas of this soil have an undulating appearance and range from 6 to 60 acres in size but average about 20 acres. Slopes are commonly about 0.6 percent.

The surface layer is dark grayish-brown fine sandy loam about 12 inches thick. The next layer is dark-brown, friable sandy clay loam. The underlying material is yellowish-brown fine sandy loam that begins at a depth of about 50 inches and extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Dumas loam, Springer fine sandy loam, and Miles loamy fine sand.

Nearly all of this Dalhart fine sandy loam is in cultivation. A few cultivated fields have been slightly eroded by soil blowing. Capability unit IIIe–4; Sandy Loam range site.

Dalhart fine sandy loam, 1 to 3 percent slopes (DaB).—This gently sloping soil is on upland interstream divides. It occupies elongated irregular areas on broad ridges that are from 15 to 600 acres in size and average about 60 acres. Topography is slightly undulating. Slopes are commonly about 1.8 percent.

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

Included with this soil in mapping are small areas of Dumas loam, Springer fine sandy loam, Miles loamy fine sand, and Dalhart fine sandy loam, 0 to 1 percent slopes.

Most of this Dalhart fine sandy loam, 1 to 3 percent slopes, is cultivated, but some areas are used for range. Some cultivated fields have been slightly damaged by soil blowing and by water erosion.

This soil is subject to a moderate hazard of soil blowing and a slight hazard of water erosion. Capability unit IIIe–4; Sandy Loam range site.

Dalhart fine sandy loam, 3 to 5 percent slopes (DaC).—This gently sloping soil is on uplands in long, narrow, irregular areas on knolls and hillsides of broad interstream divides. These areas average about 30 acres in size but range from 10 to 300 acres. Slopes are commonly about 4 percent.

This soil has a dark-brown fine sandy loam surface layer about 8 inches thick. The next layer is brown, friable sandy clay loam. The underlying material is brownish fine sandy loam that begins at a depth of about 39 inches and extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Dumas loam, Springer fine sandy loam, Miles loamy fine sand, Dalhart fine sandy loam, 1 to 3 percent slopes, and Dalhart fine sandy loam, 5 to 8 percent slopes.

About half of this Dalhart fine sandy loam, 3 to 5 percent slopes, is in range, and half is cultivated.

This soil is subject to a moderate hazard of soil blowing and water erosion. Some cultivated fields have been slightly eroded by soil blowing and water. Capability unit IVe-4; Sandy Loam range site.

Dalhart fine sandy loam, 5 to 8 percent slopes (DaD).—This sloping soil occupies uplands along many of the drainageways. It is in long, narrow, irregularly shaped areas that are mostly below areas of less sloping Dalhart fine sandy loam. These areas range from 20 to 100 acres in size and average about 50 acres.

The surface layer is brown fine sandy loam about 6 inches thick. The next layer is brown, friable sandy clay loam. The underlying material is brownish fine sandy loam that begins at a depth of about 36 inches and extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Springer fine sandy loam, Mobeetie fine sandy loam,

Springer loamy fine sand, and a few areas of Enterprise very fine sandy loam.

Nearly all of this Dalhart fine sandy loam is in range. Most areas that were cropped at one time have now been returned to grass. Some of these formerly cultivated areas are slightly eroded.

Soil blowing and water erosion are moderate hazards. This soil is susceptible to gullying caused by concentrations of water in drainageways, ranch roads, and cattle trails. Capability unit VIe-5; Sandy Loam range site.

Dalhart soils, 2 to 6 percent slopes, eroded (DhC2).—The gently sloping to sloping soils in this mapping unit are on uplands. The concave areas usually are on slopes that receive extra concentrations of water from higher lying, arable soils. Areas range from 10 to 80 acres in size and average 30 acres.

Sheet and rill erosion have removed much of the surface layer from most of these areas. A few crossable gullies about 75 feet apart, and uncrossable gullies about 100 yards apart, characterize this mapping unit. In about 30 percent of the areas, the surface layer has been mixed with the upper parts of the lower layer. This results in a surface texture that ranges from sandy clay loam to a fine sandy loam. Soil blowing has winnowed the fine sandy loam surface and removed the finer particles, and this has caused some areas to have a loamy fine sand surface.

Included in this mapping unit are small areas of Dalhart fine sandy loam that are only slightly eroded, areas of Miles loamy fine sand, Patricia fine sand, and Springer fine sandy loam.

About 40 percent of this mapping unit is in cultivation. About 60 percent is former cropland that has been returned to grass. Mostly mid and tall grasses have been reseeded on these soils.

The hazards of soil blowing and water erosion are moderate. Capability unit IVe-3; Sandy Loam range site.

Dumas Series

The Dumas series consists of deep, nearly level to gently sloping soils on interstream divides. These soils formed in loamy calcareous materials.

In a representative profile, the surface layer is dark-brown loam about 6 inches thick. The next layer is clay loam that is dark grayish brown in the upper 12 inches and brown in the next 32 inches. Below this, to a depth of more than 60 inches, is very pale brown silt loam.

Dumas soils are well drained, and their permeability is moderate. They have a high available water capacity. Most of these soils are used for crops, but a few areas are in range.

Representative profile of Dumas loam, 1 to 3 percent slopes, 300 feet northeast of a curve in a county road, which is 0.5 mile south, 1 mile east, and 2.5 miles south of Texas Highway 33, from a point 4 miles east of its junction with U.S. Highways 60 and 83. The profile is 15 miles south and east of Canadian, Tex.

Ap—0 to 6 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, nonsticky; neutral; clear, smooth boundary.

B21t—6 to 18 inches, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky; many fine pores; many worm casts; noncalcareous; mildly alkaline; gradual, smooth boundary.

B22t—18 to 50 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure; hard, friable, sticky; many films and threads of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

B23tca—50 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; weak, fine, subangular blocky structure; many masses and concretions of calcium carbonate comprising 30 percent, by volume, of this horizon.

The A horizon ranges from 6 to 12 inches in thickness and from brown to dark grayish brown in color. The B horizon ranges from reddish brown to dark grayish brown in color and from prismatic to weak blocky in structure. Depth to the B23tca horizon ranges from 36 to 60 inches.

Dumas loam, 0 to 1 percent slopes (DuA).—This soil is on broad upland divides in slightly convex or concave, nearly level areas within larger tracts of Dumas soils that are more sloping. It is usually on the tops of hills or ridges or on benches on the sides of ridges. Soil areas range from 8 to 90 acres in size but average about 30 acres.

The surface layer is dark grayish-brown loam about 12 inches thick. The next layer is a brown clay loam to a depth of 50 inches. Below this is a very pale brown, loamy, calcareous material.

Included with this soil in mapping are small areas of Dalhart fine sandy loam, Richfield clay loam, and a few areas of Dumas loam, 1 to 3 percent slopes.

Most of this Dumas loam, 0 to 1 percent slopes, is cultivated. It is slightly susceptible to soil blowing. Capability unit IIce–5; Deep Hardland range site.

Dumas loam, 1 to 3 percent slopes (DuB).—This gently sloping soil occupies broad interstream divides. Most areas are gently undulating and elongated, as they are on ridges surrounding other steeper soils that are along minor drains. Soil areas range from 15 to 200 acres in size and average 35 acres.

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

Included with this soil in mapping are small areas of Dalhart fine sandy loam, Richfield clay loam, Quanah clay loam, and Mansker and Berda loams.

About 65 percent of this Dumas loam is used for crops. The rest is in range.

This soil is subject to a slight hazard of soil blowing and a moderate hazard of water erosion. Capability unit IIe–2; Deep Hardland range site.

Dumas loam, 3 to 5 percent slopes (DuC).—This gently sloping soil is on plane to convex uplands in long narrow areas on the sides of broad ridges. Soil areas range from 15 to 200 acres in size but average about 50 acres.

The surface layer is a brown loam about 6 inches thick. The next layer is brown, friable clay loam to a depth of 40 inches. Below this is a brownish, loamy, calcareous material.

Included with this soil in mapping are small areas of Richfield clay loam, Dalhart fine sandy loam, Berda loam, Mansker loam, and Quanah clay loam.

This Dumas loam is about half in crops and half in range. A few cultivated areas are slightly eroded.

This soil is subject to a slight hazard of soil blowing and a moderate hazard of water erosion. Capability unit IIIe–9; Deep Hardland range site.

Enterprise Series

The Enterprise series consists of deep, nearly level to sloping soils on uplands. These soils formed in calcareous, loamy material that had been deposited by wind.

In a representative profile, the surface layer is brown very fine sandy loam about 8 inches thick. The next layer is a light-brown very fine sandy loam to a depth of more than 60 inches.

Enterprise soils are well drained, and their permeability is moderately rapid. The surface runoff is slow to rapid, and internal drainage is good. The available water capacity is high. These soils are used for crops and range.

Representative profile of Enterprise very fine sandy loam, 5 to 8 percent slopes, 30 feet north of a county road, from a point on the county road 3.25 miles northwest of the bridge across Red Deer Creek that is approximately 0.5 mile west of Canadian, Tex.

A—0 to 8 inches, brown (7.5YR 5/4) very fine sandy loam, brown (7.5YR 4/4) when moist; weak, fine and medium, granular structure; slightly hard, very friable, nonsticky; common fine pores; few worm casts; calcareous; moderately alkaline; diffuse, smooth boundary.

B2—8 to 35 inches, light-brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky; common fine pores; few worm casts; calcareous; moderately alkaline; diffuse, wavy boundary.

B3—35 to 60 inches, light-brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard, friable, nonsticky; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness. The B horizon ranges from loam to very fine sandy loam in texture.

Enterprise very fine sandy loam, 0 to 1 percent slopes (EnA).—This nearly level soil occupies weakly undulating terraces in areas that average about 100 acres in size.

This soil is a calcareous, friable, very fine sandy loam. It is brown above 32 inches, and light brown below and extends to depths below 60 inches.

Mapped with this soil are small areas of Tipton silty clay loam, Tipton silt loam, and Enterprise very fine sandy loam, 1 to 3 percent slopes.

Most of this Enterprise very fine sandy loam, 0 to 1 percent slopes, is cultivated.

This soil is slightly susceptible to soil blowing. Capability unit IIce–2; Mixedland range site.

Enterprise very fine sandy loam, 1 to 3 percent slopes (EnB).—This gently sloping soil is on uplands that are long and narrow. These areas range from 10 to 150 acres in size but average about 50 acres.

The surface layer is calcareous, brown very fine sandy loam about 8 inches thick. The next layer is friable, calcareous very fine sandy loam. There is little profile development, and the lower part of the layer grades into the underlying brownish, calcareous, very fine sandy loam material at a depth of about 60 inches.

Mapped with this soil are small areas of Tipton silty clay loam, Enterprise very fine sandy loam, 0 to 1 percent slopes, and Enterprise very fine sandy loam, 3 to 5 percent slopes.

Most of this Enterprise very fine sandy loam, 1 to 3 percent slopes, is used for crops, but a small acreage is in range. A few areas are irrigated. This soil is subject to slight hazards of soil blowing and water erosion. Capability unit IIe–1; Mixedland range site.

Enterprise very fine sandy loam, 3 to 5 percent slopes (EnC).—This soil occupies plane and convex slopes in elongated areas paralleling rivers or tributaries close to the river. Soil areas range from 10 to 100 acres in size but average 50 acres.

The surface layer is calcareous, brown very fine sandy loam about 6 inches thick. The next layer is friable, calcareous very fine sandy loam. This layer grades into the underlying brownish, calcareous, very fine sandy loam material at a depth of about 50 inches.

Included with this soil in mapping are small areas of Likes soils. Mobeetie fine sandy loam, Springer fine sandy loam, Guadalupe fine sandy loam on bottom lands, Enterprise very fine sandy loam, 1 to 3 percent slopes, and Enterprise very fine sandy loam, 5 to 8 percent slopes.

Most of this Enterprise very fine sandy loam, 3 to 5 percent slopes, is in range, but a few areas are used for crops.

This soil is subject to a slight hazard of soil blowing and a moderate hazard of water erosion. Concentrations of water quickly erode unprotected areas and cause deep "U" shaped gullies and escarpments that advance up the drainageway. Capability unit IIIe–3; Mixedland range site.

Enterprise very fine sandy loam, 5 to 8 percent slopes (EnD).—This sloping soil occupies a few large and many small, convex to concave, elongated areas. These areas range from 16 to 200 acres in size and average 60 acres.

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

Included with this soil in mapping are small areas of Enterprise very fine sandy loam, 3 to 5 percent slopes, Likes soils, Berda loam, Mobeetie fine sandy loam, and Springer soils near the lower edges of some areas. Also included are a few escarpments along bluffs that overlook the Canadian River.

Almost all of this Enterprise very fine sandy loam is in range. A few areas were cultivated but have been returned to grass.

A few U-shaped gullies as deep as 20 feet are in some areas. The soil is subject to a slight hazard of soil blowing and a high hazard of water erosion. Capability unit VIe–4; Mixedland range site.

Guadalupe Series

The Guadalupe series consists of deep, calcareous, nearly level soils on bottom lands. These soils formed in stream alluvium ranging from loamy fine sand to loam in texture.

In a representative profile, the surface layer is grayish-brown fine sandy loam about 12 inches thick. The next layer is light yellowish-brown fine sandy loam in the upper 13 inches and very pale brown fine sandy loam and sandy clay loam in the lower 13 inches. The underly-

ing material, to a depth of about 60 inches, is very pale brown loamy fine sand.

Guadalupe soils are well drained, and their permeability is moderately rapid. Most areas are occasionally to frequently flooded. These soils are used for crops and range.

Representative profile of Guadalupe fine sandy loam 60 feet north of the county road, from a point 0.25 mile southeast and east of the county road bridge across Red Deer Creek. This site is in the Red Deer Creek bottom lands on the western edge of Canadian, Tex.

Ap—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—5 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, very fine, subangular blocky structure; hard, friable; common medium and fine pores; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B21—12 to 18 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B22—18 to 25 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; weak, medium, subangular blocky structure; hard, friable; common medium and fine pores; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B23—25 to 30 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; common medium to fine pores; common worm casts; few threads and films of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B24—30 to 38 inches, very pale brown (10YR 7/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; weak, fine, subangular blocky structure; hard, friable; few thin strata of fine sandy loam; few medium to very fine pores; few worm casts; few threads and films of calcium carbonate; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—38 to 45 inches, very pale brown (10YR 7/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; single grained; loose; few strata of fine sandy loam; calcareous; moderately alkaline; gradual, smooth boundary.

C2—45 to 60 inches, very pale brown (10YR 8/4) loamy fine sand, very pale brown (10YR 7/4) when moist; common, distinct, medium, yellowish-brown mottles; single grained; loose; calcareous; moderately alkaline.

The A horizon ranges from 6 to 20 inches in thickness and from dark grayish brown to brown in color. The B2 horizon ranges from loam to fine sandy loam in texture and contains thinner subhorizons of sandy clay loam and loamy fine sand. Clay content at depths between 10 and 40 inches averages less than 18 percent. The depth to the C horizon ranges from 36 to 50 inches. The C horizon is stratified silt to loamy sand that contains few to many calcium carbonate pebbles and concretions.

Guadalupe fine sandy loam (Gu).—This nearly level soil occupies flood plains of creeks and streams. It is in long, narrow strips that range from 10 to 200 acres in size but average 30 acres. In a few places the strips are 1,000 feet wide. This soil is flooded on an average of once a year, but most floods last only a few hours. Some areas are high enough to escape flooding; others are flooded by each heavy rain.

Included with this soil in mapping are small areas of Bippus fine sandy loam, Spur clay loam, Lincoln soils, and meandering stream channels.

About half the acreage of this Guadalupe fine sandy loam is cultivated, and half is used for range. This soil is moderately susceptible to soil blowing. Capability unit IIIe–4; Loamy Bottomland range site.

Likes Series

The Likes series consists of deep, sandy soils of the uplands. These soils are undulating to hummocky and have concave and convex slopes that range from 1 to 20 percent but dominantly are not more than 8 percent. They formed in calcareous sandy material.

In a representative profile, the surface layer is brown loamy fine sand about 8 inches thick. The underlying material is loamy fine sand to a depth of about 60 inches. It is light yellowish brown in the upper part and very pale brown in the lower part.

Likes soils are excessively drained, and their permeability is moderately rapid. They have a low available water capacity. These soils are highly susceptible to soil blowing. They are used for range.

Representative profile of Likes loamy fine sand 200 feet east of U.S. Highway 60, from a point 0.25 mile northeast of its junction with U.S. Highway 83. This junction is 2 miles northeast of Canadian, Tex.

A1—0 to 8 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) when moist; weak, fine, granular structure; soft, loose; few roots; few, medium to very fine, quartz and calcium carbonate pebbles; calcareous; moderately alkaline; gradual, smooth boundary.

C1—8 to 32 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; single grain; soft, loose; few, medium to very fine, quartz and calcium carbonate pebbles; few threads and films of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—32 to 60 inches, very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) when moist; single grain; soft, loose; few, medium to very fine, quartz and calcium carbonate pebbles; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness and from loamy fine sand to gravelly sand in texture.

Likes loamy fine sand (Lk).—This gently sloping to sloping soil is on uplands that erode easily. Most areas are below large sand dunes and above bottom lands along the river. Soil areas are strongly convex near the hilltops and ridges, are weakly concave on the lower slopes, and have an undulating to hummocky appearances. Slopes commonly are about 6 percent. Areas of this soil are large; they range from 100 to about 1,000 acres in size and average 300 acres.

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

Included with this soil in mapping are small areas of Tivoli fine sand, Springer loamy fine sand, Mobeetie fine sandy loam, and Lincoln soils.

All of this Likes loamy fine sand is in native range. This soil is subject to a high hazard of soil blowing. Capability unit VIe–6; Sandyland range site.

Likes soils (Lm).—This mapping unit consists of Likes soils in areas dominated by gravelly knobs and ridges.

These areas are below terraces of Tipton and Enterprise soils and above the Guadalupe, Lincoln, Spur, and Sweetwater soils that are on bottom lands. Slopes range from 2 to 20 percent but are dominantly about 8 percent.

This unit consists of two soils of the Likes series, so closely associated it is not practical to map them separately at the scale used. Each area contains both soils, although the percentage of each varies from area to area. About 45 percent of the acreage is Likes loamy fine sand, 35 percent is Likes gravelly sand, and 20 percent is inclusions of other soils.

Likes loamy fine sand has a brown, loamy fine sand surface layer about 8 inches thick. The next layer is light yellowish-brown loamy fine sand about 22 inches thick. The underlying material is very pale brown loamy fine sand that extends to a depth of 60 inches.

Likes gravelly sand has a calcareous, brown, gravelly sand surface layer about 5 inches thick. This layer is about 75 percent waterworn quartz pebbles. The pebbles give the surface an erosional pavement of gravel. The next layer is brown, calcareous loamy sand that is about 15 percent quartz pebbles. The underlying material is pink, calcareous loamy sand that begins at a depth of 18 inches. It is about 15 percent quartz pebbles. The gravel content of the lower layers is 2 to about 25 percent.

In this mapping unit, Likes gravelly sand lies on strongly convex knobs and ridges. These knobs and ridges are from 10 to 40 feet high. In some places they are separate and in other places they are linked.

Other soils in this mapping unit are Tivoli fine sand, Springer loamy fine sand, Springer fine sandy loam, Mobeetie fine sandy loam, and Enterprise very fine sandy loam.

Most of the acreage of this mapping unit is in native range. Some knobs and ridges are used as a commercial source of sand and gravel (fig. 7). The Likes loamy fine sand is subject to a high hazard of soil blowing. The areas of this unit are difficult to manage because of the complexity of soils and slopes. Capability unit VIs–1; Gravelly range site.

Lincoln Series

The Lincoln series consists of deep, sandy soils on bottom lands. These soils formed in sandy alluvium. They are nearly level to undulating and occupy the broad flood plains of most of the rivers and creeks in the county.

In a representative profile, the surface layer is brown loamy fine sand about 6 inches thick. The underlying material is mainly light yellowish-brown loamy fine sand to a depth of 17 inches, pink loamy sand to a depth of

Figure 7.—Area of Likes soils; the knobs and ridges in the background are gravelly sand, and the area in the foreground is loamy fine sand.

35 inches, and very pale brown loamy fine sand and fine sand to a depth of more than 60 inches. This material contains thin strata of fine sandy loam and silt loam.

These soils are flooded about once a year and receive deposits of fresh material. They are somewhat excessively drained. Permeability is rapid, and the available water capacity is low. These soils are subject to a high hazard of soil blowing. They are used for range.

