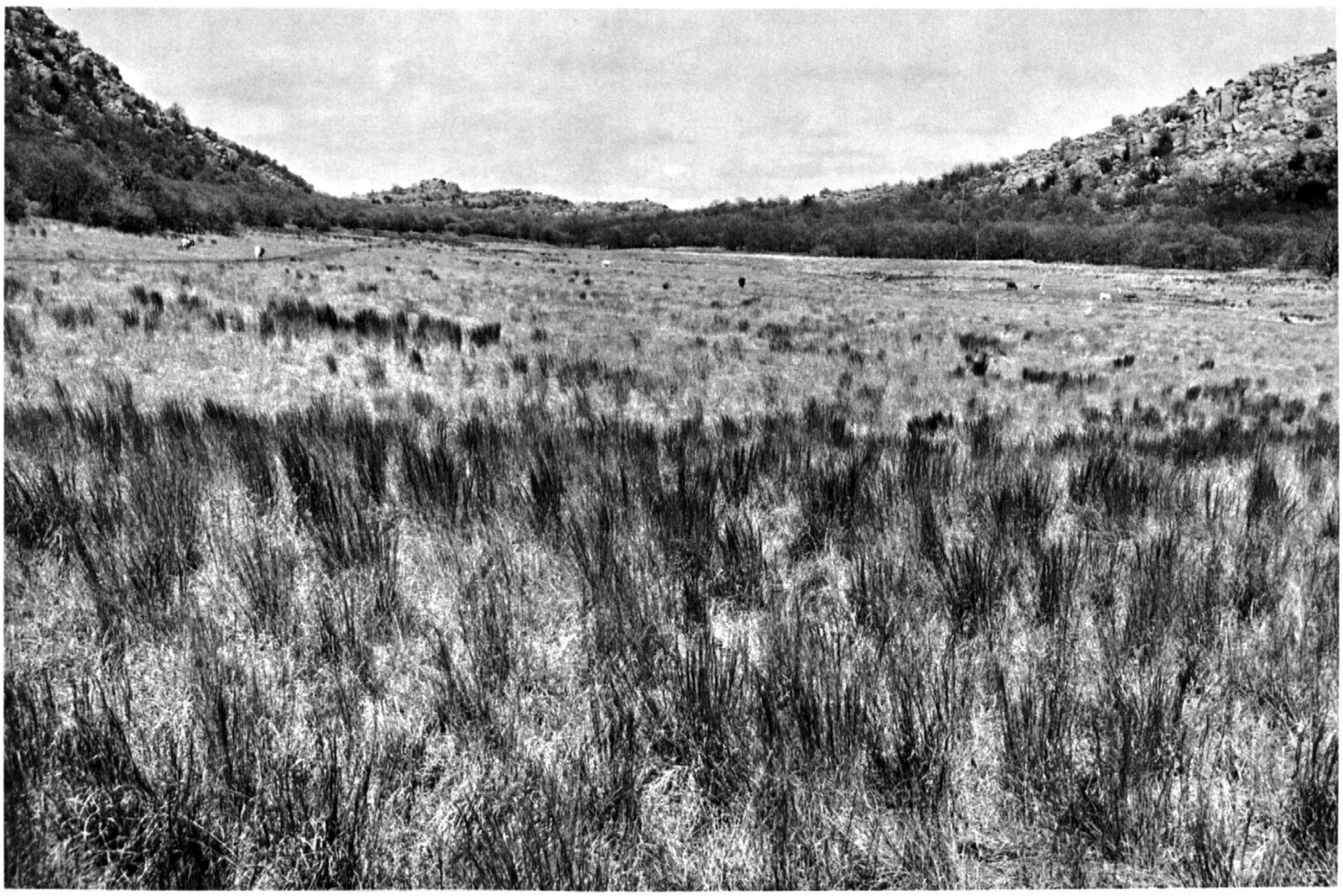
Issued August 1967

SOIL SURVEY

Comanche County, Oklahoma



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Oklahoma Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1955–63. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station; it is part of the technical assistance furnished to the Comanche County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Comanche County, Oklahoma, contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, the tree-planting group, the range site, or any other group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. 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 descriptions of the soils and from the discussions of the capability groups.

Foresters and others can refer to the section "Woodland, Windbreaks, and Post Lots," where the soils of the county are grouped according to their suitability for windbreak and post-lot plantings.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Wildlife."

Ranchers and others interested in range can find, under "Rangeland," groupings of the soils according to their suitability for range and a description of the vegetation on each range site.

Engineers and builders will find, under "Engineering Properties of the Soils," tables that describe soil properties that affect engineering and show the relative suitability of the soils for specified engineering purposes.

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

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

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

***Cover picture*—Excellent native grass on Lawton soils in Wichita Mountain Wildlife Refuge. Stony rock land in background.**

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Contents

NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued August 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N. J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF COMANCHE COUNTY, OKLAHOMA

BY HUBERT L. MOBLEY AND R. C. BRINLEE, SOIL CONSERVATION SERVICE

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

COMANCHE COUNTY is in the southwestern part of Oklahoma (fig. 1). It has a total area of approximately 693,760 acres, or 1,084 square miles. More than a third of the acreage is used for grazing. Although cropland is likely to erode and drought is a hazard, a substantial acreage is used for field crops, mainly wheat and cotton. The Fort Sill Military Reservation occupies almost a hundred thousand acres.