Representative profile of Lincoln loamy fine sand, in an area of Lincoln soils, 100 feet west of U.S. Highways 60 and 83, 0.25 mile southwest of the Canadian River bridge. This location is approximately 1.25 miles northeast of Canadian, Tex.

A1—0 to 6 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) when moist; weak, fine, granular structure; soft, loose; few roots; calcareous; moderately alkaline; gradual, smooth boundary.

C1—6 to 15 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose; few thin strata of fine sandy loam and silt loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—15 to 17 inches, light-brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4) when moist; weak, very fine, subangular blocky structure; hard, very friable; common, medium and fine pores; common worm casts; calcareous; moderately alkaline; abrupt, smooth boundary.

C3—17 to 32 inches, pink (7.5YR 7/4) loamy sand, light brown (7.5YR 6/4) when moist; single grain; loose; thin strata of fine sandy loam and silt loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C4—32 to 35 inches; pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) when moist; weak, fine, subangular blocky structure; hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

C5—35 to 45 inches, very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) when moist; single grained; loose; thin strata of sandy loam and silt loam; calcareous; moderately alkaline; gradual, smooth boundary.

C6—45 to 60 inches, very pale brown (10YR 8/4) fine sand, very pale brown (10YR 7/4) when moist; single grain; loose; calcareous; moderately alkaline.

The A horizon ranges from 5 to 14 inches in thickness and from grayish brown to pale brown in color. Texture of the A1 horizon ranges from loamy fine sand to fine sand or fine sandy loam. The C horizon ranges from fine sand to loamy fine sand in texture and contains lenses of fine sandy loam to silt loam as much as 2 inches in thickness. Depth to the water table ranges from 3 to 20 feet.

Lincoln soils (ln).—The nearly level to undulating soils in this mapping unit lie on bottom lands along creeks and rivers. Soil areas are usually long and narrow. A few areas that lie along major rivers are about half a mile wide. Areas range from 10 to 600 acres in size and average about 100 acres. Most areas are flooded occasionally to frequently.

Texture of the surface layer ranges from fine sand to loamy fine sand and fine sandy loam.

Included in this mapping unit are small areas of Sweetwater, Spur, and Guadalupe soils in sloughs or concave areas; a few low dunes of Tivoli fine sand; and meandering stream channels.

Areas of this mapping unit are used almost entirely for range. They also provide habitat for many species of wildlife, especially deer and turkey. Capability unit Vw–2; Sandy Bottomland range site.

Mansker Series

The Mansker series consists of gently sloping to sloping soils of the uplands. These soils formed in loamy calcareous material.

In a representative profile, the surface layer is grayish-brown loam about 8 inches thick. The next layer is grayish-brown loam about 6 inches thick. The underlying material is 22 inches of pale-brown loam, and then brown clay loam that extends to a depth of 48 inches.

Mansker soils are well drained, and their permeability is moderate. Surface runoff is moderate to rapid. These soils are used both for crops and range.

Representative profile of Mansker loam, in an area of Berda and Mansker loams, 3 to 6 percent slopes, 100 feet north of Farm Road 1268, from a point 0.2 mile west of its junction with Farm Road 48. This location is one mile north and 5.9 miles west of Gageby, Tex.

A1—0 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, very friable, nonsticky; common worm casts; few calcium carbonate pebbles; calcareous; moderately alkaline; gradual, smooth boundary.

Bca—8 to 14 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, granular structure; slightly hard, friable, slightly sticky; common worm casts; few calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—14 to 36 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky; 50 percent calcium carbonate, by volume, in soft masses and concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C2ca—36 to 48 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) when moist; very hard, firm; 20 percent calcium carbonate in soft masses and concretions.

The A horizon ranges from 7 to 18 inches in thickness and from dark grayish brown to brown in color. The Cca horizon ranges from pink to pale brown and brown in color. The amount of calcium carbonate ranges from 15 to 60 percent in this horizon.

Mansker loam, 1 to 3 percent slopes (McB).—This gently sloping soil is in convex areas on top of or along the ridges of interstream divides. Soil areas are irregularly elongated and average about 30 acres in size but range from 10 to 100 acres in size.

The surface layer is grayish-brown loam about 10 inches thick. The next layer, about 28 inches thick, is grayish-brown loam in the upper part and pale-brown loam in the lower part. The underlying material, extending to a depth of 45 inches, is brown clay loam.

Included with this soil in mapping are small areas of Potter soils, Berda loam, Quanah clay loam, and Richfield clay loam.

About half of this Mansker loam is in crops, and half is in range.

This soil is subject to a slight hazard of soil blowing and a moderate hazard of water erosion. Surface runoff is medium, and most areas in cultivation are slightly eroded. In a few places, part of the C horizon has been plowed up, and the calcium carbonate is exposed (fig. 8). Capability unit IIIe–7; Hardland Slopes range site.

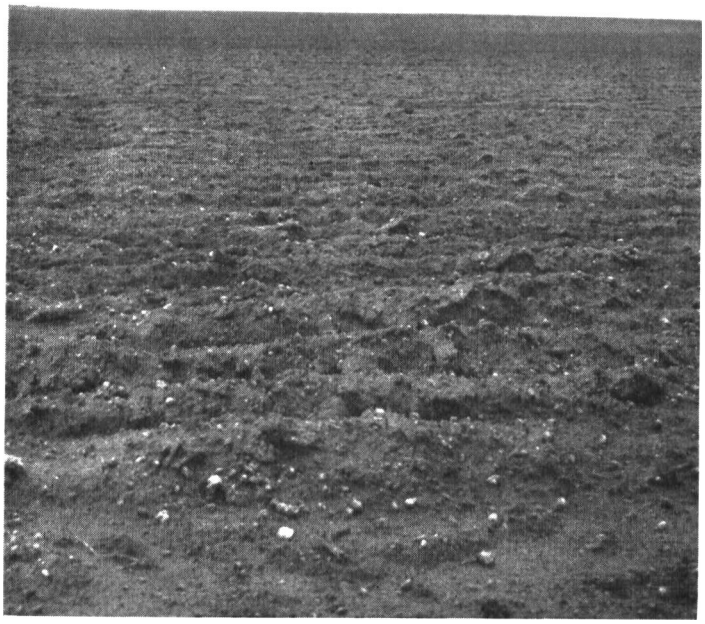

Figure 8.—Caliche pebbles in plowed Mansker loam, 1 to 3 percent slopes.

Miles Series

The Miles series consists of deep, sandy soils of the uplands. These gently undulating to sloping soils formed in sandy and loamy outwash materials.

In a representative profile, the surface layer is brown loamy fine sand about 8 inches thick. The next layer is sandy clay loam that extends to a depth of over 60 inches. It is brown in the upper 10 inches, reddish brown in the next 30 inches, and brown in the lower 12 inches.

Miles soils are well drained, and their permeability is moderate. The available water capacity is high. These soils are used for crops and range.

Representative profile of Miles loamy fine sand, 0 to 3 percent slopes, 50 feet north of the Wheeler-Hemphill county road, from a point 1.65 miles west of where the county line crosses Farm Road 277. This location is in the southeastern part of the county, 11.75 miles east of Gageby, Tex.

Ap—0 to 8 inches, brown (7.5YR 5/3) loamy fine sand, brown (7.5YR 4/3) when moist; weak, fine, granular structure; soft, very friable, nonsticky; slightly acid; abrupt, smooth boundary.

B21t—8 to 18 inches, brown (7.5YR 4/3) sandy clay loam, dark brown (7.5YR 3/3) when moist; weak, very coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable, slightly sticky; many fine and medium pores; common worm casts; slightly acid; gradual, smooth boundary.

B22t—18 to 48 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, very coarse, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, firm, sticky; common pores; few worm casts; few, very thin, patchy clay films on ped surfaces; neutral; gradual, smooth boundary.

B3—48 to 60 inches, brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) when moist; hard, friable, sticky; neutral.

The A horizon ranges from 6 to 18 inches in thickness. The B2t horizons range from reddish brown to yellowish red in color. Depth to the C horizon ranges from 50 to 70 inches.

Miles loamy fine sand, 0 to 3 percent slopes (MlB).—This gently undulating soil is in rounded or oblong areas. Slopes commonly are about 1.5 percent.

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

Included with this soil in mapping are small areas of Patricia fine sand, Dalhart fine sandy loam, small knolls of Mobeetie fine sandy loam, and a few areas of Miles loamy fine sand, 3 to 6 percent slopes.

Miles loamy fine sand, 0 to 3 percent slopes, is used mostly for crops, but a few areas are in range. Many old fields have been reseeded to grasses.

This soil is highly susceptible to soil blowing and slightly susceptible to water erosion in the gently sloping areas. Capability unit IVe-6; Sandyland range site.

Miles loamy fine sand, 3 to 6 percent slopes (MlC).—This gently sloping to sloping soil is in elongated convex areas along minor drainageways that advance into areas of smoother Miles loamy fine sand. This soil occurs below areas of Patricia fine sand and Dalhart fine sandy loam. Soil areas range from 10 to 150 acres in size and average about 70 acres.

The surface layer is brown loamy fine sand about 8 inches thick. The next layer, about 8 inches thick, is brown, friable sandy clay loam. The next lower layer is reddish-brown sandy clay loam about 24 inches thick. Below this is brown, neutral loamy fine sand beginning at a depth of about 40 inches.

Included with this soil in mapping are small areas of Springer loamy fine sand, Patricia fine sand, Dalhart fine sandy loam, and a few gently sloping areas. These inclusions make up less than 15 percent of any one area.

This Miles loamy fine sand is mostly in range. A few fields are cultivated, but most areas that were once cultivated have been returned to grass.

The soil blowing and water erosion hazards are high. Some of the drainageways on this soil have eroded into U-shaped gullies. Capability unit VIe-6; Sandyland range site.

Mobeetie Series

The Mobeetie series consists of deep, gently sloping to sloping soils of the uplands. These soils formed in a mixture of colluvial and residual materials from higher elevations.

In a representative profile, the surface layer is brown fine sandy loam about 6 inches thick. The next layer is pale-brown fine sandy loam about 20 inches thick. The underlying material is a very pale brown fine sandy loam that extends to a depth of more than 60 inches.

These soils are well drained, and their permeability is moderately rapid. They have a moderate available water capacity. Mobeetie soils are used mostly for range.

Representative profile of Mobeetie fine sandy loam, 3 to 5 percent slopes, 30 feet south of a county road, from a point 3.0 miles west of the junction of U.S. Highway 83 and Farm Road 277. This junction is 5 miles north of the Wheeler County line on U.S. Highway 83.

Ap—0 to 6 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; strong, medium, granular structure; slightly hard, friable, nonsticky; common worm casts; few calcium carbonate pebbles; calcareous; moderately alkaline; gradual, smooth boundary.

B2—6 to 26 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, nonsticky; common worm casts; few calcium carbonate pebbles; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—26 to 40 inches, very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky; few worm casts; 5 percent visible threads and films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2—40 to 60 inches, very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky; few calcium carbonate pebbles; calcareous; moderately alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from brown to dark brown in color. The B horizon ranges from loam to fine sandy loam in texture. Depth to a Ca horizon ranges from 20 to 32 inches. The texture of the C horizon is loam to fine sandy loam.

Mobeetie fine sandy loam, 1 to 3 percent slopes (MrB).—This gently sloping soil lies along drains and ridges in elongated areas 8 to 40 acres in size. The average size of these areas is 15 acres, and in most areas the surface is concave.

The surface layer is calcareous, brown fine sandy loam about 12 inches thick. The next layer is pale-brown, friable, calcareous fine sandy loam. The underlying material is very pale brown, calcareous fine sandy loam that begins at a depth of about 40 inches and has a weakly developed zone of calcium carbonate accumulation in the upper 15 inches.

Included with this soil in mapping are small areas of Mansker loam, Berda loam, Dalhart fine sandy loam, Potter soils, and a few areas of Mobeetie fine sandy loam, 3 to 5 percent slopes.

Most of this Mobeetie fine sandy loam, 1 to 3 percent slopes, is in native range. A few areas are cultivated.

These soils are subject to a moderate hazard of water erosion and soil blowing. Capability unit IIIe–8; Mixedland Slopes range site.

Mobeetie fine sandy loam, 3 to 5 percent slopes (MrC).—This gently sloping soil is along the sides of creeks and minor drainageways. The slopes are complex. Soil areas range from 15 to 300 acres in size and average 60 acres.

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

Included with this soil in mapping are small areas of Springer fine sandy loam, Manasker loam, Berda loam, Dalhart fine sandy loam, Potter soils, and small areas of Mobeetie fine sandy loam, 1 to 3 percent slopes.

Most of this Mobeetie fine sandy loam, 3 to 5 percent slopes, is in range. This soil is subject to a moderate hazard of soil blowing and a high hazard of water erosion. Capability unit IVe–9; Mixedland Slopes range site.

Mobeetie-Likes complex (Mt).—This mapping unit consists of the gently sloping to sloping Mobeetie and Likes soils that occupy erosional upland areas. In most places this unit is associated with the sandy and moderately sandy soils. Slopes commonly are about 6 percent, and these areas have well-defined drainageways. The topography is undulating to hummocky in large, shallow depressions or shallow, erosional valleys. Areas of this mapping unit average 65 acres in size but range from 15 to about 300 acres.

The soils are so closely associated that it is not practical to map them separately at the scale used. Each area of this mapping unit contains both the Mobeetie and the Likes soils, although the percentage of each may vary from area to area. About 45 percent of the area is Mobeetie fine sandy loam, 40 percent is Likes loamy fine sand, and 15 percent is inclusions of other soils.

The Mobeetie soil in this mapping unit has a surface layer of calcareous, brown fine sandy loam about 6 inches thick. The next layer is friable, calcareous, pale-brown fine sandy loam about 20 inches thick. The underlying material is calcareous, very pale brown fine sandy loam extending to a depth of 60 inches. It has a small amount of accumulated calcium carbonate in the upper 14 inches. A few caliche pebbles are scattered throughout the profile. In areas of this unit, Mobeetie fine sandy loam is on knolls and ridges.

The Likes soil in this unit has a surface layer of calcareous, loose loamy fine sand about 8 inches thick. The next layer is light yellowish-brown, loose, calcareous loamy fine sand about 24 inches thick. The underlying material is very pale brown, calcareous loamy fine sand that extends to a depth of more than 60 inches. Quartz and caliche pebbles are scattered throughout the profile. In areas of this unit, Likes loamy fine sand is on hummocky ridges and in the depressions between ridges of the Mobeetie soils.

Other soils included in this mapping unit are Tivoli fine sand, Springer loamy fine sand, Potter soils, Dalhart fine sandy loam, and Guadalupe fine sandy loam.

Most of the acreage of this mapping unit is in range. The Mobeetie fine sandy loam is subject to a moderate to high hazard of water erosion and a moderate hazard of soil blowing. Likes loamy fine sand is subject to a high hazard of soil blowing. Capability unit VIe–3; Mixedland Slopes range site.

Mobeetie-Potter complex (Mx).—This mapping unit consists of gently sloping to strongly sloping Mobeetie and Potter soils in dissected, hilly, and rolling areas.

The soils are so closely associated that it is impractical to map them separately at the scale used. Each area of this mapping unit contains both Mobeetie and Potter soils, although the percentage of each varies from area to area. About 45 percent of the area is Mobeetie fine sandy loam, about 25 percent is Potter soils, and about 30 percent is inclusions of other soils and land types.

The Mobeetie soils in this mapping unit have a surface layer of calcareous, brown fine sandy loam about 6 inches thick. The next layer is friable, calcareous, pale-brown fine sandy loam about 21 inches thick. The underlying material is calcareous, very pale brown fine sandy loam that extends to a depth of more than 60 inches. A small amount of calcium carbonate has accumulated in the upper 14 inches. A few caliche pebbles are scattered throughout the profile. In this unit Mobeetie fine sandy

loam is on concave foot slopes below ridges of other soils. Slopes are 3 to 12 percent. Many of the small drainageways in this soil have actively advancing escarpments from 1 to 4 feet high along their edges.

The Potter soils in this unit have a surface layer of calcareous, grayish-brown loam to sandy loam about 5 inches thick that grades into hard platy caliche at a depth of about 9 inches. In this unit the Potter soils are on strongly convex knobs and ridges and along the resistant caprock. Slopes are 2 to 12 percent.

Other soils and land types included in this mapping unit are areas of Rough broken land that occur along caprock escarpments; Mansker loam; Berda loam; Springer soils; Dalhart soils; Likes loamy fine sand; Bippus soils; and bottom-land areas of the Lincoln, Guadalupe, and Spur soils.

Most of the acreage of this mapping unit is in range. Capability unit VIe-3; Mixedland Slopes range site.

Patricia Series

The Patricia series consists of deep, nearly level to gently sloping soils on uplands. These soils formed in sandy outwash material.

In a representative profile, the surface layer is fine sand about 17 inches thick. It is grayish brown in the upper 5 inches and pale brown in the lower 12 inches. The next layer is yellowish-red sandy clay loam in the upper 18 inches and reddish-yellow fine sandy loam in the lower 20 inches. The underlying material is a reddish-yellow loamy fine sand that extends to a depth of 62 inches.

These soils are in crops and range. They are well drained, and their permeability is moderate. They have a moderate available water capacity.

Representative profile of Patricia fine sand, 0 to 3 percent slopes, 50 feet north of the Santa Fe railroad, from a point 0.33 mile northeast of where the railroad crosses the Wheeler County line. This location is 3 miles east on the county line road from where Farm Road 277 crosses the Wheeler County line and approximately 16.5 miles east of Gageby, Tex.

A11—0 to 5 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) when moist; structureless; soft, very friable, nonsticky; many roots; neutral; clear, smooth boundary.

A12—5 to 17 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; structureless; loose, nonsticky; fewer roots than in horizon above; slightly acid; clear, smooth boundary.

B21t—17 to 35 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, very coarse, prismatic structure parting to weak, medium, blocky; very hard, friable, sticky; few roots; few pores; few worm casts; few very thin clay films on prism faces; medium acid; diffuse, smooth boundary.

B22t—35 to 55 inches, reddish-yellow (7.5YR 6/6) fine sandy loam, strong brown (7.5YR 5/6) when moist; weak, coarse, prismatic structure parting to weak, subangular blocky; hard, very friable, nonsticky; few quartz pebbles up to 0.5 inch in diameter; slightly acid; diffuse, smooth boundary.

C—55 to 62 inches, reddish-yellow (7.5YR 7/6) loamy fine sand, reddish yellow (7.5YR 6/6) when moist; structureless; soft, very friable, nonsticky; slightly acid.

The A horizon ranges from 5 to 19 inches in thickness and from grayish brown to pale brown in color. The Bt horizon ranges from 24 to 45 inches in thickness. The C horizon ranges from reddish brown to yellowish brown in color and from light sandy clay loam to loamy fine sand in texture. Depth to the C horizon is 40 to 64 inches.

Patricia fine sand, 0 to 3 percent slopes (PaB).—This nearly level to gently sloping soil is in rounded areas that have smooth boundaries.

Included with this soil in mapping are small areas of Miles loamy fine sand, Dalhart fine sandy loam, and Springer loamy fine sand.

This Patricia fine sand is used for range and crops.

Most cultivated areas are slightly to moderately eroded by soil blowing. Most fence rows around cultivated fields have accumulations of sand as much as 3 feet high and 20 feet wide. A few of the gently sloping areas are eroded by water. Capability unit IVe-6; Sandyland range site.

Potter Series

The Potter series consists of very shallow, gently sloping to steep, calcareous soils of the uplands. These soils are in long, narrow, irregular areas bordering the caprock. They formed in beds of loamy and cemented caliche.

In a representative profile, the surface layer is grayish-brown loam about 5 inches thick. The underlying material is a mixture of platy caliche, weakly cemented caliche, and powdery caliche.

Potter soils are used for range. They are well drained, and runoff is moderate to rapid. Permeability is moderate, and the available water capacity is low.

Representative profile of Potter loam, in an area of Berda-Potter complex, 150 feet north of Farm Road 1268, from a point 2.8 miles west of its junction with U.S. Highway 83, which is 1 mile north of the Wheeler County line. This location is 20 miles south and 2.8 miles west of Canadian, Tex.

A—0 to 5 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; slightly hard, very friable, slightly sticky; few calcium carbonate pebbles; calcareous; moderately alkaline; clear, smooth boundary.

Cca—5 to 9 inches, very pale brown (10YR 8/4) slightly platy caliche, very pale brown (10YR 7/4) when moist; the upper few inches is 20 percent grayish-brown (10YR 5/2) loam between hardened caliche fragments, dark grayish brown (10YR 4/2) when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

R—9 to 60 inches, white (10YR 8/2) platy caliche; an estimated 60 percent, by volume, caliche fragments that have a hardness of slightly less than 3 Mohs scale; about 40 percent, by volume, weakly cemented and powdery caliche.

The A horizon ranges from 4 to 9 inches in thickness, from dark grayish brown to light brown in color, and from loam to fine sandy loam in texture. The amount of calcium carbonate in the Cca horizon ranges from 20 to 70 percent. The cementation of the R layer ranges from weak to strong.

Potter soils (Pe).—This mapping unit is made up of soils that lie along the escarpments and escarpment remnants leading from the High Plains. They are gently sloping to steep soils on convex mesas and ridges. Slopes range from 2 to 30 percent but commonly are about 4 percent. Areas of this mapping unit average 50 acres in size and range from 10 to 300 acres.

The surface layer is calcareous, grayish-brown loam 5 inches thick that grades into platy caliche at a depth of about 9 inches. Texture of the surface layer is loam or fine sandy loam.

Included in this mapping unit are small areas of Quanah clay loam, Mansker loam, Berda loam, and Mobeetie fine sandy loam.

The areas of this mapping unit are mostly in range. A few areas are used as a source of commercial caliche. Capability unit VIIs–1; Very Shallow range site.

Pullman Series

The Pullman series consists of deep, nearly level soils on uplands. These soils formed in calcareous loamy and clayey materials.

In a representative profile, the surface layer is dark grayish-brown clay loam about 7 inches thick. The next layer is dark grayish-brown clay in the upper 7 inches and dark-brown clay in the next 34 inches. Between the depths of 48 and 60 inches, it is brown clay loam.

Pullman soils are well drained, and their permeability is very slow. The available water capacity is high. Some rainfall is lost by runoff because water does not soak into the ground as rapidly as it falls.

Most of the areas of Pullman soils are used for crops, but a few areas are in range.

Representative profile of Pullman clay loam, 0 to 1 percent slopes, 150 feet north of Farm Road 1268, from a point 0.25 mile east of the Roberts County line. This location is in the southwestern corner of the county.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard, friable, sticky; slightly acid; gradual, smooth boundary.

B21t—7 to 14 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, blocky structure; extremely hard, very firm, very sticky; few very fine pores; clay films on ped surfaces, more pronounced films on horizontal ped surfaces; neutral; diffuse, smooth boundary.

B22t—14 to 48 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; moderate, medium, blocky structure; extremely hard, very firm, very sticky; few very fine pores; clay films on ped surfaces, more prominent films on horizontal ped surfaces; noncalcareous in upper part and calcareous below depth of 38 inches; mildly alkaline; gradual, smooth boundary.

B3ca—48 to 60 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard, firm, very sticky; few threads, films, and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The Ap horizon ranges from 5 to 10 inches in thickness. These soils become calcareous at a depth of 25 to 40 inches. Depth to a horizon of calcium carbonate accumulation is 48 to 80 inches.

Pullman clay loam, 0 to 1 percent slopes (PmA).—This nearly level soil is in one large area on the High Plains. It is 624 acres in size and is at the highest elevation in the county, about 3,000 feet above sea level.

Included with this soil in mapping are small, round, slightly depressed areas of Randall clay and a few small areas of Richfield clay loam.

Almost all of this Pullman clay loam is in cultivation. This soil is subject to a slight hazard of soil blowing. Capability unit IIIce–1; Deep Hardland range site.

Quanah Series

The Quanah series consists of deep, gently sloping soils on uplands. These soils formed in strongly calcareous, loamy materials.

In a representative profile, the surface layer is dark grayish-brown clay loam about 9 inches thick. The next layer is brown silty clay loam about 16 inches thick. The underlying material is silty clay loam to a depth of more than 60 inches. The upper part is light yellowish brown and contains 20 percent calcium carbonate, and the lower part is light reddish brown and contains 5 percent calcium carbonate.

The Quanah soils are well drained, and permeability is moderate. The available water capacity is high. These soils are used mostly for crops, but a few areas are in range.

Representative profile of Quanah clay loam, 1 to 3 percent slopes, 750 feet north of Farm Road 1268, from a point on Farm Road 1268 that is 2.25 miles west of its junction with Farm Road 48. This location is 2.75 miles east and 1 mile north of the Roberts County line in the southwestern corner of the county.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable, sticky; calcareous; moderately alkaline; gradual, smooth boundary.

B2—9 to 25 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, very coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, friable, sticky; many worm casts; few very fine pebbles of calcium carbonate; few threads and films of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C1cab—25 to 41 inches, light yellowish-brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky; 20 percent visible calcium carbonate, mostly in soft masses up to 0.5 inch in diameter and in a few fine concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C2b—41 to 60 inches, light reddish-brown (5YR 6/3) silty clay loam, reddish brown (5YR 5/3) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky; 5 percent visible soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and from dark grayish brown to brown in color. The B2 horizon ranges from 12 to 30 inches in thickness, from dark grayish brown to brown in color, from clay loam to silty clay loam in texture, and from moderate, fine, granular to moderate, medium, subangular blocky and prismatic in structure.

The C1ca horizon is 6 to 20 inches thick and is 15 to 50 percent calcium carbonate. The C2 horizon is light brown to light reddish brown.

Quanah clay loam, 1 to 3 percent slopes (QuB).—This gently sloping soil is on broad interstream divides that have convex slopes. These long, narrow, and in some places oval, areas average about 50 acres in size but range from 10 to 200 acres.

Included with this soil in mapping are small areas of nearly level Quanah soils and small areas of Mansker loam, Dumas loam, Richfield clay loam, and Berda loam.

Most of this Quanah clay loam is cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IIIe–2; Deep Hardland range site.

Randall Series

The Randall series consists of deep, clayey, somewhat poorly drained soils that are in the bottoms of playa lakes. These soils formed in clays that have been transported into the depressions from surrounding higher lying soils. They formed under alternating periods of flooding and drought.

In a representative profile, the surface layer is dark-gray clay about 24 inches thick. The underlying material, extending to a depth of more than 60 inches, is clay that is dark gray in the upper part and grayish brown in the lower part.

Permeability is very slow. Periodic flooding makes these soils poorly suited to cultivation, and the chief use is for grazing.

Representative profile of Randall clay 10 feet east of the Hemphill-Roberts county line, 0.2 mile north of where the county line crosses Farm Road 1268. This location is in the southwestern corner of Hemphill County.

A1—0 to 24 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; upper 0.5 inch has moderate, medium, granular structure; remainder of the upper 10 inches has strong, medium, blocky structure; the lower 14 inches has massive structure; very hard, very firm, very sticky; slightly acid; diffuse, wavy boundary.

C1—24 to 48 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; massive; extremely hard, extremely firm, very sticky; neutral, but becoming calcareous and mildly alkaline at a depth of 36 inches; gradual, smooth boundary.

C2—48 to 60 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) when moist; massive; extremely hard, extremely firm, very sticky; few fine concretions of calcium carbonate; calcareous; moderately alkaline.

Depth to the calcareous layer ranges from 18 to 50 inches.

Randall clay (Ra).—This soil is on the bottoms of small intermittent lakes. The soil areas are rounded or oval and range from 5 to 50 acres in size. The surface of undisturbed areas has a gilgai microrelief.

This soil is all in range except where smaller areas exist in a large cultivated field. Some of these areas are cultivated only during dry years.

After heavy rains, this Randall clay is flooded from a few days to several months. The runoff collects in these areas and remains until it evaporates. When this soil is dry and the surface is bare, the hazard of soil blowing is high. Capability unit IVw–1; range site not assigned.

Richfield Series

The Richfield series consists of deep, nearly level to gently sloping soils of the uplands. These soils formed in calcareous clay loam sediments.

In a representative profile, the surface layer is dark-brown clay loam about 10 inches thick. The next layer is clay loam to a depth of 50 inches. It is dark brown in the upper 9 inches and brown in the lower 31 inches. The underlying material, extending to a depth of about 66 inches, is yellowish-red clay loam.

These soils are well drained, and their permeability is moderately slow. The available water capacity is high. Richfield soils are used mostly for crops, but a few areas are in range.

Representative profile of Richfield clay loam, 1 to 3 percent slopes, 150 feet northwest of a county road intersection that is 4.3 miles west of the junction of U.S. Highway 83 and Farm Road 277. This junction is 5 miles north of the Wheeler County line.

Ap—0 to 6 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, sticky; mildly alkaline; abrupt, smooth boundary.

A12—6 to 10 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; hard, firm, sticky; common, medium to fine pores; common worm casts; mildly alkaline; clear, smooth boundary.

B21t—10 to 19 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; very hard, firm, very sticky; common very fine pores; few worm casts; few clay films on ped surfaces; mildly alkaline; gradual, smooth boundary.

B22t—19 to 40 inches, brown (7.5YR 5/3) clay loam, brown (7.5YR 4/3) when moist; moderate, medium, blocky structure; very hard, firm, very sticky; few very fine pores; few clay films on ped surfaces; calcareous; moderately alkaline; gradual, smooth boundary.

B3—40 to 50 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; hard, friable, sticky; few fine and very fine pores; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—50 to 58 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; weak, fine and medium, subangular blocky structure; hard, friable, sticky; 5 percent fine and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C2—58 to 66 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; structureless; hard, friable, sticky; calcareous; moderately alkaline.

The A horizon ranges from 5 to 12 inches in thickness and from dark brown to dark grayish brown in color. The B horizon ranges from 30 to 50 inches in thickness and from reddish brown to dark brown in color. Depth to the Cca horizon is 40 to 60 inches, and calcium carbonate content is 5 to 15 percent.

Richfield clay loam, 0 to 1 percent slopes (RcA).—This nearly level soil is on plane to weakly convex upland ridges. Soil areas are oblong and about 20 acres in size.

The surface layer is dark-brown, neutral clay loam about 10 inches thick. The next layer is dark-brown, firm clay loam. There is usually an 8-inch layer of calcium carbonate beginning at a depth of 50 inches. The underlying material is yellowish-red, strongly calcareous clay loam.

Included with this soil in mapping are small areas of Pullman clay loam, Randall clay, Bippus clay loam, and Dumas loam.

Most of this Richfield clay loam is in cultivation. The hazard of soil blowing is slight. Capability unit IIce–4; Deep Hardland range site.

Richfield clay loam, 1 to 3 percent slopes (RcB).—This gently sloping soil is on upland ridges. The elongated soil areas have plane to slightly convex slopes. They range from 10 to 300 acres in size but average about 70 acres.

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

Included with this soil in mapping are a few small areas of Richfield clay loam, 0 to 1 percent slopes, Quanah clay loam, Bippus clay loam, Mansker loam, Berda loam, and Dumas loam.

Most of this Richfield clay loam is cultivated. It is well suited to crops that grow in the county. Soil blowing is a slight hazard, and water erosion is a moderate hazard. Capability unit IIe–2; Deep Hardland range site.

Rough Broken Land

Rough broken land (Ro) consists of steep bluffs that are cut by canyons and deep drainage channels (fig. 9). These steep areas are extensive along and below the edge of the High Plains. They occur in areas where the caprock has checked erosion into the mantle of the High Plains.

This is a miscellaneous land type. The steep slopes dominate in the area, much of which has little or no classifiable soil. The percentages of Rough broken land and identifiable soils differ from area to area.

On the sides of the bluffs and canyons in these areas, the slopes average about 30 percent, but they range from 12 to 60 percent. Local relief ranges from 30 to 300 feet, and sheer drops of 20 to 50 feet occur in places. In most places, areas of this mapping unit are about 90 acres in size, but the range is from 15 to 1,000 acres.

About 30 percent of the acreage mapped as Rough broken land is inclusions of Berda loam on foot slopes below ridges and escarpments; about 14 percent is Potter soils along ridges and escarpments; about 13 percent is Mobeetie fine sandy loam on foot slopes below ridges and escarpments; and about 11 percent is Mansker loam on ridges closely associated with the Potter soils. Other identifiable inclusions are Bippus soils in drainageways and the Spur and Guadalupe soils in narrow bottom-land areas.

This land type is poorly suited to grass. Grazing is the main use, but only a small amount of forage is produced. This land type is also used as refuge for many kinds of wildlife. A few areas are mined for caliche.

Because this mapping unit is made up of a land type and several different soils, it is difficult to manage and use efficiently; however, this unit provides some of the most scenic landscape in the county. Capability unit VIIs–2; Rough Breaks range site.

Springer Series

The Springer series consists of deep, nearly level to sloping, sandy and loamy soils on uplands. These soils formed in sandy material.

In a representative profile, the surface layer is brown loamy fine sand about 8 inches thick. The next layer is brown fine sandy loam in the upper 7 inches and strong-brown loamy fine sand in the lower 6 inches. The underlying material, extending to a depth of 60 inches, is reddish-yellow fine sand.

These soils are well drained, and surface runoff is slow. Permeability is moderately rapid, and the available water capacity is low.

These soils are mostly in range, but a few areas are cultivated.

Representative profile of Springer loamy fine sand, hummocky, 20 feet north of U.S. Highway 60, from a point 1 mile southwest of the Lipscomb County line. This location is 4.8 miles northeast of Glazier, Tex., on U.S. Highway 60.

Figure 9.—Typical area of Rough broken land near the High Plains escarpment.

A—0 to 8 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) when moist; weak, medium, granular structure; soft, very friable, nonsticky; many roots; slightly acid; gradual, smooth boundary.

B2t—8 to 15 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) when moist; moderate, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, friable, nonsticky; few roots; few worm casts; slightly acid; gradual, smooth boundary.

B3—15 to 21 inches, strong-brown (7.5YR 5/6) loamy fine sand, strong brown (7.5YR 4/6) when moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, very friable, nonsticky; few roots; neutral; gradual, smooth boundary.

C—21 to 60 inches, reddish-yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 4/6) when moist; structureless; loose; neutral.

The A horizon ranges from 8 to 15 inches in thickness, from dark grayish brown to brown in color, and from fine sandy loam to loamy fine sand in texture. The B2t horizon ranges from 6 to 40 inches in thickness and from brown to reddish yellow in color. The B3 horizon ranges from 0 to 27 inches in thickness, from strong brown to yellowish red in color, and from loamy fine sand to fine sandy loam in texture. Depth to the C horizon is 21 to 60 inches. This horizon is reddish-yellow to pink loamy fine sand to fine sand.

Springer fine sandy loam, 1 to 3 percent slopes (SfB).—This gently sloping soil is on undulating uplands. Soil areas are oblong to irregular and average about 60 acres in size, but range from 10 to 500 acres.

The surface layer is neutral, dark-brown fine sandy loam about 12 inches thick. The next layer is friable, brown, neutral fine sandy loam about 36 inches thick. The underlying material is reddish-yellow loamy fine sand that extends to a depth of about 60 inches. It is calcareous in some areas.

Included with this soil in mapping are a few small areas of Dumas loam, Dalhart fine sandy loam, Springer loamy fine sand, and Springer fine sandy loam, 3 to 5 percent slopes.

About 80 percent of this Springer fine sandy loam, 1 to 3 percent slopes, is in native range and the rest is cultivated. Water erosion is a slight hazard and soil blowing is a moderate hazard. Capability unit IIIe–5; Sandy Loam range site.

Springer fine sandy loam, 3 to 5 percent slopes (SfC).—This gently sloping soil is on undulating uplands. Most soil areas are elongated and irregular and range from 10 to 150 acres in size. They average about 45 acres in size.

The surface layer is brown, neutral fine sandy loam about 8 inches thick. The next layer is friable, brown, neutral fine sandy loam that contains slightly more clay than the surface layer. The underlying material is reddish-yellow loamy fine sand that begins at a depth of about 30 inches. It is calcareous in some areas.

Mapped with this soil are small areas of Springer loamy fine sand, Mobeetie fine sandy loam, Dalhart fine sandy loam, Dumas loam, and small areas of gently sloping and sloping Springer fine sandy loam.

Most of this Springer fine sandy loam, 3 to 5 percent slopes, is in range. A few fields are cultivated. This soil is subject to a moderate hazard of soil blowing and water erosion. Capability unit IVe–9; Sandy Loam range site.

Springer fine sandy loam, 5 to 8 percent slopes (SfD).—This sloping soil is on uplands. Most soil areas are long, narrow, and irregular and lie along major and minor creeks and drainageways. They average about 75 acres in size but range from 10 to 500 acres.

The surface layer is a brown, neutral fine sandy loam about 8 inches thick. The next layer is a brown, neutral, friable fine sandy loam that contains slightly more clay than the surface layer. The underlying material is a reddish-yellow loamy fine sand that begins at a depth of about 24 inches. It is calcareous in some areas.

Mapped with this soil are small areas of Dalhart fine sandy loam, Mobeetie fine sandy loam, Springer loamy fine sand, and Enterprise very fine sandy loam.

This Springer fine sandy loam is in range. When unprotected by vegetation, this soil is subject to a moderate hazard of soil blowing and a high hazard of water erosion. Capability unit VIe–5; Sandy Loam range site.

Springer loamy fine sand, undulating (SlB).—This soil is nearly level to gently undulating. Slopes are 0 to 3 percent. Most soil areas are long and irregular and range from 12 to 200 acres in size. They average about 50 acres in size.

The surface layer is neutral, dark-brown loamy fine sand about 14 inches thick. The next layer is friable, neutral, brown fine sandy loam. The underlying material is reddish-yellow fine sand that begins at a depth of about 40 inches.

Mapped with this soil are a few small areas of Springer fine sandy loam, Springer loamy fine sand, hummocky, Dalhart fine sandy loam, and Miles loamy fine sand.

Most of this Springer loamy fine sand is in native range. A few areas are cultivated. The hazard of soil blowing is high. Capability unit IVe–11; Sandyland range site.

Springer loamy fine sand, hummocky (SlC).—This soil is in hummocks that have slopes of 3 to 8 percent. Slopes are irregular. The areas are dunelike in appearance, are oblong and irregular, and range from 15 to 500 acres in size. The average area is about 90 acres.

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

Mapped with this soil are small areas of gently sloping Springer loamy fine sand and Tivoli fine sand. A few small, undulating areas between ridges of Springer loamy fine sand are of Springer fine sandy loam or Dalhart fine sandy loam. A few areas of Springer loamy fine sand that have 12 percent slopes are included.

Nearly all of this Springer loamy fine sand, hummocky, is in range. It is subject to a high hazard of soil blowing. Capability unit VIe–6; Sandyland range site.

Spur Series

The Spur series consists of deep, nearly level to gently undulating, calcareous soils on bottom lands. These soils lie adjacent to drainageways, rivers, and creeks. They formed in stratified, calcareous, loamy alluvium.

In a representative profile, the surface layer is clay loam about 16 inches thick. It is grayish brown in the upper 5 inches and dark grayish brown in the lower 11 inches. The underlying material is grayish-brown clay loam that extends to a depth of 60 inches.

These soils are well drained, and their permeability is moderate. They have a high available water capacity. Spur soils are used for crops and range.

Representative profile of Spur clay loam in a cultivated field, 75 feet west of a county road, from a point 1.75 miles south of U.S. Highway 60, which is 1.5 miles southwest of its junction with U.S. Highway 83 and Texas Highway 33. This location is about 10 miles south and 2 miles west of Canadian, Tex.

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

A12—5 to 16 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable, sticky; many pores; many worm casts; calcareous; moderately alkaline; diffuse, smooth boundary.

C—16 to 60 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; slightly hard, friable, sticky; common worm casts and pores; thin strata of lighter colored fine sandy loams and loams; few quartz and calcium carbonate pebbles in thin strata; few threads and films of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 11 to 19 inches in thickness, from dark grayish brown to brown in color, and from neutral to moderately alkaline in reaction. The C horizon ranges from pale brown to dark grayish brown in color and from clay loam to loam in texture. In most places it is stratified with layers of silt loam and fine sandy loam. In a few places the C horizon contains strata of loamy fine sand. A water table occurs between depths of 5 and 10 feet in a few places.

Spur clay loam (Sp).—This nearly level to gently undulating soil is on bottom lands that are occasionally flooded. Most areas are long and narrow and range from 10 to about 200 acres in size. The average is about 20 acres in size.

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

Mapped with this soil are small areas of Guadalupe fine sandy loam, Bippus clay loam, and Lincoln soils.

About half of this Spur clay loam is cultivated. It is subject to a slight hazard of soil blowing. The occasional flooding is of short duration. Capability unit IIce–1; Loamy Bottomland range site.