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Comanche County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer,

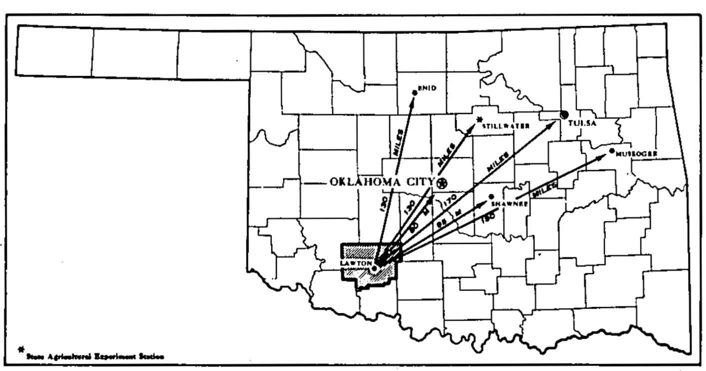

Figure 1.—**Location of Comanche County in Oklahoma.**

the major horizons of all the soils of one series 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. Foard and Lawton, 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 natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to these differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Port loam and Port clay loam are two soil types in the Port series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Lawton loam, 1 to 3 percent slopes, is one of several phases of Lawton loam, a soil type that has a slope range of 1 to 5 percent.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries 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 report was prepared from the aerial photographs.

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soils in it, for example, Lawton-Foard complex, 3 to 5 percent slopes. Also, in most areas surveyed there are tracts that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These tracts are shown on a soil map like other mapping units, but they are given descriptive names, such as Granite outcrop or Broken alluvial land, and are called land types rather than soils.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that may occur together without regularity in pattern or relative proportion. At least one of the component soils of the group occurs in every delineated area. All of the component soils may occur in some delineated areas, and more than one, but not all, in others. The individual bodies of the component soils are large enough so that they could be set apart on a detailed map. For the most part, however, the soils of an undifferentiated group are similar enough in behavior that their separation is not important for the objectives of the survey. An example is Foard and Tillman soils, 1 to 3 percent slopes.

Only part of the soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory and yield data have been assembled. The mass of detailed information then needs to be organized in such a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil survey reports. The soil scientists set up trial groups based on the yield and practice tables and other data. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Comanche 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 farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The nine associations in Comanche County are described in the paragraphs that follow. The total area of these associations is 599,376 acres, or 86.4 percent of the county. The remaining 13.6 percent, or 94,384 acres, is the Fort Sill Military Reservation.

1. Foard-Tillman association

Deep, nearly level and very gently sloping soils; clayey subsoil

This association occurs as broad areas on uplands that are dissected by West Cache, Cache, and Beaver Creeks. These creeks cross the county from north to south. The smallest area of this association is about 1,200 acres in size, and the largest, in the southwestern part of the county, is about 60,000 acres. The total area is approximately 120,726 acres, or about 18 percent of the county.

This association is about 90 percent Foard and Tillman soils and less than 1 percent Waurika soils; the rest consists of Breaks-Alluvial land complex and patches of other soils (fig. 2).

Foard soils are brownish, have a subsoil of heavy, compact clay, and are generally calcareous within a depth of 15 inches. They occupy the more nearly level parts of the landscape. Foard soils in the western part of the county have a surface layer about 5 inches thick, and those in the northern and eastern parts have a surface layer about 10 inches thick. Continuous cultivation has caused a thin, whitish surface crust to form in some areas, particularly in the areas where the surface layer is thinner.

Tillman soils are predominantly gently sloping. They are reddish brown, have a heavy, compact, clayey subsoil, and are calcareous below a depth of 15 inches. Typically, they have a transition zone between the surface layer and the subsoil. The surface layer ordinarily is clay loam. In areas where the surface layer and subsoil have been mixed by plowing, the transition zone is lacking and the surface layer is slightly heavier textured.

Waurika soils occur in the southeastern part of the county, in slight depressions in the broad, nearly level parts of the landscape. They are grayish brown and have a compact, clayey subsoil. Typically, they have a lighter colored layer, 2 to 4 inches thick, between the surface layer and the subsoil.

All of the soils in this association have a heavy subsoil and are difficult to till. Nevertheless, they are used predominantly for cultivated crops. Heavy farm machinery can be used without difficulty. Small grain, mainly wheat, is the most extensive crop. Some sorghum is grown. Only a small acreage is in cotton. The native vegetation consists of short and mid grasses, such as buffalograss, blue grama, and sideoats grama. The average size of the farms in this association is about 640 acres.

2. Zaneis-Lawton-Lucien association

Deep and shallow, very gently sloping and sloping, loamy soils

This association occurs on erosional uplands. The parts that join the flood plains of the larger drainageways are strongly sloping. The total area is about 132,700 acres, or a little more than 19 percent of the county.

This association is 41 percent Zaneis soils; 23 percent Lawton soils; 25 percent Lucien-Zaneis-Vernon complex; 2 percent Vanoss soils; and 9 percent Minco, Cottonwood, and other soils.

Zaneis soils are very gently sloping and gently sloping, reddish brown, and loamy. They have a moderately fine textured subsoil. They occur as scattered areas throughout the eastern part of the county and are associated with the Zaneis-Slickspots complex.

Lawton soils are deep, brown to reddish brown, noncalcareous, loamy, and granitic. They occur as scattered

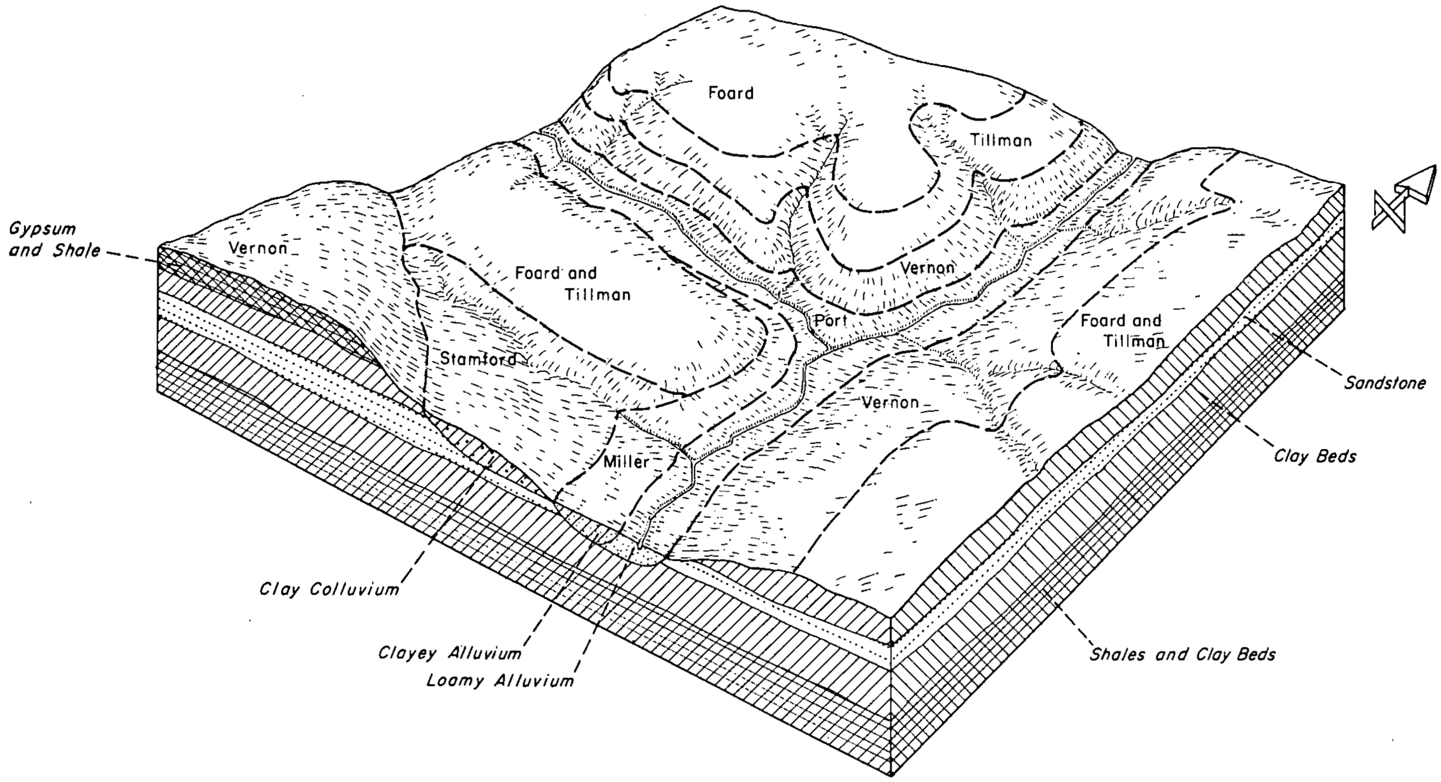

Figure 2.—**Topography and underlying material of major soils in associations 1 and 7.**

patches along the courses of former drainageways that spread out from the mountains onto the plains. These soils formed from old granitic outwash. Granitic sand and small pockets of gravel are common throughout the profile.

Lucien soils occur in this county as a complex with Zaneis and Vernon soils. They are reddish-brown sandy loams that are shallow over fine-grained sandstone. Vernon soils are reddish, calcareous, and clayey. Small patches of other loamy soils are included in the complex. Some are along drains and contain narrow strips of soils that formed in alluvium, and some have large, grayish sandstone rocks on the surface.

Vanoss soils are brown and loamy and have a brown to yellowish-brown subsoil. They occupy the more nearly level parts of the uplands and are closely associated with Zaneis soils.

Minco soils are sloping, deep, and reddish brown and have a loam subsoil. They occur along streams in the eastern part of the county. Cottonwood soils are inextensive and occur east of U.S. Highway No. 277, along the north boundary of the county. They are very shallow, are grayish brown, and overlie gypsum.

Zaneis, Lawton, and Vanoss soils are intensively cultivated to small grain, sorghum, and cotton. Lucien soils are used as range. About 18,000 acres of this association is eroded. Most of the eroded acreage has been seeded to grass.

The Lucien-Zaneis-Vernon complex occupies sloping to strongly sloping parts of this association. These soils are not suitable for cultivation but are excellent for range. Mid and tall grasses, mainly little bluestem, are predominant. Short grasses grow on the finer textured soils. The average size of the farms in this association is about 480 acres.

3. *Zaneis-Foard-Slickspots association*

Slickspots and deep, nearly level and very gently sloping soils; clayey or loamy subsoil

This association is on uplands in both the eastern and western parts of the county. It occupies approximately 66,150 acres, or about 9 percent of the county. It is 51 percent Zaneis-Slickspots complex; 42 percent Foard-Slickspots complex; and 7 percent Slickspots.

The Zaneis-Slickspots complex occupies about 33,500 acres. Zaneis soils are very gently sloping, reddish brown, and loamy and have a moderately fine textured subsoil. Slickspots are abundant. They have a surface layer as much as 12 inches thick, but almost all have a heavy, compact, blocky subsoil. If cultivated, these spots lose their surface layer and the heavy clayey subsoil is exposed. If used for pasture, they can be identified by the difference in vegetation.

The Foard-Slickspots complex occupies about 28,000 acres. It is on nearly level and very gently sloping parts of the uplands. Foard soils are brownish and have a heavy, compact, clay subsoil. They are ordinarily calcareous within a depth of 15 inches. The slickspots have a crusty surface, a surface layer less than 10 inches thick, and a heavy, compact, dark-brown, clay subsoil.

Slickspots occupy about 5,000 acres in the county. They generally occur on old terraces. Severely crusted areas are barren.

The Zaneis-Slickspots complex is subject to erosion and should be used as pasture or range. The Foard-Slickspots complex can be cultivated and is fairly productive in years when the moisture supply is favorable. Slickspots are used predominantly as range.

4. *Port-Zavala-Lela association*

Level and nearly level, loamy and clayey soils on flood plains

This association is on flood plains. It is dominantly level and nearly level, but the parts near stream channels are more sloping. The total area is approximately 76,800 acres, or about 11 percent of the county.

This association is 83 percent Port soils; 2 percent Zavala soils; 1 percent Lela soils; 1 percent Miller soils; and 13 percent Broken alluvial land and Wet alluvial land.