Spur clay loam, broken (Su).—This soil occupies long, low, narrow areas in and along many of the channels of the minor drains. It includes the drainage channels, channel banks, and flood plains that are dissected by old channels. These channels are winding and often present a braided pattern. They are from 1 to 6 feet deep and 4 to 10 feet wide. The bottoms of the channels have been scoured by running water. Most of this area is flooded following heavy rains. Soil areas range from 10 to 200 acres in size and average 40 acres.

The surface layer is calcareous, dark grayish-brown clay loam about 14 inches thick. The underlying material is brownish, friable, calcareous clay loam that contains thin strata of very fine sandy loam, silt loam, and loamy fine sand.

Included with this soil in mapping are areas of the smoother Spur clay loam. Also included are many small areas of Guadalupe and Lincoln soils.

Most of the Spur clay loam, broken, is in range. It is good wildlife habitat. Capability unit Vw–1; Loamy Bottomland range site.

Sweetwater Series

The Sweetwater series consists of deep, nearly level to gently undulating, calcareous soils on bottom lands. These soils are in the flood plains of the major rivers and their tributaries. They formed in calcareous alluvial fine sands and silty clay loams that have a water table close to the surface.

In a representative profile, the surface layer is dark-gray silty clay loam in the upper 14 inches and grayish-brown clay loam in the lower 10 inches. The underlying material is very pale brown loamy fine sand that extends to a depth of 60 inches.

These soils are poorly drained. The water table is constantly at or near the surface. This limits the kinds of vegetation that will grow on these soils.

Representative profile of Sweetwater silty clay loam, in an area of Sweetwater soils, 750 feet south of Farm Road 2266, from a point 1 mile east of its junction with U.S. Highway 60, which is 1 mile northeast of Canadian, Tex. This location is 2 miles northeast of Canadian on the north side of the Canadian River.

A11—0 to 14 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; few, very fine, distinct, dark yellowish-brown mottles; moderate, fine, granular structure; very hard, friable; many roots; calcareous; moderately alkaline; clear, smooth boundary.

A12—14 to 24 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, faint, yellowish-brown mottles; weak, fine, granular structure and very fine subangular blocky structure; very hard, friable; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

C—24 to 60 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) when moist; common, coarse, faint, dark yellowish-brown mottles; structureless; slightly hard, very friable; few very thin strata of grayish-brown fine sandy loam; calcareous; moderately alkaline.

The A11 horizon ranges from 7 to 20 inches in thickness, from dark reddish gray to gray in color, and from loam to silty clay loam in texture. The mottling in the subsurface horizons ranges from faint to prominent.

Sweetwater soils (Sw).—These nearly level to gently sloping soils are on the gently undulating bottom lands of the major drains and on a few foot slopes. Slopes range from 0 to 3 percent. Soil areas are elongated and range from 12 acres to 900 acres in size but average about 60 acres. Texture of the surface layer is silty clay loam, loam, or silt loam.

Included in this mapping unit are small areas of Lincoln, Spur, Guadalupe, and Tivoli soils, and small meandering stream channels.

All of the acreage of this mapping unit is in native grass. Much of it is used for meadows or hay (fig. 10). These soils provide excellent habitat for wildlife.

These soils are frequently flooded, and artificial drainage is not practical. Capability unit Vw–3; Loamy Bottomland range site.

Tipton Series

The Tipton series consists of deep, nearly level to gently sloping, loamy soils. These soils formed in calcareous clay loam sediments.

Figure 10.—Sweetwater soils used for hay.

In a representative profile, the surface layer is dark grayish-brown silty clay loam about 19 inches thick. The next layer is silty clay loam about 31 inches thick. It is dark brown in the upper 19 inches and grayish brown in the lower 12 inches. The underlying material is calcareous, yellowish-brown silty clay loam that extends to a depth of 64 inches.

These soils are well drained, and their permeability is moderate. The available water capacity is high. Most of the Tipton soils are cultivated, and a few are in range.

Representative profile of Titpon silty clay loam, 0 to 1 percent slopes, 100 feet south of a county road, from a point 3.5 miles north and northwest by county road from the intersection of the county road and State Highway 33, 13 miles east of the intersection of State Highway 33 and U.S. Highway 83 and 60, southeast of Canadian, Tex.

A1—0 to 19 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky; common pores; slightly acid; diffuse, smooth boundary.

B21t—19 to 38 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) when moist; weak, very coarse, prismatic structure parting to moderate, medium, granular; hard, friable, sticky; common pores; common worm casts; mildly alkaline; gradual, smooth boundary.

B22t—38 to 50 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 4/3) when moist; weak, very coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable, sticky; common pores; few worm casts; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—50 to 64 inches, yellowish-brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 3/4) when moist; weak, very coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable, sticky; common pores; few threads and films of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from silty clay loam to silt loam in texture, from dark grayish brown to brown in color, and from 10 to 20 inches in thickness.

The B21t horizon ranges from dark brown to brown in color. The B2t horizons range from clay loam to silty clay loam in texture, from reddish brown to light yellowish brown in color, and from 30 to 45 inches in thickness. Depth to the C horizon is 40 to 60 inches.

Tipton silt loam, 0 to 1 percent slopes (ToA).—This nearly level soil is on terraces. Most areas are rounded or oblong and weakly undulating in appearance. They average about 45 acres in size but range from 12 to 160 acres.

The surface layer is dark-brown, neutral silt loam about 12 inches thick. The next layer is brown clay loam that becomes calcareous at a depth of about 38 inches. The underlying material is yellowish-brown, calcareous silty clay loam that begins at a depth of about 50 inches.

Included with this soil in mapping are some small areas of Tipton silty clay loam, Enterprise very fine sandy loam, and Dalhart fine sandy loam.

Most of this Tipton silt loam is cultivated. Most crops that grow in the county grow well on this soil. A few areas are in range.

There is little water erosion on this soil, and the hazard of soil blowing is slight. Capability unit IIce–2; Mixedland range site.

Tipton silt loam, 1 to 3 percent slopes (ToB).—This gently sloping soil occupies terraces in areas that range from 25 to 200 acres in size and average about 65 acres. The surface is plane to slightly convex and gently undulating.

The surface layer is neutral, brown silt loam about 12 inches thick. The next layer is brown, neutral clay loam or silty clay loam that is calcareous at a depth of about 30 inches. The underlying material is yellowish-brown, calcareous clay loam that begins at a depth of about 50 inches.

Mapped with this soil are small areas of Tipton silt loam, 0 to 1 percent slopes, Tipton silty clay loam, and Dalhart fine sandy loam.

About half of this Tipton silt loam, 1 to 3 percent slopes, is in cultivation, and the rest is in range.

This soil is subject to slight hazards of soil blowing and water erosion. Capability unit IIe–1; Mixedland range site.

Tipton silty clay loam, 0 to 1 percent slopes (TtA).—This nearly level soil is on terraces in rounded or oblong areas 20 to 600 acres in size.

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

Included with this soil in mapping are small areas of Tipton silty clay loam, 1 to 3 percent slopes, and Tipton silt loam.

Almost all of this Tipton silty clay loam, 0 to 1 percent slopes, is cultivated to small grains or row crops. Some of it is irrigated. A few areas are in range. This soil is subject to a slight hazard of soil blowing. Capability unit IIce–1; Deep Hardland range site.

Tipton silty clay loam, 1 to 3 percent slopes (TtB).—This gently sloping soil is on elongated terraces around the edge of level Tipton soils. The surface is plane to slightly convex and gently undulating. Soil areas average about 35 acres in size but range from 12 to 100 acres.

The surface layer is neutral, dark grayish-brown silty clay loam about 15 inches thick. The next layer is grayish-brown silty clay loam that is calcareous below a depth of about 30 inches. The underlying material is yellowish-brown, calcareous silty clay loam that begins at a depth of about 50 inches.

Mapped with this soil are a few small areas of Dumas loam, Tipton silt loam, and Dalhart fine sandy loam.

About 70 percent of this Tipton silty clay loam is in cultivation. A few areas are in native range. This soil is subject to a slight hazard of soil blowing and a moderate hazard of water erosion. Capability unit IIe–2; Deep Hardland range site.

Tivoli Series

The Tivoli series consists of deep, brown, loose sands. These soils have gently sloping to steep slopes and a dune-like appearance. They formed in wind-deposited fine sand.

In a representative profile, the surface layer is brown fine sand about 8 inches thick. The underlying material is strong-brown fine sand that extends to a depth of more than 60 inches.

These soils are excessively drained, and their permeability is rapid. Tivoli soils have a low available water capacity. They are used for range.

Representative profile of Tivoli fine sand, 50 feet north of a county road, from a point 4.75 miles north of Lake Marvin. This location is 9.7 miles east and south of Glazier, Tex., by U.S. Highway 60 and county roads.

A1—0 to 8 inches, brown (10YR 5/3) fine sand, brown (10YR 4/3) when moist; single grain; loose; many roots; neutral; gradual, smooth boundary.

C—8 to 60 inches, strong-brown (7.5YR 5/6) fine sand, strong brown (7.5YR 4/6) when moist; single grain; loose; neutral.

The A horizon ranges from 4 to 10 inches in thickness. The C horizon ranges from strong brown to brownish yellow in color.

Tivoli fine sand (Tv).—This gently sloping to steep soil is on dunes (fig. 11). Slopes are mainly 3 to 8 percent, but some dunes have slopes as steep as 30 percent. Soil areas are irregular in shape, and some large duned areas cover several sections.

Mapped with this soil are small areas of Springer loamy fine sand, Likes loamy fine sand, a few areas of Active dunes, and Lincoln soils in bottom-land areas.

All of this Tivoli fine sand is in native range. This soil is highly susceptible to soil blowing. Capability unit VIIe–1; Deep Sand range site.

Use and Management of the Soils

This section explains the system of capability classification used by the Soil Conservation Service, discusses management of the soils by capability units for dryland crops, and gives estimated average acre yields of the principal crops. Following this is a brief discussion of irrigation, and then management of the soils for range, wildlife, and engineering is described.

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

Figure 11.—Native range on Tivoli fine sand.

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 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 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 that 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.

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.

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.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, 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, 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–2 or IIIe–5. 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. The capability units are not numbered consecutively in Hemphill County because not all of the capability units used in Texas are in this county.

Management by Capability Units

The soils of Hemphill County have been placed in capability units to facilitate discussion of their management. All the soils in a given capability unit are similar in their response to management. The names of the soils in each capability unit can be found in the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIcc–1

This unit consists of deep, well-drained, nearly level soils that have a clay loam or silty clay loam surface layer and moderately permeable lower layers. Some areas of these soils are in bottom lands that receive extra water and are occasionally flooded.

Grain sorghum and wheat are the principal crops. Forage sorghum, cotton, and alfalfa also are grown.

A cropping system that includes wheat, or some other crop that produces a large amount of residue, is well suited to the soils in this unit. Crop residue kept on their surface helps control soil blowing and helps maintain good soil tilth.

In some places diversion terraces and grassed waterways are needed to divert runoff from higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIcc–2

This unit consists of deep, well-drained, nearly level soils that have a very fine sandy loam or silt loam surface layer and moderately to moderately rapidly permeable very fine sandy loam to silt loam lower layers.

The principal crops are cotton, wheat, alfalfa, and grain sorghum, but other crops grown in the county also are well suited.

A cropping system that includes cover crops, mulches, or crops such as grain sorghum that produce a large amount of residue, is well suited to the soils in this unit. Crop residue kept on the surface helps control soil blowing and helps maintain good soil tilth.

In some places, diversion terraces and grassed waterways are needed to divert runoff from higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIce–4

The deep, well-drained, nearly level Richfield clay loam, 0 to 1 percent slopes, is the only soil in this unit. It has moderately slowly permeable lower layers.

The principal crops are cotton, wheat, and grain sorghum, but other crops grown in the county also are well suited.

A cropping system that includes wheat or some other crop that produces a large amount of residue is well suited. If the residue is kept on the surface, it helps to control soil blowing and to prevent surface crusting.

In some places diversion terraces and grassed waterways are needed to divert runoff from higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIce–5

The deep, well-drained, nearly level Dumas loam, 0 to 1 percent slopes, is the only soil in this unit. It has moderately permeable clay loam lower layers.

The main crops are grain sorghum and wheat. Cotton, forage sorghums, and other crops well suited to the county also are grown.

Cropping systems that include crops such as grain sorghum, which produces a large amount of residue, are well suited to the soil in this unit. The residue from such crops, when kept on the surface, helps control soil blowing and helps maintain good soil tilth.

Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. In some places diversion terraces and grassed waterways are needed to divert runoff from higher lying soils.

CAPABILITY UNIT IIe–1

This unit consists of gently sloping, well-drained, deep soils that have a very fine sandy loam to silt loam surface layer. These soils are moderately to moderately rapidly permeable.

Wheat and grain sorghum are the main crops, but cotton, forage sorghum, alfalfa, and other crops grown in the county also are well suited.

A cropping system that includes crops such as grain sorghum, which produces a large amount of residue, is well suited to the soils in this unit. The residue from these crops, when kept on the surface, helps control soil

blowing and water erosion and helps maintain good soil tilth.

Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage helps prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIe–2

This unit consists of deep, gently sloping soils that have a loam, silty clay loam, or clay loam surface layer and moderately to moderately slowly permeable lower layers.

The main crops are cotton, wheat, and grain sorghum. Other crops grown in the county also are suited to these soils.

A cropping system that includes crops such as wheat, which produces a large amount of residue, is well suited to the soils in this unit. This residue, when kept on the surface, helps to control soil blowing and water erosion and helps prevent surface crusting.

Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIIce–1

The deep, well-drained, nearly level Pullman clay loam, 0 to 1 percent slopes, is the only soil in this unit. It has very slowly permeable clay lower layers. The clay lower layers tend to impede movement of water, air, and roots.

Crops are mostly wheat and grain sorghum. Other crops grown in the county also are well suited to this soil.

Cropping systems that include crops such as wheat and grain sorghum, which produce a large amount of residue, are well suited to the soil in this unit. The residue from these crops helps to control soil blowing, to prevent surface crusting, and to maintain good soil tilth.

Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. In some places diversion terraces and waterways are needed to divert runoff from higher lying soils.

CAPABILITY UNIT IIIe–2

This unit consists of deep, well-drained, gently sloping soils that have a clay loam surface layer and moderately permeable lower layers.

The main crops are grain sorghum, forage sorghum, and wheat.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to these soils. This residue, when kept on the surface, helps reduce soil blowing and water erosion.

Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. Terraces and contour farming help control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff.

CAPABILITY UNIT IIIe–3

The deep, well-drained Enterprise very fine sandy loam 3 to 5 percent slopes, is the only soil in this unit. It has moderately rapidly permeable lower layers.

The principal crops are cotton, wheat, and grain sorghum.

A cropping system that includes crops that produce a large amount of residue, such as grain sorghum, is well suited to the soil in this unit. This residue, when kept on the surface, helps control soil blowing and water erosion and helps maintain good soil tilth.

Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage helps prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIIe–4

This unit consists of deep, well-drained, nearly level to gently sloping soils that have a fine sandy loam surface layer and moderately to moderately rapidly permeable lower layers.

The principal crops are cotton, wheat, and grain sorghum. Some alfalfa is grown.

A cropping system that includes cover crops, mulches, or crops that produce a large amount of residue, such as grain sorghum, is well suited to the soils in this unit. The residue from these crops helps control soil blowing and water erosion.

Terraces and contour farming help control water erosion on gently sloping areas that are cultivated. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage is needed to prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIIe–5

The deep, well-drained, gently sloping Springer fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This soil has moderately rapidly permeable lower layers.

The main crops are wheat and grain sorghum. Small acreages of cotton and alfalfa also are grown.

A cropping system that includes cover crops, mulches, or crops that produce a large amount of residue, such as grain sorghum, is well suited to this soil. Crop residue kept on the surface helps control soil blowing and water erosion.

Contour farming helps control water erosion on gently sloping cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage is needed to prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIIe–7

The well-drained, gently sloping Mansker loam, 1 to 3 percent slopes, is the only soil in this unit. This soil is moderately permeable.

The main crops are wheat and grain sorghum.

Cropping systems that include crops that produce a large amount of residue, such as wheat, are well suited to this soil. Crop residue kept on the surface helps control

soil blowing and water erosion and helps maintain good soil tilth.

Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage is needed to prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IIIe-8

The well-drained, calcareous, gently sloping Mobeetie fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This soil has moderately rapidly permeable lower layers.

The main crops are wheat, grain sorghum, and forage sorghum.

A cropping system that includes cover crops, mulches, or grain sorghum is well suited to this soil. The large amount of residue produced by such crops helps control soil blowing and water erosion and helps maintain good soil tilth.

Terraces and contour farming help control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion. Emergency tillage is needed to help prevent soil blowing in fields that are left uncovered for extended periods.

CAPABILITY UNIT IIIe-9

The well-drained Dumas loam, 3 to 5 percent slopes, is the only soil in this unit. This soil has moderately permeable lower layers.

Wheat and sorghums are the main crops.

A cropping system that includes cover crops, mulches, or grain sorghum is well suited to this soil. The large amount of residue from such crops helps control soil blowing and water erosion and helps maintain good soil tilth.

Terraces and contour farming help control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff. Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil.

CAPABILITY UNIT IVe-2

The Berda and Mansker loams, 3 to 6 percent slopes, are the only soils in this unit. These soils are well drained and moderately permeable. Grain and forage sorghums and wheat are the main crops.

A cropping system containing only wheat or a similar crop that produces a large amount of residue is needed for adequate soil protetcion. Crop residue left on the surface helps protect the soil until the next crop is planted.

Terraces and contour farming help control water erosion on cropland. Grassed waterways and diversion terraces are needed to help prevent erosion from runoff. Emergency tillage helps prevent soil blowing in unprotected fields.

CAPABILITY UNIT IVe-3

The deep, well-drained Dalhart soils, 2 to 6 percent slopes, eroded, are the only soils in this unit. These soils are moderately permeable.

Wheat, grain sorghum, and forage sorghum are the main crops. These soils are best suited to range.

A cropping system made up of crops that produce a large amount of residue or permanent vegetation is well suited to these soils. Crop residue, kept on the surface, helps control erosion and conserve moisture.

Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent water erosion. Emergency tillage is needed to prevent soil blowing in fields that are left unprotected for an extended period.

CAPABILITY UNIT IVe-4

This unit consists of deep, well-drained, gently sloping soils that have a fine sandy loam surface layer and moderately permeable lower layers.

Wheat and grain sorghum are the main crops, but small acreages of cotton, forage sorghum, and other crops also are grown.

A cropping system that includes cover crops, mulches, or grain sorghum is well suited to the soils in this unit. These crops produce a large amount of residue that helps control soil blowing and water erosion.

Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff.

CAPABILITY UNIT IVe-6

This unit consists of deep, well-drained, nearly level to gently sloping soils that have a fine sand or loamy fine sand surface layer and moderately permeable lower layers.

Cotton, grain sorghum, forage sorghum, and wheat are the main crops.

Cropping systems that include cover crops, mulches, or crops that produce a large amount of residue, such as grain sorghum, are well suited to the soils in this unit. This residue, when kept on the surface, helps control soil blowing and water erosion.

Emergency tillage is needed to prevent soil blowing in bare fields during periods of strong winds. Deep plowing also helps control soil blowing on these soils.

Contour farming helps control water erosion on gently sloping cultivated areas. Diversion terraces and grassed waterways help prevent erosion from runoff.

CAPABILITY UNIT IVe-9

This unit consists of deep, well-drained, gently sloping soils that have a fine sandy loam surface layer and moderately rapidly permeable lower layers.

Wheat, grain sorghum, and forage sorghum are the main crops. This unit is best suited for range, and its suitability for cropland is marginal.

A crop that produces a large amount of residue, such as grain sorghum, is needed in the cropping system to help control soil blowing and water erosion.

Emergency tillage is needed where soils are left bare for extended periods. Grassed waterways and diversion terraces help prevent erosion from runoff.

Figure 12.—When this diversion terrace on a Mobeetie fine sandy loam has been smoothed and seeded, it will direct water away from a field of Tipton silt loam.

CAPABILITY UNIT IVe-10

The deep, well-drained Bippus clay loam, 3 to 5 percent slopes, is the only soil in this unit. This soil is moderately permeable.

Wheat, forage sorghum, and grain sorghum are the main crops.

A cropping system that includes cover crops, mulches, or grain sorghum is well suited to this soil. Where the large amount of residue produced by these crops is kept on the surface, it helps control soil blowing and water erosion.

Emergency tillage helps prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. Terraces and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help prevent erosion from runoff.

CAPABILITY UNIT IVe-11

The deep, well-drained, nearly level to gently sloping Springer loamy fine sand, undulating, is the only soil in this unit. This soil is moderately rapidly permeable.