Port soils are loams and clay loams. They are brownish and noncalcareous in the surface layer and grade to reddish-brown, alkaline and calcareous clay loams at a depth of 15 inches or more. In places they are stratified, particularly the loams. Intermingled with Port soils are other soils and slickspots.

Zavala soils are brown, noncalcareous fine sandy loams. They occur in the northeastern part of the county, along the Little Washita River. Small, scattered spots of these soils have received recent deposits of coarse sand.

Lela soils are dark-colored, noncalcareous clays and have a clay subsoil. They occupy the nearly level parts of the infrequently inundated flood plains.

Miller soils are reddish-brown, calcareous and alkaline, and clayey. They have a clay subsoil. For the most part, they occur on fans where small streams enter the flood plains of the larger creeks. They have received fairly recent deposits. Broken alluvial land and Wet alluvial land are along streams.

The soils in this association are used for cultivated crops, mainly small grain, sorghum, cotton, and alfalfa. They are the most productive soils in the county. Overflow is a hazard, and crops are damaged occasionally by flooding. These soils are also suited to tall grasses, but only the slickspots and the areas most frequently damaged by overflow are used as range. Elm, cottonwood, and pecan trees grow in open stands along the stream channels.

5. *Stony rock land-Granite cobbly land association*

Rock outcrop and steep, deep to very shallow soils

This association occurs on rolling, erosional uplands in the Wichita Mountains. The total area is approximately 86,000 acres, or 12 percent of the county.

This association is 51 percent Stony rock land; 23 percent Granite cobbly land; 21 percent Rock land; and 5 percent Granite outcrop.

Stony rock land is hilly and steep. It consists of granite outcrops, very shallow soils over gravel, and deep, stony soils.

Granite cobbly land is rolling to steep and occurs on dissected hills and ridges. It consists of deep soils that are 25 to 70 percent cobblestones. The fine-textured material is brown to reddish-brown loam to clay loam and contains an appreciable amount of gravel. There are a few scattered boulders.

Rock land is gently sloping to moderately steep. It consists of granite rock outcrops, very shallow soils over granite bedrock, and deep, stony soils. It is almost 90 percent rock outcrop. Granite outcrop consists of barren, granitic mountain peaks, cliffs, and escarpments. It is more than 90 percent exposed bedrock.

This association is used only as range. Granite cobbly land produces the best grasses and the largest amount of forage. Rock land and Stony rock land produce mid and short grasses and provide a fair amount of grazing if they are well managed. Granite outcrop has little or no value as range.

6. *Konawa-Windthorst association*

Deep and moderately deep, very gently sloping and gently sloping, sandy to loamy soils

This association occurs on dissected, rolling, sandy uplands in the northeastern and southwestern parts of the county. The total area is approximately 25,000 acres, or about 4 percent of the county.

This association is 64 percent Konawa soils; 30 percent Windthorst soils; and 6 percent Eufaula soils.

Konawa soils are deep, brown to reddish brown, and sandy. They have a light-colored surface layer and a reddish sandy clay loam subsoil. These soils developed from old alluvium, under scrub oak forest.

Windthorst soils are brown to grayish-brown sandy loams that have a sandy clay subsoil. They developed from noncalcareous granitic outwash.

Eufaula soils are deep, light-colored, loose sands that have little textural development.

This association is suitable for cultivated crops, mainly small grain, sorghum, cotton, peanuts, and watermelons. It can also be used as range. The native vegetation consists of scrub blackjack oak and post oak and a sparse cover of mid and tall grasses.

7. *Vernon association*

Shallow, gently sloping and strongly sloping, red, clayey soils

This association is mainly in the western and southern parts of the county. It occupies approximately 57,500 acres, or about 8 percent of the county. It is 96 percent Vernon soils and 4 percent Stamford soils (fig. 2).

Vernon soils are reddish calcareous clays and clay loams. They are rarely more than 20 inches deep on the lesser slopes, and are less than 15 inches deep where the slopes are strongest. These soils are very sticky when wet and tend to crack when dry.

Stamford soils are reddish brown, very gently sloping, calcareous, and clayey. They have a clay subsoil. They formed from local alluvium and colluvium derived from red clays. These soils occur near drainageways, on plains below Vernon soils.

Areas within the upper part of the slope range predominate in this association and are used intensively as range and pasture. Buffalograss, blue grama, sideoats grama, and little bluestem are the dominant grasses. Mesquite trees have invaded overgrazed areas. The lesser slopes are used for cultivated crops, mainly small grain. Stamford soils are well suited to alfalfa.

8. *Tarrant-Limestone cobbly land association*

Rock outcrop and sloping to steep, shallow and very shallow soils

This association occurs on sloping to steep stony hills and ridges, north of the granite mountains in the Wichita

Mountain area. It occupies approximately 21,000 acres, or about 3 percent of the county. It is 64 percent Tarrant-Rock outcrop and 36 percent Limestone cobbly land.

The Tarrant-Rock outcrop complex is 40 percent limestone outcrop. Ledges of tilted limestone protrude as much as 2 feet above the surface. The Tarrant soil is dark grayish-brown silt loam that is 3 to 12 inches thick over bedrock. Films of fine earth extend to a considerable depth, probably several feet, along the tilted bedding planes and joints.

Limestone cobbly land is dark colored and cobbly and is very shallow to shallow over limestone conglomerate, limestone, or caliche. The surface is nearly paved with gravel and cobblestones in some areas, and there are a few boulders.

The soils of this association are used only as range. They produce small to moderate amounts of forage. The dominant vegetation consists of sideoats grama, blue grama, hairy grama, big and little bluestem, and indiangrass.

9. *Cobb association*

Moderately deep, very gently sloping and gently sloping, loamy prairie soils

This association occurs on the treeless prairie in the northeastern part of the county. Sandstone crops out in spots. The total area is 13,500 acres, or about 2 percent of the county.

This association consists entirely of Cobb soils (fig. 3). These soils are brown to reddish-brown fine sandy loams that have a reddish-brown sandy clay loam subsoil. About 8,000 acres within this association is moderately eroded. Much of this acreage has been seeded to grass.

Cobb soils are suitable for cultivation and for use as range. Small grain, sorghum, cotton, peanuts, and watermelons are the main crops. Yields of peanuts and watermelons are very good. The native vegetation consists of mid and tall grasses.

Descriptions of the Soils

This section describes the soil series and the mapping units of Comanche County. The approximate acreage and the proportionate extent of each mapping unit are given in table 1.

A general description of each soil series is given, and this is followed by brief descriptions of the mapping units in that series. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit.

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 the description of each mapping unit are the capability unit, the tree-planting group, and the range site in which the mapping unit has been placed. The page on which each capability unit, tree-planting group, and range site is described can be found readily by referring to the "Guide to Mapping Units" at the back of the report.

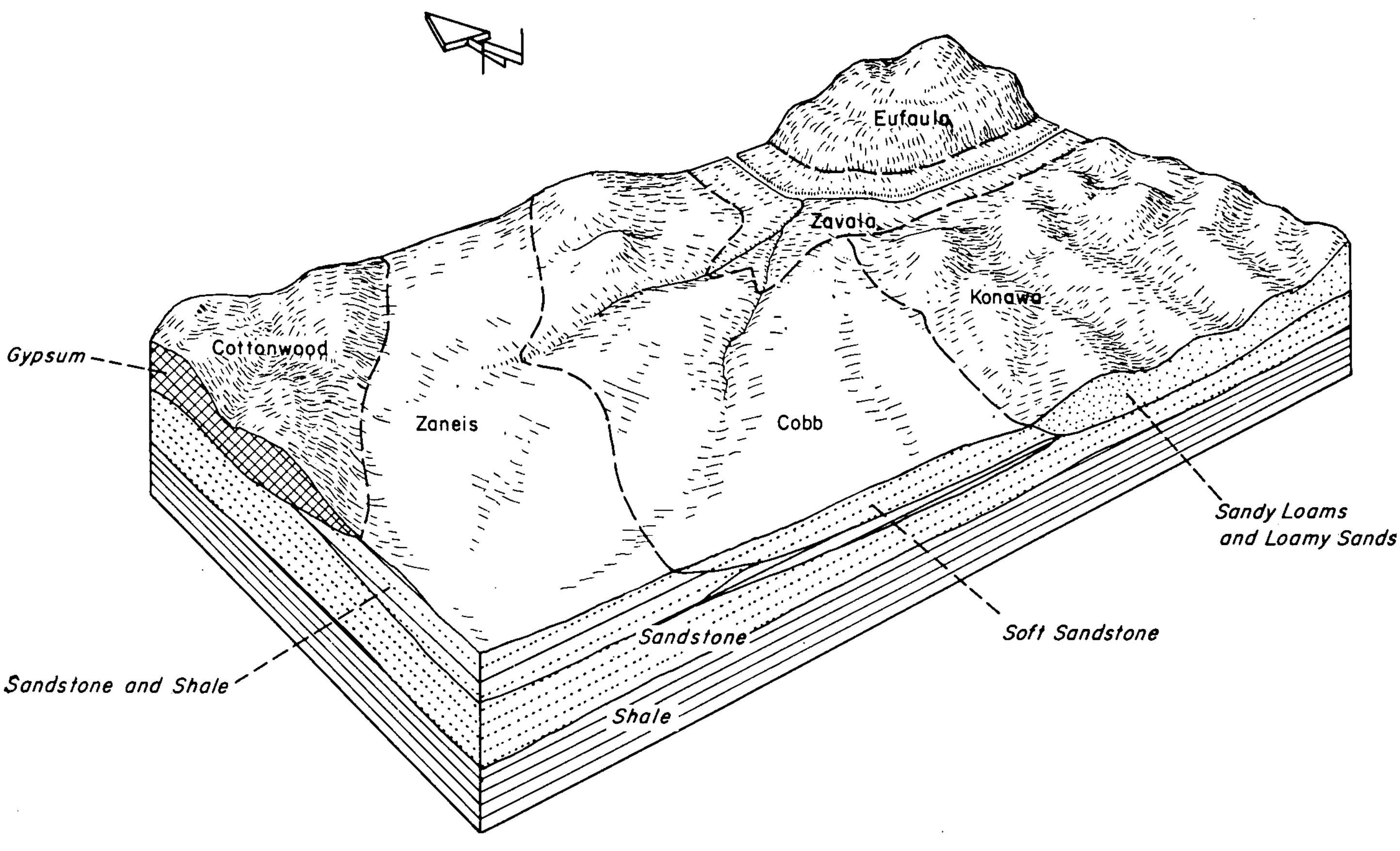

Figure 3.—**Topography and underlying material of major soils in northeastern part of county.**