Grain and forage sorghums are the main crops. This unit is best suited to range. Its suitability for cropland is marginal.

A large amount of residue from grain sorghum or a similar crop helps protect against soil blowing. Where the surface of the soil is bare, emergency tillage is needed during periods of strong winds.

CAPABILITY UNIT IVw-1

The deep, somewhat poorly drained Randall clay is the only soil in this unit. This soil is very slowly permeable.

Grain sorghum, forage sorghum, and wheat are the main crops. Some crops die following periods of heavy rains that flood this soil. When this unit is flooded, ducks and geese frequently use it for resting and feeding during migration. Water-tolerant grasses and sedges grow on this soil.

Cropping systems that include crops that produce a large amount of residue, such as wheat and grain sorghum, are well suited to this soil. The residues from these crops help to control soil blowing, to prevent surface crusting, and to maintain and improve soil tilth.

Emergency tillage is needed to help prevent soil blowing in fields that do not have an adequate cover of growing plants or enough crop residue to hold the soil. In some places, diversion terraces are needed to divert runoff from higher lying soils.

CAPABILITY UNIT Vw-1

Spur clay loam, broken, is the only soil in this unit. This soil lies in the flood plain along minor drainageways. It is flooded several times in most years. This soil is not

suited to cultivation. Its best use is for range or production of hay.

CAPABILITY UNIT Vw–2

Lincoln soils are the only soils in this unit. These soils occupy flood plains along the rivers and major creeks.

These soils receive runoff from surrounding higher lying soils. They are subject to the hazards of frequent flooding, washing, and deposition of new soil material.

These soils are not suitable for cultivation but are used for range and hay.

CAPABILITY UNIT Vw–3

This unit consists of the Sweetwater soils. These soils are permanently wet and subject to occasional flooding. They are also subject to scouring and deposition of small amounts of fresh soil material.

These soils are not suitable for cultivation but are used for hay production and range.

CAPABILITY UNIT VIe–2

This unit consists of the gently sloping to strongly sloping Berda-Potter complex. These soils are moderately permeable.

The soils of this unit are not suitable for cultivation but are used for range.

CAPABILITY UNIT VIe–3

This unit consists of gently sloping to strongly sloping, well-drained to excessively drained soils that have a calcareous, fine sandy loam or loamy fine sand surface layer. These soils are moderately to moderately rapidly permeable.

These soils are not suitable for cultivation but are used for range.

CAPABILITY UNIT VIe–4

This unit consists of deep, well-drained Enterprise very fine sandy loam, 5 to 8 percent slopes. This soil is moderately rapidly permeable.

This soil is not well suited to cultivation because of slopes and the hazard of erosion. It is used for range. Even under a good stand of grass, careful management is needed to control erosion.

CAPABILITY UNIT VIe–5

This unit consists of deep, well-drained, sloping soils that have a fine sandy loam surface layer. These soils are moderately to moderately rapidly permeable.

These soils are not well suited to cultivation because of slopes and the hazard of erosion. They are used for range. Even under a good stand of grass, careful management is needed to prevent erosion.

CAPABILITY UNIT VIe–6

This unit consists of deep, well-drained to excessively drained, gently sloping to sloping soils that have a loamy fine sand surface layer. These soils are moderately to moderately rapidly permeable. They are not suitable for cultivation and are in range.

CAPABILITY UNIT VIs–1

The Likes soils are the only soils in this unit. These soils are gently sloping to sloping and occupy gravelly knobs and ridges that dominate the landscape. They have a high sand and gravel content.

These Likes soils are not suitable for cultivation because they are too steep and gravelly. They are used for range, and a few areas are used as a commercial source of sand and gravel.

CAPABILITY UNIT VIIe–1

Tivoli fine sand is the only soil in this unit. This soil is excessively drained, is gently sloping to steep, and has a duned appearance. It is rapidly permeable.

This soil is not suitable for cultivation and is used for range. Even under a good stand of grass, careful management is needed to prevent erosion.

CAPABILITY UNIT VIIs–1

This unit consists of the well-drained, very shallow, gently sloping to steep Potter soils. These very shallow soils are limited in use. They are used for range, and caliche is mined in a few areas.

CAPABILITY UNIT VIIs–2

This unit consists of Rough broken land. It occupies rough, gently sloping to steep, dissected areas. Small patches of loamy soils occupy foot slopes and mesas in association with the steeper areas of Rough broken land. This unit is not suitable for cultivation, and it is of limited use for grazing.

CAPABILITY UNIT VIIIe–1

This unit consists of Active dunes. This duned sand is several feet thick, and the surface is bare. These areas are constantly shifting and changing with each strong wind.

Vegetation is insufficient for use as range or even to stabilize the dunes. Several kinds of wildlife roam the area.

These areas are used for recreation, wildlife, and esthetic purposes.

Estimated Yields

Table 2 gives the estimated average yields per acre under nonirrigated farming for the principal crops grown in the county—cotton, grain sorghum, and wheat. The yields shown are for a high level of management and are based on the experience of farmers and on the observations of agricultural workers in the county. Soils not suitable for cultivation are not listed.

Yields under nonirrigated farming depend largely on the supply of moisture that is available in the soils at planting time and during the growing season. Generally, the higher the rainfall during the growing season, the higher the yields.

Consistent high yields depend on good soil management and adequate moisture and fertility. The soil that is used within its capabilities and managed according to its needs will produce the best average yields. A high level of management for Hemphill County soils includes use of terraces and contour farming where needed, use of soil-improving crops, cover crops, and crops that produce a large amount of residue.

If all of these conservation practices are not used, crop yields can be expected to decrease.

The yields shown in table 2 reflect a high level of management. The estimated yields are an average of yields obtained over a period of 10 to 20 years and cannot be expected every year. In some years they will be higher

465–913—74——3

TABLE 2.—*Estimated yields per acre of principal crops*

[Only the arable soils are listed in this table. Absence of entry indicates the crop is not grown on the soil or the soil is not suited to it]

Soil	Wheat	Grain sorghum	Cotton (lint)
	Bu.	*Lbs.*	*Lbs.*
Berda and Mansker loams, 3 to 6 percent slopes	11	1, 050	
Bippus clay loam, 1 to 3 percent slopes	15	1, 300	
Bippus clay loam, 3 to 5 percent slopes	11	1, 050	
Bippus fine sandy loam, 1 to 3 percent slopes	17	1, 300	
Bippus fine sandy loam, 3 to 5 percent slopes	12	1, 100	
Dalhart fine sandy loam, 0 to 1 percent slopes	17	1, 300	275
Dalhart fine sandy loam, 1 to 3 percent slopes	16	1, 300	250
Dalhart fine sandy loam, 3 to 5 percent slopes	11	1, 100	195
Dalhart soils, 2 to 6 percent slopes, eroded	9	950	145
Dumas loam, 0 to 1 percent slopes	25	2, 000	325
Dumas loam, 1 to 3 percent slopes	20	1, 750	300
Dumas loam, 3 to 5 percent slopes	15	1, 500	250
Enterprise very fine sandy loam, 0 to 1 percent slopes	25	2, 250	350
Enterprise very fine sandy loam, 1 to 3 percent slopes	20	2, 000	325
Enterprise very fine sandy loam, 3 to 5 percent slopes	15	1, 500	250
Guadalupe fine sandy loam	20	1, 700	
Mansker loam, 1 to 3 percent slopes	15	1, 400	
Miles loamy fine sand, 0 to 3 percent slopes	15	1, 500	230
Mobeetie fine sandy loam, 1 to 3 percent slopes	15	1, 600	
Mobeetie fine sandy loam, 3 to 5 percent slopes	10	1, 000	
Patricia fine sand, 0 to 3 percent slopes	15	1, 400	200
Pullman clay loam, 0 to 1 percent slopes	15	1, 500	
Quanah clay loam, 1 to 3 percent slopes	15	1, 700	250
Randall clay	10	1, 000	
Richfield clay loam, 0 to 1 percent slopes	20	1, 800	325
Richfield clay loam, 1 to 3 percent slopes	20	1, 750	300
Springer fine sandy loam, 1 to 3 percent slopes	17	1, 500	250
Springer fine sandy loam, 3 to 5 percent slopes	11	1, 050	160
Springer loamy fine sand, undulating		1, 050	
Spur clay loam	25	2, 500	
Tipton silt loam, 0 to 1 percent slopes	25	2, 500	325
Tipton silt loam, 1 to 3 percent slopes	20	2, 250	300
Tipton silty clay loam, 0 to 1 percent slopes	20	2, 250	300
Tipton silty clay loam, 1 to 3 percent slopes	20	2, 000	300

than the average, and in others they will be lower. No estimates were made for crops grown under irrigation, but yields of irrigated crops are considerably higher than those obtained under nonirrigated farming.

The following are practices used under the high level of management:

1. Rainfall is conserved by using all necessary conservation measures, including a properly maintained system of terraces, contour farming, and stubble-mulch tillage.
2. Crop residue is managed for effective control of erosion.
3. The fertility of the soils is maintained by timely application of fertilizer, in amounts based on soil tests and the needs of the crop to be grown, and by growing and managing adapted soil-improving crops.
4. Soil tilth is adequately maintained by using a cropping sequence that insures an adequate supply of organic matter in the surface layer; by avoiding tillage and harvesting operations when the soils are wet; and by tilling only when it is necessary to prepare the seedbed or to control weeds.
5. Suitable methods of controlling insects, diseases, and weeds are employed.

Irrigation

Irrigation in Hemphill County is of minor importance. As of August, 1965, 19 irrigation wells in the county provided supplemental irrigation for about 1,000 acres of land. Well depths mainly range from 18 feet to 250 feet; a few are deeper. The water yield ranges from about 100 to 1,200 gallons per minute. Most wells produce less than 500 gallons per minute. The quality of water is good. The quantity of irrigation water is limited in most areas.

The first irrigation well was drilled in 1953. One or two wells have been drilled every year since. The wells and irrigated fields are scattered throughout the county.

The soils best suited to irrigation are the Bippus, Spur, Guadalupe, Miles, Tipton, Dalhart, Dumas, Richfield, Enterprise, and Pullman. Soils features that affect suitability for irrigation are topography, permeability, and available water capacity. The soils now irrigated, however, are those that have available irrigation water nearby. In 1965 the main crops irrigated were cotton, wheat, grain sorghum, alfalfa, forage sorghum, pasture, and soybeans.

Two types of irrigation systems are used in the county, row and sprinkler. Row irrigation requires nearly level land, and land leveling is generally necessary before this system is effective. Sprinkler irrigation works

satisfactorily on most slopes in the county and is the system generally necessary on the more sandy and permeable soils.

More information on irrigation can be obtained from representatives of the Hemphill County Soil and Water Conservation District.

Use of the Soils for Range [2]

Approximately 480,000 acres of Hemphill County is in range. This range is broadly divided into different kinds of land. The sandy rangeland occupies a wide band of deep sand hills and swales. Alluvial bottom-land range and meadow are along the stream courses of the major creeks and rivers of the county.

The rest of the rangeland is in intermittent swales, in narrow valleys, and on flat mesas.

Beef cattle production is the primary livestock enterprise in the county. Some ranchers produce horses, primarily for ranch use, and two or three ranchers breed quarter horses as a part of their ranching operations.

Most of the ranches and stock farms run cow herds and sell feeder or replacement calves at weaning time. A few ranchers carry over some calves to be fed and sold as stocker cattle. There is a trend away from cow-calf operations to stocker operations. In a stocker operation, 300 pound calves are purchased in the fall, are run on the range until the following fall, and then sold as feeder cattle. Some feedlots are operating in the county.

Range sites and condition classes

Different kinds of soil have different capacities to produce grass and other plants for grazing. The soils that produce about the same kind and amount of forage, if the range on all is in similar condition, make up what is called a range site.

A *range site* is a kind of rangeland that differs from each other kind of range in its ability to produce significantly different kinds and amounts of vegetation. A significant difference is one that is great enough to influence the grazing use and management needed to maintain or improve the present vegetation. If cultivated crops are not to be grown, the most productive group of forage plants on a range site is generally the original combination of plants. In many areas, the present potential of the range is considerably less than the original potential. Erosion is a principal cause for this permanent loss in productivity.

Decreasers are species in the potential plant community that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and also the most palatable to livestock.

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

Invaders are plants that cannot withstand the competition for moisture, nutrients, and light in the potential plant community. Hence, they come in and grow along with the increasers after the potential plant community has been reduced by grazing. Many are annual weeds; some are shrubs that have some grazing value, but others have little value for grazing.

Four *range condition classes* are used to indicate the degree of departure from the native, or original, 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 native vegetation that could grow there.

Four range condition classes are recognized: excellent, good, fair, and poor. A range is in excellent condition if 76 to 100 percent of the existing vegetation is of the same composition as that of the potential 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.

Range condition is judged according to standards that apply to the particular kind of range site and its climate. Potential forage production depends on the characteristics of the range site. Current forage production depends on the range condition and the moisture that the plants get during their growing season.

A primary objective of good range management is to keep rangeland in excellent and good condition. If this is done, water is conserved, yields are improved, and soils are protected. This can be done only if important changes in the kind of plants on a range site are recognized.

These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by abundant rainfall may lead to the conclusion that the range is in good condition, though the cover actually is weedy and the trend in both range condition and production is downward. Some rangeland that has been closely grazed for relatively short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites

The 12 range sites in Hemphill County are described in this subsection. The composition of the potential plant community is given along with principal invaders for the site. The total annual air-dry herbage yield, when the site is in excellent range condition, is also provided. The name of the range site in which each soil has been placed can be found in the "Guide to Mapping Units" at the back of this survey.

LOAMY BOTTOMLAND RANGE SITE

Soils of this range site lie on lowlands along streams and rivers. The extra water from occasional overflows and a high water table, especially during winter, together with the high available water capacity of the soils, make this a productive range site.

If in good to excellent range condition, this site is capable of producing good stands of mid and tall grasses. Tall trees grow in scattered clumps adjacent to the stream beds. If overgrazed for extended periods, the site deteriorates, less productive and less palatable increaser grasses flourish, and numerous weeds and brushy plants invade.

The kinds of climax plants depend on the origin of the alluvial deposits that make up the soils at a particular site. In areas that have a high water table, about 70 per-

[2] By HERSHEL M. BELL, range conservationist, Soil Conservation Service.

cent of the vegetation is original decreasers, such as eastern gamagrass and prairie cordgrass. In the drier areas indiangrass, switchgrass, Canada wildrye, little bluestem, Texas bluegrass, side-oats grama, and sand bluestem are abundant. Alkali sacaton grows in saline areas. In many areas alkali sacaton makes up a large percentage of the vegetation and limits production of decreaser grasses.

Increasers that make up approximately 30 percent, by weight, of the climax vegetation are western wheatgrass, vine-mesquite, tall dropseed, blue grama, silver bluestem, buffalograss, sedges, and some desirable forbs and woody plants. As the site deteriorates, it is invaded by inland saltgrass in saline areas, and in nonsaline areas by sand dropseed, three-awn, western ragweed, and numerous species of brush and annual weeds.

Livestock prefer to graze this site, and in many areas competitive grasses have been grazed out and mesquite and other brush have invaded. This site responds to brush control by mechanical methods. Chemical control is not suitable, because it has an adverse affect on the wildlife habitat provided by the site.

Where flooding is not a problem, this site responds favorably to range seeding. The extra water received on the site makes seeding this site less hazardous than seeding upland sites.

Where this site is in excellent condition, the potential yield of air-dry herbage, in pounds per acre, ranges from 1,800 in dry years to 3,500 in wet years. Where the soils have a high water table, the potential yield of air-dry herbage ranges from 5,000 to 10,000 pounds per acre.

SANDY BOTTOMLAND RANGE SITE

Lincoln soils are the only soils in this range site. The sandy soils of this site are in bottom lands along the streams and rivers of the county. The site is slightly undulating in some places.

The vegetation of this site differs little from the vegetation on other soils on bottom lands in the county. The important grasses that decrease under heavy grazing are eastern gamagrass and prairie cordgrass in areas that have a high water table. Where the water table is not so high, the decreasers are indiangrass, switchgrass, sand bluestem, little bluestem, Canada wildrye, Texas bluegrass, needle-and-thread, and western wheatgrass. Illinois bundleflower, American licorice, lespedeza, and heath aster are other important decreaser plants on this site.

Important grasses that increase on this site are vine-mesquite, tall dropseed, sand dropseed, silver bluestem, blue grama, sedges, and alkali sacaton where soils are saline. In addition, scarlet gaura, Baldwin ironweed, sand sagebrush, wildplum, skunkbush, and shin oak are native to the site and increase as the site deteriorates. Also, brush growth from tall species, such as cottonwood, elm, and hackberry, increase on the site.

Such plants as western ragweed, several species of croton, and numerous annual weeds invade the site along with tamarix (saltcedar).

This site responds to mechanical brush control, but chemical methods are not suitable.

Where this site is in excellent condition, the potential yield of air-dry herbage, in pounds per acre, ranges from 2,000 in dry years to 3,600 in wet years. Where the water table is high, yields range from 6,000 to 10,000 pounds per acre.

DEEP SAND RANGE SITE

Tivoli fine sand is the only soil in this range site. The site is duned, and some areas are active sand dunes that require specialized treatment for stabilization. This is a productive site if maintained in an excellent condition. When overgrazed, it deteriorates rapidly.

The potential plant community of the site, when in its original or climax condition, includes such decreaser grasses as sand bluestem, switchgrass, indiangrass, little bluestem, sand lovegrass, Canada wildrye, giant dropseed, needle-and-thread, and Texas bluegrass. Other plants that decrease are leadplant, wild alfalfa, prairie-clover, and catclaw sensitivebriar (fig. 13).

This site is characterized by a wide variety of plants that increase as the condition of the range begins to deteriorate. These are side-oats grama, blue grama, hairy grama, three-awn, sand dropseed, big sandreed, sand sagebrush, shin oak, yucca, sand plum, skunkbush, plains wild indigo, and wild buckwheat.

Plants that invade the site are red lovegrass, gummy lovegrass, fall witchgrass, tumble windmillgrass, and numerous annual grasses and weeds.

This range site, exclusive of active dune areas, responds to brush control if cover is maintained that protects the area from soil blowing.

Figure 13.—Tall grasses on Tivoli fine sand in the Deep Sand range site.

Grass may be reseeded successfully on this site. After brush control, grass will recover naturally if the range is well managed.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,600 in dry years to 3,400 in wet years.

SANDY LOAM RANGE SITE

The soils of this site are on smooth, gently sloping to sloping upland plains. If in excellent condition, this site is dominated by the mid grasses, little bluestem and side-oats grama.

Important decreasers are side-oats grama, little bluestem, needle-and-thread, sand bluestem, indiangrass, switchgrass, Canada wildrye, Texas bluegrass, leadplant, prairie-clover, and prairie spiderwort.

The principal increasers are blue grama, buffalograss, silver bluestem, hairy grama, sand dropseed, three-awn, and sand sagebrush. In addition, such plants as shin oak, yucca, skunkbush, and wild buckwheat grow in places, especially where the soils are more sandy than the rest of the site.

The more common invaders of this site are broom snakeweed, western ragweed, sand muhly, pricklypear, mesquite, and many annual weeds.

Brush control is effective. Quick natural grass recovery may be expected when there is a source of desirable species on the site. Range seeding by any appropriate method will result in quick response when climatic conditions are favorable. Water control measures, such as water spreading, renovation, furrows, and small terraces, are appropriate to the site. All treatment must be supported by good range management to be effective.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,800 in dry years to 3,000 in wet years.

MIXEDLAND RANGE SITE

The deep soils of this range site have a silt loam or very fine sandy loam surface layer. This is primarily a mid grass site that has a small amount of tall grasses and usually an abundance of short grasses.

If this site is in excellent condition, the important decreasers are side-oats grama, vine-mesquite, little bluestem, sand bluestem, groundplum milkvetch, wild alfalfa, dotted gayfeather, and heath aster.

Increasers are blue grama, buffalograss, silver bluestem, sand dropseed, and a few forbs. Invaders are sand muhly, three-awn, broom snakeweed, western ragweed, yucca, pricklypear, and sand sagebrush.

This site responds to most good range management practices. Brush control, range seeding, and water control measures all are effective when applied correctly and supported by good range management.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,500 in dry years to 2,500 in wet years.

SANDYLAND RANGE SITE

The soils of this range site are nearly level to sloping and have an undulating to hummocky topography. The site is in large areas and, in places, it is interspersed with areas of the Deep Sand range site. The soils have a loamy fine sand or fine sand surface layer.