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Breaks-Alluvial land complex	13, 473	1. 9	Lucien-Zaneis-Vernon complex, 5 to 12 percent slopes	30, 424	4. 4
Broken alluvial land	8, 846	1. 3	Miller clay	609	. 1
Cobb fine sandy loam, 1 to 3 percent slopes	3, 191	. 5	Minco loam, 3 to 8 percent slopes	7, 750	1. 1
Cobb fine sandy loam, 3 to 5 percent slopes	2, 130	. 3	Port clay loam	29, 805	4. 3
Cobb fine sandy loam, 3 to 5 percent slopes, eroded	8, 197	1. 2	Port loam	24, 515	3. 5
Cottonwood soils, 5 to 12 percent slopes	465	. 1	Port-Slickspots complex	9, 361	1. 3
Eroded clayey land	6, 493	. 9	Rock land	18, 191	2. 6
Eroded loamy land	18, 127	2. 6	Slickspots	4, 938	. 7
Eufaula fine sand, rolling	1, 546	. 2	Stamford clay, 1 to 3 percent slopes	2, 040	. 3
Foard silt loam, 0 to 1 percent slopes	14, 305	2. 1	Stony rock land	43, 649	6. 3
Foard and Tillman soils, 1 to 3 percent slopes	81, 926	11. 9	Tarrant-Rock outcrop complex	13, 345	1. 9
Foard-Slickspots complex, 0 to 1 percent slopes	3, 955	. 6	Tillman clay loam, 3 to 5 percent slopes	8, 859	1. 3
Foard-Slickspots complex, 1 to 3 percent slopes	23, 836	3. 4	Vanoss loam, 0 to 1 percent slopes	1, 243	. 2
Granite cobbly land	19, 648	2. 8	Vanoss loam, 1 to 3 percent slopes	1, 202	. 2
Granite outcrop	4, 339	. 6	Vernon soils, 3 to 5 percent slopes	16, 839	2. 4
Hollister silt loam, 0 to 2 percent slopes	1, 590	. 2	Vernon soils, 5 to 12 percent slopes	38, 544	5. 6
Konawa loamy fine sand, 1 to 3 percent slopes	1, 482	. 2	Waurika silt loam	768	. 1
Konawa loamy fine sand, 3 to 5 percent slopes	5, 704	. 8	Wet alluvial land	1, 518	. 2
Konawa loamy fine sand, 3 to 5 percent slopes, eroded	4, 162	. 6	Windthorst sandy loam, 1 to 3 percent slopes	2, 984	. 4
			Windthorst sandy loam, 3 to 5 percent slopes	4, 657	. 7
Konawa soils, 2 to 8 percent slopes, severely eroded	4, 771	. 7	Zaneis loam, 1 to 3 percent slopes	9, 460	1. 4
			Zaneis loam, 3 to 5 percent slopes	6, 844	1. 0
Lawton loam, 1 to 3 percent slopes	14, 964	2. 2	Zaneis loam, 3 to 5 percent slopes, eroded	14, 990	2. 2
Lawton loam, 3 to 5 percent slopes	9, 708	1. 4	Zaneis-Slickspots complex, 1 to 3 percent slopes	33, 403	4. 9
Lawton loam, 3 to 5 percent slopes, eroded	3, 111	. 4	Zavala fine sandy loam	1, 435	. 2
Lawton-Foard complex, 3 to 5 percent slopes	1, 676	. 2	Lake Ellsworth and Lake Lawtonka	5, 872	. 8
Lela clay	703	. 1	Fort Sill Military Reservation [1]	94, 384	13. 6
Limestone cobbly land	7, 783	1. 1			
			Total	693, 760	100. 0

[1] Not surveyed.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the Section "Genesis, Classification, and Morphology of the Soils." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Bk) consists of shallow to deep, loamy to clayey, upland soils on broken and moderately steep side slopes along drainageways and of alluvial soils on narrow bottom lands between the side slopes. This complex occurs in all parts of the county. Slickspots are common in some parts but are no more than 10 percent of any one area. The areas are long and are between 100 and 500 feet wide. The slope is 8 to 20 percent on the breaks and 0 to 2 percent on the bottom lands.

This complex is too small for separate use and management. It is better suited to range and pasture than to crops, but strips that cross cultivated fields are cultivated. This complex also provides a good habitat for wildlife. The vegetation on the side slopes consists of short and mid grasses, and that on the bottom lands, of tall grasses and deciduous trees.

Protecting the grass by controlling grazing, reseeding barren areas, controlling erosion, and protecting wildlife are the important management problems. (Capability unit VIe-1; tree-planting group IV; Loamy Prairie and Loamy Bottomland range sites)

Broken Alluvial Land

Broken alluvial land (Br) consists of broken slopes and channeled areas in the alluvium of flood plains. It is dissected by meandering channels and is frequently flooded. This land type occurs in all parts of the county. The dominant slope is 0 to 2 percent, but the broken side slopes have gradients of at least 8 percent, and some are nearly vertical. The texture ranges from fine sandy loam to heavy clay loam.

This land type is loamy and fertile but, because of broken slopes and frequent flooding, is unsuitable for cultivation. It is suitable for use as pasture and range and as a wildlife habitat. A few small areas are used for gardens. The vegetation consists chiefly of deciduous trees and tall grasses.

Management that will protect the grass and control erosion is needed. Clearing and then establishing grass is advisable in some areas. (Capability unit Vw-1; tree-planting group IV; Loamy Bottomland range site)

Cobb Series

The Cobb series consists of moderately deep, loamy, very gently sloping to sloping soils on uplands.

The surface layer of these soils is brown to reddish-brown fine sandy loam. It is granular, friable, and 6 to 14 inches thick. The subsoil ranges from reddish brown to red in color and from sandy clay loam to heavy fine sandy loam in texture. It has blocky structure and is friable when moist and hard when dry. Both of these layers are slightly acid. Noncalcareous reddish sandstone occurs at a depth of 20 to 48 inches.

Cobb soils are associated with Vanoss, Zaneis, and Konawa soils. They have a less sandy, darker colored surface layer than Konawa soils, which developed in deep sandy sediments. They are more reddish than

Vanoss soils and have a less clayey subsoil than either Vanoss or Zaneis soils.

Some areas of these soils are in native pasture. The vegetation consists of tall grasses, such as big and little bluestem, indiangrass, and switchgrass.

Cobb fine sandy loam, 1 to 3 percent slopes (CoB).—This soil is on uplands in the northeastern part of the county. Included in mapping were small areas of eroded Cobb soils and associated Konawa soils and a few scattered rock outcrops.

This soil is suited to small grain, cotton, sorghum, peanuts, and watermelons. It is easy to till, and most of the acreage is cultivated. Cultivated areas are subject to moderate wind and water erosion. Terraces, contour farming, cover crops, and fertilizer are needed to help control erosion, conserve moisture, and maintain fertility. (Capability unit IIe-2; tree-planting group III; Sandy Prairie range site)

Cobb fine sandy loam, 3 to 5 percent slopes (CoC).—This soil is on uplands and is closely associated with the gently sloping Cobb soil. Included in mapping were small areas of Konawa soils and eroded Cobb soils and a few scattered rock outcrops.

Part of the acreage is cultivated, and part is in pasture. Small grain, cotton, sorghum, and peanuts are the main crops. Cultivated areas are subject to moderate wind and water erosion. Terraces, contour farming, cover crops, and fertilizer are needed to help control erosion, conserve moisture, and maintain fertility. (Capability unit IIIe-3; tree-planting group III; Sandy Prairie range site)

Cobb fine sandy loam, 3 to 5 percent slopes, eroded (CoC2).—This soil is on uplands and is closely associated with other Cobb soils. Included in mapping were small areas of severely eroded Konawa soils and noneroded Cobb soils and a few scattered rock outcrops.

The surface layer of this soil is ordinarily less than 5 inches thick. In patches it consists wholly of the original surface material, but in some areas it is a mixture of the original surface layer and material from the subsoil.

Most of the acreage is cultivated. Small grain, cotton, sorghum, and peanuts are the main crops. Controlling wind and water erosion is the main problem. Terraces, contour farming, cover crops, and fertilizer are needed to help control erosion, conserve moisture, and maintain fertility. (Capability unit IIIe-4; tree-planting group IV; Sandy Prairie range site)

Cottonwood Series

The Cottonwood series consist of very shallow, dark-colored, loamy soils in the northeastern part of the county.

The surface layer of these soils is very dark grayish-brown loam. It is commonly about 6 inches in thickness but ranges from 2 to 10 inches. It has granular structure, is soft when dry and friable when moist, and is about neutral in reaction. Few to many small fragments of gypsum occur locally on the surface and throughout this thin layer of soil. Light-colored gypsum occurs at a depth of 2 to 10 inches.

Cottonwood soils are associated with Zaneis, Vanoss, and Cobb soils.

Cottonwood soils, 5 to 12 percent slopes (CtD).—These soils are shallow, droughty, and unproductive. They support only a sparse cover of mid grasses and weeds. Water intake is very slow, and runoff is rapid. The entire acreage is suitable only for range.

These soils need careful management. It is advisable to allow vigorous growth of native plants and to leave a mulch on the surface. (Capability unit VIIs-4; tree-planting group IV; Gyp range site)

Eroded Clayey Land

Eroded clayey land (Es) consists of areas of severely eroded, fine-textured soils and some gullies. The slope range is 2 to 5 percent. Erosion has removed most or all of the original surface layer. Where part of the surface layer remains, it is less than 2 inches thick. The plow layer consists predominantly of material from the subsoil and substratum. Most of these areas are in the western half of the county.

This land type has been retired from cultivation. It is suitable only for use as pasture and as a wildlife habitat. Except in areas that have been reseeded to native grasses, the vegetation consists only of weeds and annual grasses.

Reestablishing the grass is difficult but necessary on these severely eroded areas. Only limited amounts of vegetation can be expected. Little bluestem, buffalograss, blue grama, and sideoats grama are suitable native grasses. Properly placed diversions aid in stabilizing gullies. (Capability unit VIe-2; tree-planting group IV; Eroded Clay range site)

Eroded Loamy Land

Eroded loamy land (Et) consists of severely eroded areas of loamy soils dissected with gullies that are close together and 2 to 4 feet deep. The slope range is 2 to 8 percent. This land type occurs as scattered areas throughout the county, but the largest acreage is in the eastern half. Erosion has removed all or most of the original surface layer. Where part of the surface layer remains, it is less than 4 inches thick. The plow layer consists predominantly of subsoil and substratum material. The slope is 2 to 8 percent.

This land type has been retired from cultivation. All of it should be seeded to grasses. Except in areas that have been reseeded, the vegetation consists only of weeds and annual grasses. If fertilized and otherwise well managed, tame pasture grows well. Controlling erosion is important. Gullies become stabilized more rapidly if runoff is diverted. (Capability unit VIe-3; tree-planting group IV; Loamy Prairie range site)

Eufaula Series

The Eufaula series consists of light-colored, deep, loose sands that are slightly acid to medium acid in reaction. These soils formed under a mixed cover of tall grasses and trees in the northeastern part of the county.

The surface layer of these soils is brown to pale-brown fine sand. It is 40 to 60 inches or more thick, is structureless, and is very pale brown to reddish yellow. The subsoil is light-red fine sand with thin bands of red loamy fine sand. It is structureless and is very friable when moist. When it is dry, the fine sand is loose and the bands of loamy fine sand are slightly hard. The underlying material is sandy alluvium that is very friable and medium acid.

Eufaula soils are associated with Cobb and Konawa soils but are more sandy than either and lack the sandy clay loam subsoil. They have a lighter colored surface layer than Cobb soils and lack the sandstone below the substratum.

Eufaula soils are somewhat excessively drained. They have little if any runoff and low water-holding capacity. They are subject to wind erosion.

Eufaula fine sand, rolling (EuD).—This somewhat excessively drained soil occurs on rolling uplands. The slope range is 5 to 12 percent. Included in mapping were small areas of Konawa loamy fine sand.

If cover is inadequate, this soil is highly susceptible to wind erosion. It is used only as range. The vegetation consists of scrub forest of blackjack oak and post oak and some tall grasses. Native pastures have low carrying capacity. (Capability unit VIs-1; tree-planting group II; Deep Sand Savannah range site)

Foard Series

The Foard series consists of deep, nearly level to gently sloping, dark-brown to dark grayish-brown soils on uplands. These soils developed from calcareous red-bed clays and clay loams.