This is a mid and tall grass site and normally supports a wide variety of secondary plants that increase as the range condition deteriorates. Decreaser plants make up about half the total plant composition. The important decreaser plants are little bluestem, sand bluestem, indiangrass, switchgrass, Canada wildrye, needle-and-thread, Texas bluegrass, sand lovegrass, leadplant, bigtop dalea, roundhead lespedeza, and prairie clover.

Plants that increase on the site as the better grasses decline are blue grama, side-oats grama, silver bluestem, hairy grama, three-awn, sand dropseed, sand sagebrush, yucca, sand plum, skunkbush, wild buckwheat, and several legumes such as loco, wild alfalfa, and blue indigo. Shin oak also is a common increaser on this site.

Invaders include red lovegrass, western ragweed, tumble lovegrass, gummy lovegrass, queensdelight, and numerous annual weeds.

This site responds to brush control, and good to excellent natural grass recovery results if good range management is practiced. Low growing shrubs can be mechanically controlled by mowing.

Range seeding is feasible where the desirable grasses have been completely eliminated.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,700 in dry years to 3,100 in wet years.

DEEP HARDLAND RANGE SITE

The smooth, nearly level to gently sloping soils of this site lie on upland plains. They are deep and have a loam, clay loam, or silty clay loam surface layer.

The vegetation of this range site is made up primarily of short grasses. The important climax decreasers are blue grama, vine-mesquite, western wheatgrass, and side-oats grama. Of the increasers, buffalograss is most important, and silver bluestem is a minor grass. The principal invaders on this site are three-awn, sand dropseed, sand muhly, broom snakeweed, western ragweed, and a small amount of yucca, pricklypear, and mesquite.

This site will respond to brush control. It is feasible to seed the site, but because of the droughty nature of these soils, the best known methods and techniques must be employed.

The site will respond to water conservation measures such as renovation, furrows, and water spreading.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,500 in dry years to 2,500 in wet years.

HARDLAND SLOPES RANGE SITE

The deep to very shallow soils of this site have a loam surface layer. The site is generally smooth and occupies long slopes.

If in excellent condition, the site is characterized by a predominance of side-oats grama. Other important climax decreasers on this site include little bluestem, prairie clover, wild alfalfa, silktop dalea, and dotted gayfeather.

Increasers are important to the site. They are blue grama, buffalograss, silver bluestem, three-awn, and sand dropseed. Other plants that increase are scarlet gaura and plains blackfoot.

Plants that invade this site are sand muhly, western ragweed, broom snakeweed, pricklypear and, to a limited extent, yucca and some annual weeds.

This range site responds favorably to the control of yucca and pricklypear. Individual plants can be treated by either chemical or mechanical methods. Range seeding is seldom done except on areas that have been plowed out. The site generally is not suited to water control practices because of the nature of the soils and the slopes. It does, however, respond to good range management.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,600 in dry years to 2,500 in wet years.

MIXEDLAND SLOPES RANGE SITE

The deep to very shallow soils of this site have a loam, fine sandy loam, or loamy fine sand surface layer. The site is characterized by gently sloping to steep hills and ridges, cut by tributaries of the main rivers and creeks that traverse the county.

The dominant vegetation of the site, if in excellent range condition, is a composition of tall and mid grasses. The tall grasses grow where the soil-moisture relationship is the most favorable.

The important decreasers are side-oats grama, little bluestem, sand blestem, Canada wildrye, prairie-clover, indian rushpea, dotted gayfeather, and catclaw sensitive-briar. Increasers on the site are blue grama, hairy grama, buffalograss, three-awn, silver bluestem, sand dropseed, sand sagebrush, and yucca. The principal invaders are sand muhly, broom snakeweed, western ragweed, pricklypear, and annual weeds.

This site responds to brush control. Range seeding can be done, but is not generally feasible unless all climax grasses have been killed out. When seeding is necessary, the methods used for converting cropland to range are most successsful. Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,800 in dry years to 2,800 in wet years.

VERY SHALLOW RANGE SITE

Potter soils are the only soils in this range site. These are very shallow soils that are underlain by soft or hard platy caliche. The site is gently sloping to steep and rolling to hilly. It is a transitional area between the deeper soils and rougher lands.

The decreasers are little bluestem, sand bluestem, indiangrass, switchgrass, Canada wildrye, and New Mexico feathergrass. Decreaser forbs are bigtop dalea, dotted gayfeather, and blacksamson.

Increasers are side-oats grama, hairy grama, blue grama, three-awn, rough tridens, catclaw acacia, and yucca. Invaders common to the site are hairy tridens, sand muhly, ring muhly, pricklypear, and redberry juniper.

If in good to excellent condition, the vegetation is predominantly mid grasses with lesser amounts of tall grasses on the areas receiving the most water. The site does not deteriorate its short grass cover, but it does develop a weedy or woody plant cover under poor range management.

There is little treatment that is appropriate to this site except controlled grazing. The control of redberry juniper on the more gentle slopes may be feasible, but this is not considered a problem in the county.

Where this site is in excellent condition, the total yield of air-dry herbage, in pounds per acre, ranges from 700 in dry years to 1,600 in wet years.

GRAVELLY RANGE SITE

The Likes soils are the only soils in this range site. These soils are in small areas along the major stream courses and particularly along the Canadian River. Areas of this site have gravel in the profile and, in most places, occur as small hills with steep slopes.

The site produces a wide variety of vegetation, including most of the better grasses common to the county. Important decreasers are side-oats grama, little bluestem, sand bluestem, Canada wildrye, blacksamson, and dotted gayfeather. Increasers that dominate, even under good range management, are blue grama, hairy grama, silver bluestem, three-awn, sand dropseed, rough tridens, yucca, feather dalea, catclaw acacia, and plains actinea. Plants that commonly invade the site are sand muhly, hairy tridens, pricklypear, and redberry juniper.

Range treatment, other than good range management, is not feasible on this site. The limited extent of the site, topography, and characteristics of the soil prevent the application of established methods of treatment.

Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 1,000 in dry years to 1,600 in wet years.

ROUGH BREAKS RANGE SITE

Rough broken land is the only land type in this range site. This site consists of steep, nearly vertical escarpments adjacent to the caprock of mesa areas and of escarpment remnants, steep ridges, and severely gullied areas.

Although the area is inaccessible to grazing in many places, it supports a wide variety of sparse vegetation. Mid grasses are the dominant type of vegetation, but both tall and short grasses grow on this site.

Because the soils vary a great deal, and because no clear pattern of grazing has developed, it is difficult to determine the true classification of plant behavior on this site. The patterns of associated sites indicate that the decreases are little bluestem, sand bluestem, indiangrass, switchgrass, Canada wildrye, New Mexico feathergrass, several forbs, and a few woody plants.

Increasers are side-oats grama, hairy grama, silver bluestem, three-awn, sand dropseed, hairy dropseed, yucca, catclaw acacia, skunkbush, feather dalea, redberry juniper, mountainmahogany, Mohrs shin oak, hackberry, plains blackfoot, and stemless actinea. Pricklypear, broom snakeweed, and numerous annual weeds are invaders on the site.

No range treatment, other than good range management, is appropriate to the Rough Breaks site. Where this site is in excellent condition, the total annual yield of air-dry herbage, in pounds per acre, ranges from 400 in dry years to 800 in wet years.

Use of the Soils for Wildlife

This section discusses the use of the soils of the county as habitat for the major kinds of wildlife. The soils of

the county are grouped into wildlife sites, and the principal kinds of wildlife that inhabit each site are listed.

Antelope, buffalo, prairie chicken, and quail were once abundant in this county. Deer, turkey, and squirrel were plentiful along the wooded streams (fig. 14). The buffalo were killed by hunters about the time the county was settled. After the county was settled and livestock were introduced, heavy grazing, fencing, and cultivation limited the number of antelope, deer, squirrel, turkey, and prairie chicken. Antelope, once numerous, are now uncommon. A large number of quail, doves, songbirds, small animals, and predators still inhabit the county. The streams, ponds, playa lakes, and grainfields attract ducks and geese during migration. Habitats for fish are limited to artificial impoundments, such as Lake Marvin, and ponds on ranches and farms.

The Texas Parks and Wildlife Department maintains the 6,042-acre Gene Howe Wildlife Management Area, located 7 miles east of Canadian. This wildlife area was established for the study and improvement of wildlife and wildlife habitat.

Management by soil association

The soils of Hemphill County have been placed in five wildlife sites, each consisting of one or more 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." Each wildlife site is unique in topography, kinds and amount of vegetation, productivity, and principal species of wildlife.

WILDLIFE SITE 1

This site consists mainly of the Tivoli-Springer soil association. These are deep, duned to hummocky, sandy soils. The site also includes narrow areas of soils that lie on the flood plains of creeks.

The native vegetation is mainly mid and tall grasses, such as side-oats grama, little bluestem, sand bluestem, indiangrass, switchgrass, and sand dropseed. Woody species on this site are mainly sand plum, skunkbush, sand sagebrush, and shin oak.

This site provides excellent food, cover, and water for wildlife. The principal kinds of animals on this site are rabbit, coyote, deer, skunk, opossum, badger, and raccoon. Among the kinds of birds are quail, dove, prairie chicken, turkey, and songbirds.

WILDLIFE SITE 2

This site is made up of the Dalhart-Dumas-Springer and the Enterprise-Tipton soil associations. These associations consist of nearly level to sloping, loamy soils on uplands. These soils are used for crops and range. The native vegetation is mainly blue grama, side-oats grama, little bluestem, vine-mesquite, buffalograss, sand dropseed, hairy tridens, silver bluestem, and three-awn. Mesquite, yucca, and sand sagebrush are the main woody plants. Food is plentiful on this site during summer but at times is limited during winter. Sufficient cover is not always available, but this is a fair site for wildlife when properly managed.

Antelope, deer, rabbit, coyote, and skunk are the main animals on this site. Dove, duck, geese, prairie chicken, turkey, and songbirds are the principal birds.

Figure 14.—Flock of wild turkeys on Sweetwater soils.

WILDLIFE SITE 3

This site consists of the Mobeetie-Berda-Potter soil association. These are loamy, gently sloping to steep soils on dissected topography along the major rivers and creeks. These soils are mostly in range. The native vegetation is mainly little bluestem, blue grama, side-oats grama, hairy grama, buffalograss, sand bluestem, sand dropseed, and silver bluestem.

Rabbit, coyote, squirrel, skunk, antelope, deer, and raccoon inhabit this site. The main kinds of birds are turkey, quail, duck, geese, dove, and songbirds.

WILDLIFE SITE 4

This site consists of the Lincoln-Sweetwater soil association. These are nearly level to undulating, sandy and loamy soils on bottom lands. They are used mostly for range and for hay. The native vegetation is mostly blue grama, side-oats grama, western wheatgrass, switchgrass, indiangrass, sand bluestem, prairie cordgrass, and alkali sacaton. Trees on this site are cottonwood, hackberry, tamarix, and willow. This site provides good food and cover for wildlife.

Rabbit, coyote, squirrel, skunk, deer, and raccoon inhabit this site. The main kinds of birds are turkey, quail, duck, geese, dove, and songbirds. Ducks and geese are more numerous during the migration season.

WILDLIFE SITE 5

This site consists of the Miles-Patricia soil association. These are deep, nearly level to sloping, sandy soils. The soils are used for crops and range. The native vegetation is mainly side-oats grama, little bluestem, sand bluestem, indiangrass, switchgrass, sand lovegrass, sand dropseed, and perennial three-awn. Woody species are shin oak, sand sagebrush, and skunkbush.

This site provides good food and cover for wildlife. Rabbit, coyote, skunk, and deer inhabit this site. The main kinds of birds are quail, turkey, prairie chicken, dove, and songbirds.

Engineering Uses of the Soils [3]

This section is useful to those who need information about soils used as structural material or as foundations upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the properties of soils most important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size,

[3] By JOHN W. JACKSON, agricultural engineer, Soil Conservation Service.

TABLE 3.—*Estimated engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first column of this table. Absence of entry in a column indicates that properties are not than]

Soil series and map symbols	Hydrologic group	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
*Berda: BmC, Bp	B	0–14	Loam	CL	A–6
		14–34	Clay loam	CL	A–6
		34–62	Loam	CL	A–6
For Mansker part of BmC and Potter part of Bp, see Mansker and Potter series, respectively.					
Bippus:					
BrB, BrC	B	0–60	Clay loam	CL	A–6
BuB, BuC	B	0–24	Fine sandy loam	SM-SC	A–4
		24–60	Clay loam	CL	A–6
Dalhart: DaA, DaB, DaC, DaD, DhC2	B	0–8	Fine sandy loam	SM	A–4
		8–20	Sandy clay loam	SC, CL	A–6
		20–60	Fine sandy loam	SM, SC	A–2 or A–4
Dumas: DuA, DuB, DuC	B	0–6	Loam	CL	A–4 or A–6
		6–50	Clay loam	CL	A–6
		50–60	Silt loam	CL	A–6
Enterprise: EnA, EnB, EnC, EnD	B	0–60	Very fine sandy loam	ML, ML–CL	A–4
Guadalupe: Gu	B	0–38	Fine sandy loam and sandy clay loam.[1]	SM–SC, SM	A–2 or A–4
		38–60	Loamy fine sand	SM	A–2–4
Likes: Lk, Lm	A	0–60	Loamy fine sand	SM–SC	A–2–4

plasticity, and reaction. Also important are slope and depth to the water table and to bedrock. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and of construction equipment.
7. Develop other preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 3 and 4, which show, respectively, several estimated soil properties significant to engineering and interpretations for various engineering uses. This information, along with the soil maps and other parts of this publication, can be used to make interpretations in addition to those given in tables 3 and 4. It also can be used to make other useful maps.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Estimates generally are made to a depth of about 5 feet, and interpretations do not apply to greater depths. Also, engineers should not apply specific values to the estimates for bearing capacity and traffic supporting capacity given in this survey. Investigation of each site is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some of the terms used in this soil survey have special meaning to soil scientists not known to all engineers. Many of the terms commonly used in soil science are defined in the Glossary at the back of this survey.

properties of the soils

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions estimated. No estimates were made for Active dunes and Rough broken land. The symbol > means greater than; the symbol < means less

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
100	100	80–95	60–70	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
100	100	80–95	70–80	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	Low.
100	100	80–95	60–70	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
100	100	80–100	75–85	0. 63–2. 0	0. 16–0. 18	6. 6–8. 4	Low.
100	90–100	70–85	36–50	2. 0–6. 3	0. 12–0. 14	6. 6–7. 3	Low.
100	100	80–100	75–85	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	Low.
100	90–100	70–85	40–50	2. 0–6. 3	0. 12–0. 14	6. 6–7. 3	Low.
100	95–100	80–90	40–55	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	Low.
90–100	90–100	80–90	30–50	0. 63–2. 0	0. 10–0. 12	7. 4–7. 8	Low.
100	100	85–90	50–75	0. 63–2. 0	0. 12–0. 16	6. 6–7. 3	Low.
100	100	90–100	70–85	0. 63–2. 0	0. 14–0. 18	7. 4–8. 4	Low.
100	90–100	90–100	70–85	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
90–100	90–100	90–99	50–65	2. 0–6. 3	0. 14–0. 18	7. 9–8. 4	Low.
95–100	95–100	70–90	30–45	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
95–100	95–100	70–90	20–30	2. 0–6. 3	0. 06–0. 10	7. 9–8. 4	Low.
90–98	90–98	75–95	12–30	2. 0–6. 3	0. 06–0. 10	7. 9–8. 4	Low

TABLE 3.—*Estimated engineering*

Soil survey and map symbols	Hydrologic group	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		Inches			
Lincoln: Ln	A	0–45	Loamy fine sand, very fine sandy loam, loamy sand, and fine sandy loam.	SM	A–2
		45–60	Fine sand	SP–SM	A–3 or A–2
Mansker: McB	B	0–36	Loam	CL	A–6
		36–48	Clay loam	CL	A–6
Miles: MIB, MIC	B	0–8	Loamy fine sand	SM	A–2
		8–60	Sandy clay loam	SC, CL	A–6
*Mobeetie: MrB, MrC, Mt, Mx For Likes part of Mt and Potter part of Mx, see Likes and Potter series, respectively.	B	0–60	Fine sandy loam	SM–SC	A–4
Patricia: PaB	B	0–17	Fine sand	SP–SM	A–2
		17–35	Sandy clay loam	SC, CL	A–6
		35–55	Fine sandy loam	SM–SC	A–4
		55–62	Loamy fine sand	SM, SP–SM	A–2
Potter: Pe	C	0–5	Loam	ML, CL	A–4 or A–6
		5–60	Slightly platy caliche.		
Pullman: PmA	D	0–7	Clay loam	CL	A–6
		7–48	Clay	CL, CH	A–6 or A–7
		48–60	Clay loam	CL	A–6
Quanah: QuB	B	0–9	Clay loam	CL	A–4 or A–6
		9–60	Silty clay loam	CL	A–6 or A–7
Randall: Ra	D	0–60	Clay	CH	A–7
Richfield: RcA, RcB	C	0–10	Clay loam	CL	A–6
		10–40	Clay loam	CL	A–6 or A–7
		40–66	Clay loam	CL	A–6
Springer:					
SfB, SfC, SfD	B	0–48	Fine sandy loam	SM	A–4
		48–60	Loamy fine sand	SM, SP–SM	A–2
SlB, SlC	B	0–8	Loamy fine sand	SM	A–2
		8–15	Fine sandy loam	SM	A–4
		15–21	Loamy fine sand	SM	A–2
		21–60	Fine sand	SM	A–2
Spur: Sp, Su	B	0–60	Clay loam	CL, ML–CL	A–6
Sweetwater: Sw	D	0–14	Silty clay loam	CL	A–7
		14–24	Clay loam	CL	A–6
		24–60	Loamy fine sand	SM	A–2
Tipton:					
ToA, ToB	B	0–12	Silt loam	ML	A–4
		12–64	Silty clay loam	ML, CL	A–6
TtA, TtB	B	0–64	Silty clay loam	ML, CL	A–6
Tivoli: Tv	A	0–60	Fine sand	SP–SM	A–2

[1] This layer is not continuous.

properties of the soils—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	(No. 200) (0.074 mm)				
90–100	90–100	50–90	15–30	6. 3–20. 0	0. 06–0. 10	7. 9–8. 4	Low.
90–100	85–100	50–90	5–15	6. 3–20. 0	0. 03–0. 07	7. 9–8. 4	Low.
80–100	80–95	80–95	60–75	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
95–100	90–100	85–95	70–80	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	Low.
90–100	85–100	80–95	15–30	2. 0–6. 3	0. 06–0. 10	6. 1–6. 5	Low.
98–100	98–100	90–97	36–55	0. 63–2. 0	0. 13–0. 17	6. 1–7. 3	Low.
100	90–100	70–85	40–50	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
100	100	95–100	9–20	2. 0–6. 3	0. 03–0. 07	6. 1–7. 3	Low.
100	100	95–100	36–55	0. 63–2. 0	0. 13–0. 17	5. 6–6. 0	Low.
100	100	95–100	40–50	0. 63–2. 0	0. 11–0. 14	6. 1–6. 5	Low.
85–100	80–100	90–85	15–25	2. 0–6. 3	0. 06–0. 10	6. 1–6. 5	Low.
90–95	70–90	60–80	50–70	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Low.
100	100	95–100	90–95	0. 06–0. 2	0. 16–0. 20	6. 1–6. 5	Moderate.
100	100	95–100	90–95	<0. 06	0. 15–0. 19	6. 6–7. 8	High.
100	100	90–100	90–95	0. 06–0. 2	0. 15–0. 18	7. 9–8. 4	Moderate.
100	95–100	90–100	70–90	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	Low.
100	95–100	95–100	85–95	0. 63–2. 0	0. 16–0. 19	7. 9–8. 4	Low.
100	100	95–100	90–100	<0. 06	0. 15–0. 19	6. 1–8. 4	High.
100	100	90–100	70–80	0. 20–0. 63	0. 16–0. 18	6. 6–7. 3	Moderate.
100	100	90–100	75–85	0. 20–0. 63	0. 16–0. 18	6. 6–8. 4	Moderate.
100	100	90–100	80–95	0. 20–0. 63	0. 16–0. 18	7. 9–8. 4	Moderate.
90–100	90–100	70–85	40–50	2. 0–6. 3	0. 10–0. 13	6. 6–7. 3	Low.
85–100	80–100	70–85	15–30	2. 0–6. 3	0. 06–0. 10	6. 6–8. 4	Low.
90–100	85–100	70–85	15–30	2. 0–6. 3	0. 06–0. 10	6. 1–6. 5	Low.
90–100	85–100	70–85	40–50	2. 0–6. 3	0. 10–0. 13	6. 1–6. 5	Low.
90–100	85–100	70–85	15–30	2. 0–6. 3	0. 06–0. 10	6. 6–7. 3	Low.
90–100	85–100	65–80	15–25	6. 3–20. 0	0. 03–0. 07	6. 6–7. 3	Low.
100	100	95–100	70–85	0. 63–2. 0	0. 16–0. 18	6. 6–8. 4	Low.
100	100	95–100	85–95	0. 2–0. 63	0. 16–0. 20	7. 9–8. 4	Low.
100	100	85–95	70–80	0. 2–0. 63	0. 12–0. 14	7. 9–8. 4	Low.
100	100	50–80	15–30	2. 0–6. 3	0. 06–0. 10	7. 9–8. 4	Low.
100	100	90–100	70–90	0. 63–2. 0	0. 13–0. 16	6. 6–7. 3	Low.
100	100	95–100	85–95	0. 63–2. 0	0. 16–0. 20	6. 6–8. 4	Low.
100	100	95–100	85–95	0. 63–2. 0	0. 16–0. 20	6. 1–8. 4	Low.
100	95–100	65–80	10–20	6. 3–20. 0	0. 03–0. 07	6. 6–7. 3	Low.

TABLE 4.—*Engineering*

An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different
entry in a column indicates that characteristics are too variable for the

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	Farm ponds: Reservoir area
*Berda: BmC, Bp For Mansker part of BmC and Potter part of Bp, see Mansker and Potter series, respectively.	Fair: 8 to 14 inches of loam.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight if slopes are 1 to 5 percent; moderate if slopes are 5 to 10 percent; severe if slopes are 10 to 12 percent.	Moderate if slopes are 2 to 7 percent; severe if slopes are 7 to 12 percent; moderate permeability.	Moderate: moderate permeability.
Bippus:							
BrB, BrC	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	None to slight	Moderate: moderate permeability; slopes of 2 to 5 percent.	Moderate: moderate permeability.
BuB, BuC	Good	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	None to slight	Moderate: moderate permeability; slopes of 2 to 5 percent.	Moderate: moderate permeability.
Dalhart: DaA, DaB, DaC, DaD, DhC2.	Fair: 6 to 11 inches of fine sandy loam.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	None to slight	Moderate: moderate permeability.	Moderate: moderate permeability.
Dumas: DuA, DuB, DuC	Fair: 6 to 12 inches of loam.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Moderate: moderate permeability.	Moderate: moderate permeability; slopes of 2 to 5 percent.	Moderate: moderate permeability.
Enterprise: EnA, EnB, EnC, EnD.	Good	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight if slopes are 0 to 5 percent; moderate if slopes are 5 to 8 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Guadalupe: Gu	Good	Good	Severe: flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Likes: Lk; Lm	Poor: loamy fine sand texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Lincoln: Ln	Poor: loamy fine sand texture.	Good	Severe: flood hazard.	Severe: flood hazard.	Severe: flood hazard; inadequate filtration.	Severe: rapid permeability.	Severe: rapid permeability.
Mansker: McB	Good	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Moderate: moderate permeability.

interpretations

properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table. Absence of material to be classified. No interpretations were made for Active dunes]

Degree of limitations and soil features affecting—Continued					Soil features affecting—			Corrosivity class for uncoated steel and contributing soil features
Farm ponds—Con.	Recreation				Irrigation	Terraces and diversions	Waterways	
Embankments	Camp area	Picnic area	Playgrounds	Paths and trails				
Moderate: fair resistance to piping and erosion.	Slight if slopes are 1 to 8 percent; moderate if slopes are 8 to 12 percent.	Slight if slopes are 1 to 8 percent; moderate if slopes are 8 to 12 percent.	Slight if slopes are 1 to 2 percent; moderate if slopes are 2 to 6 percent.	None to slight	Slopes	Slopes	Highly erodible.	Moderate: conductivity.
Moderate: fair resistance to piping and erosion.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture; slopes of 2 to 5 percent.	Moderate: clay loam texture.	Moderate intake rate.	Receives outside water.	All features favorable.	Moderate: clay loam texture.
Moderate: fair resistance to piping and erosion.	None to slight	None to slight	None to slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 5 percent.	None to slight	High intake rate	Receives outside water.	All features favorable.	Moderate: clay loam texture.
Moderate: fair resistance to piping and erosion.	None to slight	None to slight	None to slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 6 percent; severe if slopes are 6 to 8 percent.	None to slight	Moderate intake rate.	Moderate: susceptibility to soil blowing; some steep slopes.	Moderate susceptibility to to soil blowing; some steep slopes.	Low.
Moderate: fair resistance to piping and erosion.	None to slight	None to slight	None to slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 5 percent.	None to slight	Moderate intake rate.	Slopes	Slopes	Moderate: clay loam texture.
Moderate: poor resistance to piping and erosion.	None to slight	None to slight	None to slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 6 percent; severe if slopes are 6 to 8 percent.	None to slight	Moderately high intake rate.	Frequent slope variation.	Highly erodible.	Low.
Moderate: poor resistance to piping and erosion.	Severe: flooding	Moderate: flooding.	Moderate: flooding.	Slight	Flood hazard	Flood hazard	Flood hazard	Low.
Moderate: poor resistance to piping and erosion.	Moderate if slopes are less than 15 percent; loamy fine sand texture. Severe if slopes are 15 to 20 percent.	Moderate if slopes are less than 15 percent; loamy fine sand texture.	Moderate if slopes are 2 to 6 percent; loamy fine sand texture. Severe if slopes are 6 to 20 percent.	Moderate if slopes are less than 15 percent; loamy fine sand texture. Severe if slopes are 15 to 20 percent.	Rapid intake rate.	Severe susceptibility to soil blowing; undulating and hummocky topography.	Severe susceptibility to soil blowing.	Low.
Severe: poor resistance to piping and erosion.	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	High water table; slight to strong salinity.	Severe susceptibility to soil blowing; sand texture.	Highly erodible.	Low.
Moderate: fair stability; fair resistance to piping and erosion.	None to slight	None to slight	Moderate if slopes are 2 to 3 percent.	None to slight	Caliche at depth of 10 to 20 inches.	All features favorable.	All features favorable.	Moderate: conductivity.

TABLE 4.—*Engineering*

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	Farm ponds: Reservoir area
Miles: MIB; MIC	Poor: loamy fine sand texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight if slopes are 0 to 5 percent; moderate if slopes are 5 to 6 percent.	Moderate: moderate permeability.	Moderate: moderate permeability.
*Mobeetie: MrB, MrC, Mt, Mx - For Likes part of Mt and Potter part of Mx, see Likes and Potter series, respectively.	Good	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	None to slight if slopes are 1 to 5 percent; moderate if slopes are 5 to 10 percent; severe if slopes are 10 to 12 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Patricia: PaB	Poor: fine sand texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Moderate: moderate permeability.
Potter: Pe	Poor: 4 to 9 inches of loam.	Poor: 4 to 9 inches of material.	Severe: platy caliche at depth of 4 to 9 inches.	Severe: platy caliche at depth of 4 to 9 inches.	Severe: platy caliche at depth of 4 to 9 inches.	Severe: platy caliche at depth of 4 to 9 inches.	Severe: platy caliche at depth of 4 to 9 inches.
Pullman: PmA	Fair: clay loam texture.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight
Quanah: QuB	Fair: clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	None to slight	Slight	Moderate: moderate permeability.
Randall: Ra	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	Slight
Richfield: RcA, RcB	Fair: clay loam texture.	Fair: fair traffic supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight	Moderate: moderately slow permeability.
Rough broken land: Ro							
Springer: SfB, SfC, SfD	Good	Good	Slight if slopes are 1 to 6 percent; moderate if slopes are 6 to 8 percent.	Slight if slopes are 1 to 6 percent; moderate if slopes are 6 to 8 percent.	Slight if slopes are 1 to 5 percent; moderate if slopes are 5 to 8 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.

interpretations—Continued

Degree of limitations and soil features affecting—Continued					Soil features affecting—			Corrosivity class for uncoated steel and contributing soil features
Farm ponds—Con.	Recreation				Irrigation	Terraces and diversions	Waterways	
Embankments	Camp area	Picnic area	Playgrounds	Paths and trails				
Moderate: fair stability; poor resistance to piping and erosion.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture; slopes are 2 to 6 percent.	Moderate: loamy fine sand texture.	Rapid intake rate.	High susceptibility to soil blowing.	High susceptibility to soil blowing.	Moderate: sandy clay loam texture.
Moderate: poor resistance to piping and erosion.	None to slight if slopes are less than 8 percent; moderate if slopes are 8 to 12 percent.	None to slight if slopes are less than 8 percent; moderate if slopes are 8 to 12 percent.	None to slight if slopes are 1 to 2 percent; moderate if slopes are 2 to 6 percent; severe if slopes are 6 to 12 percent.	None to slight.	Moderate intake rate.	Moderate susceptibility to soil blowing and water erosion.	Highly erodible; steep slopes.	Moderate: conductivity.
Moderate: poor resistance to piping and erosion.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Rapid intake rate.	High susceptibility to soil blowing.	High susceptibility to soil blowing.	Low.
Severe: platy caliche at depth of 4 to 9 inches.	Slight if slopes are 1 to 8 percent; moderate if slopes are 8 to 15 percent; severe if slopes are 15 to 30 percent.	Slight if slopes are 1 to 8 percent; moderate if slopes are 8 to 15 percent; severe if slopes are 15 to 30 percent.	Slight if slopes are 1 to 2 percent; moderate if slopes are 2 to 6 percent; severe if slopes are 6 to 30 percent.	Slight if slopes are 1 to 15 percent; moderate if slopes are 15 to 30 percent.	Nonarable.	Nonarable.	Nonarable.	Moderate: conductivity.
Moderate: fair resistance to piping and erosion.	Moderate: very slow permeability; clay loam texture.	Moderate: clay loam texture.	Moderate: very slow permeability; clay loam texture.	Moderate: clay loam texture.	Slow intake rate.	All features favorable.	All features favorable.	High: clay texture.
Moderate: fair resistance to piping and erosion.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture; slopes are 2 to 3 percent.	Moderate: clay loam texture.	All features favorable.	All features favorable.	All features favorable.	Moderate: clay loam texture.
Moderate: fair slope stability.	Severe: clay texture; very slow permeability.	Severe: clay texture.	Severe: clay texture; very slow permeability.	Severe: clay texture.	Slow intake rate.	Depressional topography.	All features favorable.	High: clay texture.
Moderate: fair resistance to piping and erosion.	Moderate: clay loam texture; moderately slow permeability.	Moderate: clay loam texture.	Moderate: clay loam texture; moderately slow permeability.	Moderate: clay loam texture.	All features favorable.	All features favorables.	All features favorable.	Moderate: clay loam texture.
----------	Severe: slopes.	Severe: slopes.	Severe: slopes.	Severe: slopes.				
Moderate: poor resistance to piping and erosion.	None to slight.	None to slight.	Slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 6 percent; severe if slopes are 6 to 8 percent.	None to slight.	Rapid intake rate.	Moderate susceptibility to soil blowing.	Moderate susceptibility to soil blowing.	Low.

TABLE 4.—*Engineering*

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	Farm ponds: Reservoir area
Springer—Continued							
SlB, SlC	Poor: loamy fine sand texture.	Good	Slight if slopes are 1 to 6 percent; moderate if slopes are 6 to 8 percent.	Slight if slopes are 1 to 6 percent; moderate if slopes are 6 to 8 percent.	Slight if slopes are 1 to 5 percent; moderate if slopes are 5 to 8 percent.	Severe: moderately rapid permeability.	Severe; moderately rapid permeability.
Spur: Sp, Su	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.	Moderate: moderate permeability.
Sweetwater: Sw	Poor: poorly drained.	Poor: poorly drained.	Severe: poorly drained; flood hazard.	Severe: flood hazard.	Severe: flood hazard; water table at depth of less than 2 feet.	Severe: seepage	Severe: seepage
Tipton:							
ToA, ToB	Fair: 12 inches of loam.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Moderate: moderate permeability.
TtA, TtB	Fair: silty clay loam texture.	Fair: fair traffic supporting capacity.	Moderate: fair traffic supporting capacity.	Slight	Slight	Moderate: moderate permeability.	Moderate: moderate permeability.
Tivoli: Tv	Poor: fine sand texture.	Good	Slight if slopes are 3 to 6 percent; moderate if slopes are 6 to 15 percent; severe if slopes are 15 to 30 percent.	Slight if slopes are 3 to 6 percent; moderate if slopes are 6 to 15 percent; severe if slopes are 15 to 30 percent.	Severe: inadequate filtration.	Severe: rapid permeability.	Severe: rapid permeability.

interpretations—Continued

Degree of limitations and soil features affecting—Continued					Soil features affecting—			Corrosivity class for uncoated steel and contributing soil features
Farm ponds—Con.	Recreation				Irrigation	Terraces and diversions	Waterways	
Embankments	Camp area	Picnic area	Playgrounds	Paths and trails				
Moderate: poor resistance to piping and erosion.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Moderate if slopes are 2 to 6 percent; loamy fine sand texture. Severe if slopes are 6 to 8 percent.	Moderate: loamy fine sand texture.	Rapid intake rate.	Severe susceptibility to soil blowing; undulating and hummocky topography.	Severe susceptibility to soil blowing.	Low.
Moderate: fair resistance to piping and erosion.	Severe: flooding.	Moderate: flooding; clay loam texture.	Severe: flooding.	Moderate: clay loam texture.	Flood hazard	Flood hazard	Flood hazard	Moderate: clay loam texture.
Moderate: poor resistance to piping and erosion.	Severe: wetness, poorly drained.	Severe: wetness, poorly drained.	Severe: wetness, poorly drained.	Severe: wetness, poorly drained.	Flood hazard; high water table.	Flood hazard; high water table.	Flood hazard; high water table.	High: poorly drained.
Moderate: fair resistance to piping and erosion.	None to slight	None to slight	None to slight if slopes are 0 to 2 percent; moderate if slopes are 2 to 3 percent.	None to slight	All features favorable.	All features favorable.	All features favorable.	Moderate: silty clay loam texture.
Moderate: fair resistance to piping and erosion.	Moderate: silty clay loam texture.	Moderate: silty clay loam texture.	Moderate: silty clay loam texture; slopes are 2 to 3 percent.	Moderate: silty clay loam texture.	All features favorable.	All features favorable.	All features favorable.	Moderate: silty clay loam texture.
Severe: poor resistance to piping and erosion; poor stability.	Severe if slopes are 15 to 30 percent; fine sand texture.	Severe if slopes are 15 to 30 percent; fine sand texture.	Severe if slopes are 6 to 30 percent; fine sand texture.	Severe if slopes are 15 to 30 percent; fine sand texture.	High intake rate; low available water capacity; dune topography.	Dune topography; severe susceptibility to soil blowing.	Severe susceptibility to soil blowing.	Low.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*8*) used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML–CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the 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 or more for the poorest.

Engineering properties of the soils

Table 3 gives the estimated engineering classification and some of the estimated physical properties of the soils in Hemphill County. These properties were estimated by comparing the soils of Hemphill County with the soils of similar series, from field tests, and from other soil surveys.

The depth to bedrock is not shown in table 3, because all the soils except the Potter are deeper than 60 inches to bedrock. Potter soils are 4 to 9 inches deep to slightly platy caliche. A seasonal high water table is generally not a problem in this county, except in Lincoln and Sweetwater soils.

In the column headed "Hydrologic group," the soils are placed in one of four groups on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation. The groups range from open sands that have the lowest runoff potential (Group A) to heavy clays that have the highest runoff potential (Group D). Description of those four groups are as follows:

Group A.—Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well-drained to excessively drained sand, gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B.—Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C.—Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and a slow infiltration rate. The soils of group C have a slow rate of water transmission and a high runoff potential.

Group D.—Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with claypan or clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. Soils of group D have a very slow rate of water transmission and a very high runoff potential.

Soil texture is described in table 3 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this soil survey.

The data on percentage passing sieves in table 3 show a range in percentage of soil materials passing four different sieve sizes. This information is useful in helping to determine suitability of the soil as a source of material for construction purposes. Since the estimates are for modal soils, considerable variation in the grain size of any specified soil should be anticipated.

Permeability, as used in table 3, relates only to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties resulting from use of the soils are commonly not considered.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

In the column on reaction, the degree of acidity or alkalinity is expressed in pH values. The pH of a neutral soil is 7.0, of an acid soil is less than 7.0, and of an alkaline soil is more than 7.0. For a description of the pH groups used in table 3, see *reaction, soil* in the Glossary at the back of this survey.

The shrink-swell potential indicates a change in volume to be expected in a soil material with changes in moisture content. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures. Shrink-swell potential is rated *low*, *moderate*, and *high*. In general, deep clay loam soils have a high shrink-swell potential. Clean sands and gravel (single-grain structure) and those having small

amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have a low shrink-swell potential.

Engineering interpretations of the soils

In table 4 the soils are rated according to their suitability as sources of topsoil and as sources of road subgrade. Also listed for the soils are properties that affect their suitability as sites for specified engineering uses. The rating and other interpretations in this table are based on estimated engineering properties of the soils in table 3, and observations of the field performance of the soils.

Topsoil is fertile soil material that ordinarily is rich in organic matter. It is used to topdress roadbanks, dams, disturbed areas, gardens, lawns, and similar areas where vegetation is to be established and maintained. Normally, only the surface layer is removed for topsoil, but other layers also may be suitable sources.

Road subgrade is soil material useful for building up road grades for supporting base layers. The suitability of a soil for road subgrade depends on its texture, plasticity, shrink-swell potential, traffic supporting capacity, inherent erodibility, compaction characteristics, and natural water content. Soils that have a high shrink-swell potential are difficult to place and compact and are rated poor as a source of road fill.

Highway location is chosen after consideration of those properties of the soil that affect its performance as a location of highways. The entire soil profile is evaluated on basis of the assumption that the soil is not disturbed and is not artificially drained. It is assumed that the surface soil, because of its higher organic matter content, will be removed in construction and used for topsoil.

Foundations for low buildings is a classification depending on those features and qualities of undisturbed soils that affect their suitability for supporting foundations of buildings less than three stories high. Usually it is the substratum of the soil that provides the base for foundations and therefore is the material that should be evaluated. The foundation of a building transmits the weight of the structure to the natural undisturbed soils. The Unified classification system was used for evaluating the soils in terms of their bearing capacity, shrink-swell potential, and shear strength.

Septic tank filter fields and sewage lagoons function satisfactorily if permeability of the soils, ground water levels, flooding hazards, land slopes, and depth to rock or other impervious materials are favorable. Creviced material is a limitation because it may cause pollution of water supplies.

Reservoir areas are selected on basis of the limitations of the soils for water retention, and primarily on the seepage, and coarse-textured soils that do not have any binding or sealing characteristics have high seepage.

Farm pond embankments are affected by qualities of disturbed soils. Both the subsoil and substratum are evaluated where they are contrasting in character and have significant thickness for use as borrow. The primary features that affect suitability are stability, compaction characteristics, susceptibility to piping, shrink-swell potential, compacted permeability, compressibility, erodibility, and gypsum content.

Some of the more common properties affecting the use of the soils for recreation are hazard of flooding, slope, permeability, soil texture, depth to bedrock, and stoniness or rockiness. In table 4 the soils of the county are rated for specific recreational uses, and the nature of the soil limitations that influenced the ratings are shown.

The ratings used are *none to slight*, *moderate*, *severe*, and *very severe*. If the rating is *none to slight*, little or no adjustments are needed in use or the limitation is not serious and is easy to overcome. A rating of *moderate* means that some adjustments are needed in use, and *severe*, that extensive adjustments are needed before the soil is suitable for a specific purpose.

Camp area soil ratings apply to areas suitable for tent and camp trailer sites and the accompanying activities for outdoor living. They are used frequently during the camp season. These areas require little site preparation and should be suitable for unsurfaced parking for cars and camp trailers and heavy foot traffic by humans or horses or vehicular traffic. The soils should be free of coarse fragments and rock outcroppings. Suitability of soil for supporting vegetation is a separate item to be considered in the final selection of a site. Factors considered in establishing ratings are wetness hazard, flooding hazard, permeability, slope, surface soil texture, coarse fragments, and stoniness or rockiness.

Picnic area ratings are based on soil features only and do not include other features, such as presence of trees or lakes, that may affect the desirability of a site. Suitability of soil for supporting vegetation is a separate item to be considered in the final selection of sites. Items considered in establishing ratings are wetness hazard, flooding hazard, slope, surface soil texture, stoniness, and rockiness.

Playground ratings apply to areas to be developed for playgrounds and organized games, such as baseball, football, and badminton. These areas are subject to intensive foot traffic. An area selected for this use generally requires a nearly level surface, good drainage, and a soil texture and consistence that give a firm surface. The most desirable soil is free of rock outcrops and coarse fragments. It is assumed that a good grass cover can be established and maintained. Factors affecting soil selection for playgrounds are wetness hazard, flooding hazard, permeability, slope, surface soil texture, depth to hard bedrock, stoniness, and coarse fragments.

Paths and trails require nonintensive use of soils for more or less random movement of people, as in cross-country hiking or riding along bridle paths. It is assumed that the areas are used as they occur in nature, and little soil moved. Ratings are based on soil features only and do not include other items that may be important in the selection of a site for this use. Soils rated as having severe soil limitations may be best from the natural beauty or use standpoint, but they do require more preparation or maintenance. Factors considered in establishing ratings are wetness hazard, flooding hazard, slope, surface soil texture, and surface stoniness or rockiness.

Suitability of a soil for *irrigation* depends largely on intake rate, available water capacity, depth of soil, slope, and flooding hazard.

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 at desired specifications. Both level and graded terraces and diversions are constructed in the county.

Waterways on the soils of Hemphill County have to be carefully stabilized. On highly erodible soils, the accumulation of windblown material in waterways creates a difficult maintenance problem.

Corrosivity ratings in table 4 are for uncoated steel pipe. Steel pipe should have a protective coating to retard corrosion when placed in any soil in the county. The corrosivity class for concrete is low for all soils in the county.

Most of the soils in the county are not suited as a source of sand or gravel. Generally, the Lincoln soils and Tivoli soils are fair sources of sand. A few sources of gravel are along the Canadian River in areas of Likes soils.

In general, the soils in Hemphill County do not present problems of surface or internal drainage. Soil features affecting agricultural drainage are permeability, soil depth to layers that influence the rate of water movement in the soil, and presence of a high water table. The Lincoln and Sweetwater soils are the only soils that are affected by a high water table. The Randall soils are the only soils that are very slowly permeable and have water standing on them for an extended period.

Formation and Classification of the Soils

This section consists of two main parts. First, the five major factors of soil formation and the process involved in soil horizon differentiation are discussed briefly in terms of their effect on the soils of Hemphill County. Second, the system of classifying soils is discussed and the soils are placed in the 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, parent material, relief, and time. If a factor such as climate or vegetation is varied, a different soil is formed.

Climate.—The climate of Hemphill County is warm and semiarid. The low rainfall has retarded soil development. Climate is generally uniform throughout the county. The major differences in Hemphill County soils therefore are not the result of climate. Minor local modification of soils does result from differences in slope and related differences in amount of runoff.

Plants and Animals.—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 plants and animals.

Vegetation, dominantly grasses, has affected soil formation in Hemphill County. The grass vegetation produced soils that dominantly are high to medium in organic matter and have a relatively dark colored surface layer. Exceptions are soils such as the Tivoli, which are relatively low in organic matter because their parent material was sandy.

Parent Material.—The parent material of a soil is the unconsolidated mass of mineral matter from which it formed. Parent material determines the limits of the chemical and mineralogical composition of the soil. Most of the soils of Hemphill County formed in deposits of the Cenozoic era. The thick deposits of the High Plains or Ogallala, were deposited in the Tertiary period (*3*). The soils are alkaline to calcareous, loamy and sandy earths.

Most of the parent materials of the soils in Hemphill County contain small to large amounts of lime. The finer sized particles also contain more weatherable minerals that are made available to plants and animals during the process of soil formation. Particle size also influences the rate at which water enters, percolates through, and is retained within the soil material. Water infiltrates rapidly through sands, but little is retained for use by plants. Water infiltrates slowly through clays, and much is retained for use by plants.

Relief.—Relief affects the formation of soils by its local influence on drainage and runoff, on rate of erosion, on kinds and amount of plant cover, and on exposure to sun and wind. The degree of development in the soil profile depends on the average amount of moisture in the soil. Moisture in turn affects the kinds and amounts of plant and animal life on and in the soil. The soils on the steeper slopes absorb less moisture and usually have less well developed profiles than soils that form on nearly level and gently sloping areas. Soils that form on foot slopes or in concave areas receive additional water and sediments from higher lying soils, and they develop thick, dark-colored A horizons.

Time.—Usually a long time is required for formation of soils that have distinct horizons. The differences in length of time that parent materials have been in place therefore are commonly reflected in the degree of development of the soil profile.

The soils in Hemphill County range from young to old. The young soils have little profile development, and the older soils have well developed soil horizons.

Processes of Horizon Differentiation

Several processes were involved in the formation of soil horizons in the soils of Hemphill County: (1) the accumulation of organic matter; (2) the leaching of calcium carbonates and bases; (3) the reduction and transfer of iron; and (4) the formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

Accumulation of organic matter in the upper profile to form an A1 horizon has been important. The soils of Hemphill County range from very low to medium in organic matter.

Leaching of carbonates and bases has occurred in nearly all of the soils. Soil scientists are generally agreed that leaching of bases in soils usually precedes translocation of silicate clay minerals. Most of the soils of the county are slightly to moderately leached, and this has contributed to the development of weak horizons in some soils.

Reduction and transfer of iron, a process called gleying, is evident in the poorly drained Sweetwater soils of the county. The gray color in the lower horizons indicates the reduction of iron. Some horizons contain yellowish-brown mottles, which indicate segregation of iron.

In some soils of Hemphill County, the translocation of clay minerals has contributed to horizon development. Their eluvial A horizon, above the B2t horizon, has granular structure and is lower in clay content than the B2t. The B2t horizon usually has an accumulation of clay (clay films) in pores and on ped surfaces. Soils having such A and B horizons were probably leached of carbonates and soluble salts 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 Hemphill County.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*5*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*4*) and was adopted in 1965 (*7*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families (table 5), may change as more precise information becomes available.

TABLE 5.—*Classification of soil series*

Series	Family	Subgroup	Order
Berda	Fine-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Bippus	Fine-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols.
Dalhart [1]	Fine-loamy, mixed, mesic	Aridic Haplustalfs	Alfisols.
Dumas [2]	Fine-loamy, mixed, mesic	Aridic Paleustolls	Mollisols.
Enterprise	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Guadalupe	Coarse-loamy, mixed, thermic	Fluventic Ustochrepts	Inceptisols.
Likes	Mixed, thermic	Typic Ustipsamments	Entisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Mansker [3]	Fine-loamy, carbonatic, thermic	Calciorthidic Paleustolls	Mollisols.
Miles	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Mobeetie	Coarse-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Patricia [4]	Fine-loamy, mixed, thermic	Aridic Paleustalfs	Alfisols.
Potter	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Pullman [5]	Fine, mixed, thermic	Torrertic Paleustolls	Mollisols.
Quanah	Fine-silty, mixed, thermic	Typic Calciustolls	Mollisols.
Randall	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Richfield [6]	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Springer [7]	Coarse-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Spur	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.
Sweetwater	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), thermic.	Fluvaquentic Haplaquolls	Mollisols.
Tipton	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.

[1] The soils of Hemphill County named for this series are outside the range for the series in that they have dark-brown colors to 20 inches below the surface, and Hemphill County is in a more humid and warmer environment.

[2] The soils of Hemphill County named for this series are outside the range for the series in that Hemphill County is in a more humid and warmer environment.

[3] The soils of Hemphill County named for this series are outside the range for the series in that Hemphill County is in a more humid environment.

[4] The soils of Hemphill County named for this series are outside the range for the series in that they have more than 20 percent clay decrease above a depth of 60 inches, and Hemphill County is in a more humid environment.

[5] The soils of Hemphill County named for this series are outside the range for the series in that they have chromas of 4 or less throughout the argillic horizon.

[6] The soils of Hemphill County named for this series are outside the range for the series in that they have more than 20 percent clay decrease above a depth of 60 inches, and Hemphill County is in a more humid and warmer environment.

[7] The soils of Hemphill County named for this series are outside the range for the series in that they have more than 20 percent clay decrease above a depth of 60 inches.

Climate [4]

Hemphill County has a dry steppe climate with mild winters. The average annual precipitation is 20.50 inches (table 6).

Rainfall most frequently results from thunderstorms. Monthly and annual amounts are extremely variable. Thundershowers reach a peak late in spring and early in summer. Three-fourths of the average annual precipitation falls during the 6-month period May through October. Rainfall drops off significantly in the colder months, November through March, as frequent "northers" cut off the supply of moisture from the Gulf of Mexico. The variability in rainfall is evidenced by the fact that, in one year out of every ten, on an average, the total annual rainfall is likely to be less than 13 inches. In contrast, in one year out of ten, the rainfall is likely to be twice this amount. During exceptionally wet years, much of the precipitation results from heavy thundershowers that produce excessive runoff.

The mean annual snowfall is 8.2 inches, but seasonal values have ranged from only a trace in 1934 to 18.8 inches in 1942. An even snow cover is unusual, since strong winds frequently blow the snow into drifts. Except where it is piled in drifts on northern slopes, snow usually is on the ground only 2 or 3 days at a time.

Prolonged droughts have occurred in the periods 1933–35 and 1952–56. During the drought starting in 1952, total annual precipitation was less than 75 percent of the 1934–63 average of 20.50 inches. Other exceptionally dry years were 1917 and 1945. Periods of no rain that last 2 to 3 weeks are fairly common, and monthly periods of no measurable rain have been observed.

The area is subjected to sudden and pronounced temperature changes, especially during winter and early in spring. In these seasons, cold fronts from the northern Rocky Mountains and Plains States sweep across the Panhandle at speeds of up to 40 miles an hour. Temperature drops of 50 to 60 degrees within a 12-hour period are not uncommon. January, the coldest month, has an average temperature of 35.3° F. Summer days are hot, but good wind motion and low humidity prevent temperatures from being uncomfortable.

Winds are strongest during intense thunderstorms, but these squalls are brief. The strongest continuous winds occur during March and April. These winds are associated with strong low-pressure centers and sometimes bring in dust from surrounding areas.

Sunshine is abundant the year round. On the average, the sun shines about 70 percent of the total possible time. Relative humidity averages about 58 percent. Evaporation is high, as would be expected in a dry steppe climate. Average annual lake evaporation is approximately 64 inches.

The average date of the last 32° freeze in spring is April 9, and the average date of the first 32° freeze in fall is October 30. The average growing season (freeze free period) is 204 days.

[4] By Robert B. Orton, State climatologist for Texas, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Austin, Texas.

TABLE 6.—*Temperature*

[Data from Canadian, Hemphill County, Texas, elevation

Month	Average temperature				Average number of days when maximum temperature is—		Average number of days when minimum temperature is—	
	Daily maximum	Daily minimum	Monthly	Heating degree days[1]	90° F. or above	32° F. or below	32° F. or below	0° F. or below
	°F.	°F.	°F.					
January	48.6	21.9	35.3	903	0	3	28	1
February	54.6	26.7	40.7	665	(2)	3	22	0
March	63.1	33.1	48.1	533	(2)	(2)	16	(2)
April	73.8	44.2	59.0	199	4	0	2	0
May	80.5	54.0	67.3	54	7	0	(2)	0
June	89.4	63.4	76.4	3	17	0	0	0
July	95.0	67.7	81.4	(2)	26	0	0	0
August	94.0	67.1	80.6	0	26	0	0	0
September	85.6	58.1	71.9	16	12	0	0	0
October	76.1	47.0	61.6	152	4	0	1	0
November	61.5	31.7	46.6	534	0	(2)	16	0
December	52.9	25.9	39.4	776	0	2	26	(2)
Year	72.9	45.1	59.0	3835	96	8	111	1

[1] Calculated from a base of 65° F.
[2] Less than one-half day.

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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.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

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.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

and precipitation data

2,335 feet, mainly for the period from 1934-63]

Precipitation								
Average monthly	Greatest daily	1 year in 10 will have—		Average number of days when precipitation is—			Snow, sleet	
		Less than—	More than—	0.10 inch or more	0.50 inch or more	1.00 inch or more	Monthly average	Monthly maximum
Inches	*Inches*	*Inches*	*Inches*				*Inches*	*Inches*
0.62	2.50	0	1.18	1	(2)	0	2.1	8.0
.70	1.33	0	1.48	2	(2)	0	2.1	8.5
.90	1.15	.05	1.69	2	1	(2)	1.2	7.0
1.57	1.53	.23	3.10	2	1	(2)	.4	8.0
4.09	4.75	1.87	6.48	6	2	1	0	0
3.05	3.57	1.22	4.99	6	2	1	0	0
2.44	4.65	.19	4.68	5	2	1	0	0
2.17	3.80	.51	3.68	4	2	1	0	0
1.84	3.85	.06	3.78	3	1	1	0	0
1.78	2.14	.21	4.03	3	1	(2)	(3)	.5
.59	1.43	0	1.75	1	(2)	(2)	.2	3.0
.75	2.15	0	1.66	1	(2)	(2)	2.2	12.0
20.50	4.75	12.82	27.86	36	12	5	8.2	12.0

[3] Trace.

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.

High Plains. A physiographic region of the great plains having a smooth surface, undissected by streams. In Hemphill County it is that land in the southwestern part above the rim rock or cap rock of calcareous material called caliche. It has the highest elevation in the county.

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 residue.

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 accumulation 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.

Hummocky. Irregular or choppy relief where there are small dunes or mounds 3 to 10 feet high and a gradient of 3 to 8 percent.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottles. Spots or blotches differing from the rest of the soil mass in color.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Outwash. Cross-bedded gravel, sand, silt, and clay deposited by melt water as it flowed from glacial ice. In this county, outwash refers to soil material that was washed from areas in the High Plains and Rocky Mountains by melt water, carried in streams, and deposited on the Permian red beds during the Pleistocene epoch.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. It is estimated in inches per hour. Terms and rates used to describe permeability are as follows:

Class	*Rate in Inches per Hour*
Very slow	Less than 0.06
Slow	0.06 to 0.20
Moderately slow	0.20 to 0.63
Moderate	0.63 to 2.60
Moderately rapid	2.60 to 6.3
Rapid	6.3 to 20.00
Very rapid	More than 20.00

Playas. Undrained basins that generally are dry but that contain water for periods following rains.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.5 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface 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.

Slope. A vertical rise or fall of the land surface in feet per 100 feet of horizontal distance. In this survey slope classes by names refer to specific ranges in percent as follows:

Nearly level	0 to 1 percent
Gently sloping	1 to 5 percent
Sloping	5 to 8 percent
Strongly sloping	8 to 12 percent
Moderately steep	12 to 20 percent
Steep	20 percent or more

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.

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).

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Undulating. Topography that rises or falls like waves; characterized by a rhythmic succession of wavelike crests and hollows

or of higher and lower levels. In this county the rises are less than 5 feet high and have a gradient of less than 3 percent.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Winnow. The removal of clay and silt particles from the soil by strong winds. The coarser textured particles are left, and the soil becomes more sandy and highly erodible.

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 or a range site, read the introduction for its section for general management information. For facts about wildlife turn to the section beginning on page 36. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Estimated yields, table 2, page 32.
Engineering uses of the soils, tables 3, and 4, pp. 38 through 47.

Map symbol	Mapping unit	Described on page	Capability unit		Range site	
			Symbol	Page	Name	Page
Ad	Active dunes	6	VIIIe-1	31	----------	--
BmC	Berda and Mansker loams, 3 to 6 percent slopes	7	IVe-2	29	Hardland Slopes	35
Bp	Berda-Potter complex	8	VIe-2	31	Hardland Slopes	35
BrB	Bippus clay loam, 1 to 3 percent slopes	8	IIIe-2	28	Deep Hardland	35
BrC	Bippus clay loam, 3 to 5 percent slopes	8	IVe-10	30	Deep Hardland	35
BuB	Bippus fine sandy loam, 1 to 3 percent slopes	9	IIIe-4	28	Sandy Loam	35
BuC	Bippus fine sandy loam, 3 to 5 percent slopes	9	IVe-4	29	Sandy Loam	35
DaA	Dalhart fine sandy loam, 0 to 1 percent slopes	10	IIIe-4	28	Sandy Loam	35
DaB	Dalhart fine sandy loam, 1 to 3 percent slopes	10	IIIe-4	28	Sandy Loam	35
DaC	Dalhart fine sandy loam, 3 to 5 percent slopes	10	IVe-4	29	Sandy Loam	35
DaD	Dalhart fine sandy loam, 5 to 8 percent slopes	10	VIe-5	31	Sandy Loam	35
DhC2	Dalhart soils, 2 to 6 percent slopes, eroded	11	IVe-3	29	Sandy Loam	35
DuA	Dumas loam, 0 to 1 percent slopes	11	IIce-5	27	Deep Hardland	35
DuB	Dumas loam, 1 to 3 percent slopes	11	IIe-2	28	Deep Hardland	35
DuC	Dumas loam, 3 to 5 percent slopes	11	IIIe-9	29	Deep Hardland	35
EnA	Enterprise very fine sandy loam, 0 to 1 percent slopes	12	IIce-2	27	Mixedland	35
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes	12	IIe-1	27	Mixedland	35
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes	12	IIIe-3	28	Mixedland	35
EnD	Enterprise very fine sandy loam, 5 to 8 percent slopes	12	VIe-4	31	Mixedland	35
Gu	Guadalupe fine sandy loam	13	IIIe-4	28	Loamy Bottomland	33
Lk	Likes loamy fine sand	13	VIe-6	31	Sandyland	35
Lm	Likes soils	13	VIs-1	31	Gravelly	36
Ln	Lincoln soils	15	Vw-2	31	Sandy Bottomland	34
McB	Mansker loam, 1 to 3 percent slopes	15	IIIe-7	28	Hardland Slopes	35
MlB	Miles loamy fine sand, 0 to 3 percent slopes	16	IVe-6	29	Sandyland	35
MlC	Miles loamy fine sand, 3 to 6 percent slopes	16	VIe-6	31	Sandyland	35
MrB	Mobeetie fine sandy loam, 1 to 3 percent slopes	17	IIIe-8	29	Mixedland Slopes	36
MrC	Mobeetie fine sandy loam, 3 to 5 percent slopes	17	IVe-9	29	Mixedland Slopes	36
Mt	Mobeetie-Likes complex	17	VIe-3	31	Mixedland Slopes	36
Mx	Mobeetie-Potter complex	17	VIe-3	31	Mixedland Slopes	36
PaB	Patricia fine sand, 0 to 3 percent slopes	18	IVe-6	29	Sandyland	35
Pe	Potter soils	18	VIIs-1	31	Very Shallow	36
PmA	Pullman clay loam, 0 to 1 percent slopes	19	IIIce-1	28	Deep Hardland	35
QuB	Quanah clay loam, 1 to 3 percent slopes	19	IIIe-2	28	Deep Hardland	35
Ra	Randall clay	20	IVw-1	30	----------	--
RcA	Richfield clay loam, 0 to 1 percent slopes	20	IIce-4	27	Deep Hardland	35
RcB	Richfield clay loam, 1 to 3 percent slopes	20	IIe-2	28	Deep Hardland	35
Ro	Rough broken land	21	VIIs-2	31	Rough Breaks	36
SfB	Springer fine sandy loam, 1 to 3 percent slopes	22	IIIe-5	28	Sandy Loam	35
SfC	Springer fine sandy loam, 3 to 5 percent slopes	22	IVe-9	29	Sandy Loam	35
SfD	Springer fine sandy loam, 5 to 8 percent slopes	22	VIe-5	31	Sandy Loam	35
SlB	Springer loamy fine sand, undulating	22	IVe-11	30	Sandyland	35
SlC	Springer loamy fine sand, hummocky	22	VIe-6	31	Sandyland	35
Sp	Spur clay loam	23	IIce-1	27	Loamy Bottomland	33
Su	Spur clay loam, broken	23	Vw-1	30	Loamy Bottomland	33
Sw	Sweetwater soils	23	Vw-3	31	Loamy Bottomland	33
ToA	Tipton silt loam, 0 to 1 percent slopes	25	IIce-2	27	Mixedland	35
ToB	Tipton silt loam, 1 to 3 percent slopes	25	IIe-1	27	Mixedland	35
TtA	Tipton silty clay loam, 0 to 1 percent slopes	25	IIce-1	27	Deep Hardland	35
TtB	Tipton silty clay loam, 1 to 3 percent slopes	25	IIe-2	28	Deep Hardland	35
Tv	Tivoli fine sand	25	VIIe-1	31	Deep Sand	34

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