The surface layer is grayish-brown to dark-brown, friable silt loam. It is 5 to 10 inches thick and has weak granular structure. It is slightly acid or neutral in reaction. The boundary between the surface layer and the subsoil is abrupt. The subsoil is dark grayish-brown to dark-brown, very firm clay. It has weak blocky structure or is massive, and it is extremely hard when dry. This layer is neutral or moderately alkaline in reaction. It is underlain by clayey red beds that are mottled in spots with redder and yellower colors.

Foard soils are associated with Tillman, Waurika, and Vernon soils. They are less red in the subsoil than Tillman soils and lack the transition zone between the surface layer and the subsoil. They also lack the grayish, leached layer, in the lower part of the surface layer, that is typical of Waurika soils.

Foard soils are moderately well drained and moderately fertile. They are somewhat droughty, have very slow permeability, and release moisture to plants rather slowly. The depth to free carbonates ranges from 12 to 24 inches.

Foard silt loam, 0 to 1 percent slopes (FaA).—This soil occurs as nearly level flats, mostly in the southern part of the county. Included in mapping were small areas having slopes of 1 to 3 percent and a few scattered slickspots.

Most of this soil is cultivated to small grain and cotton, but part of it is in sorghum. Some areas are in native pasture. The pastures have limited carrying capacity. The vegetation consists of short and mid grasses, such as buffalograss, blue grama, sideoats grama, and little bluestem. If there is enough moisture, crops respond to fertilizer. Surface crusting and droughtiness are the major limitations. (Capability unit IIs-1; tree-planting group III; Hardland range site)

Foard and Tillman soils, 1 to 3 percent slopes (FtB).—This mapping unit is 60 to 70 percent Foard silt loam and 30 to 40 percent Tillman clay loam. Tillman clay loam is described under the heading "Tillman Series." Included in mapping were soils similar to Tillman soils but calcareous to the surface, small areas of Vernon soils and Stamford clay, and a few scattered slickspots.

Controlling erosion is a problem in places, but not a serious one. The cultivated soils are used mainly for small grain and cotton and partly for sorghum. Terraces, contour farming, and stubble-mulch tillage are needed to control erosion and conserve moisture. If there is enough moisture, crops on these soils respond to fertilizer. (Capability unit IIIe-1; tree-planting group III; Hardland range site)

Foard-Slickspots complex, 0 to 1 percent slopes (FsA).—This complex is 65 to 90 percent Foard soils and 10 to 35 percent slickspots.

The surface layer of the slickspots ranges from loam to clay loam in texture, is 2 to 10 inches thick, and has a crust that is ⅛ to 1 inch thick and is glazed and whitish when dry. The surface layer of the Foard soil ranges from silt loam to clay loam in texture. The boundary between the surface layer and a dense, massive clay subsoil is abrupt (fig. 4). The color of these layers ranges from grayish brown to reddish brown. The reaction is mildly or moderately alkaline. The depth to calcareous material ranges from 10 to 30 inches.

This complex is difficult to till. Plant emergence is retarded because the surface tends to crust and moisture is not readily available. Applying agricultural gypsum to the slickspots helps to reduce surface crusting, increases water intake, and improves the soil structure.

Figure 4.—Profile of Foard soil in Foard-Slickspots complex, showing dense, massive clay subsoil.

This complex is suited to small grain or cool-season crops and to native grasses, mainly buffalograss, alkali sacaton, blue grama, and little bluestem. Most of the acreage is cultivated to wheat, cotton, and grain sorghum, and part is in alfalfa. (Capability unit IIIs-2; tree-planting group IV; Hardland and Slickspots range sites)

Foard-Slickspots complex, 1 to 3 percent slopes (FsB).—This complex is on uplands. It is 10 to 45 percent slickspots. Except for spots of Tillman clay loam, which were included in mapping and make up 10 to 15 percent of the acreage, the rest of this complex consists of Foard soils.

The surface layer of the slickspots ranges from loam to clay loam in texture, is 2 to 10 inches thick, and has a crust that is 2 to 10 inches thick and is glazed and whitish when dry. The surface layer of the Foard soil ranges from silt loam to clay loam in texture. The boundary between the surface layer and a dense, massive clay subsoil is abrupt. The color of these layers ranges from grayish brown to reddish brown. The reaction is mildly or moderately alkaline. The depth to calcareous material ranges from 10 to 30 inches.

Much of this complex is cultivated. Controlling sheet erosion is a major problem. Soil-conserving practices are needed to control erosion and reduce surface crusting. Applying agricultural gypsum to the slickspots helps to reduce surface crusting, increases water intake, and improves the soil structure.

This complex is suited to small grain. Many areas previously cultivated have now been reseeded to native grass. (Capability unit IVe-3; tree-planting group IV; Hardland and Slickspots range sites)

Granite Cobbly Land

Granite cobbly land (Gc) consists of rolling to steep areas on dissected hills and ridges on uplands. The slope is 5 to 40 percent. Granite cobblestones make up 25 to 70 percent of each area. The rest consists of deep, brown to reddish-brown loams to clay loams that contain an appreciable amount of gravel. There are a few scattered boulders. Included in mapping were spots of alluvial soils, less than 200 feet wide, and small areas where the depth to bedrock is 1 to 4 feet.

This land type is suitable for use as range and as a wildlife habitat. It is excessively drained and has excessive runoff. Permeability is moderate. The vegetation consists of mid and tall grasses. Scrub oak is common in some areas. Controlled grazing and protection from fire are needed. (Capability unit VIIs-1; tree-planting group IV; Boulder Ridge range site)

Granite Outcrop

Granite outcrop (Go) consists of barren, granitic mountain peaks, cliffs, and escarpments (fig. 5). At least 90 percent of it is exposed bedrock. Included in mapping were small areas of Rock land and Stony rock land. This land type is in the northwestern part of the county, in the Wichita Mountains. Most of it is inaccessible to livestock and has no agricultural value. It is scenic and is suitable for recreation and for watershed projects. The only vegetation is on the small included areas of other land types. (Capability unit VIIIs-1; tree-planting group IV; no range site classification)

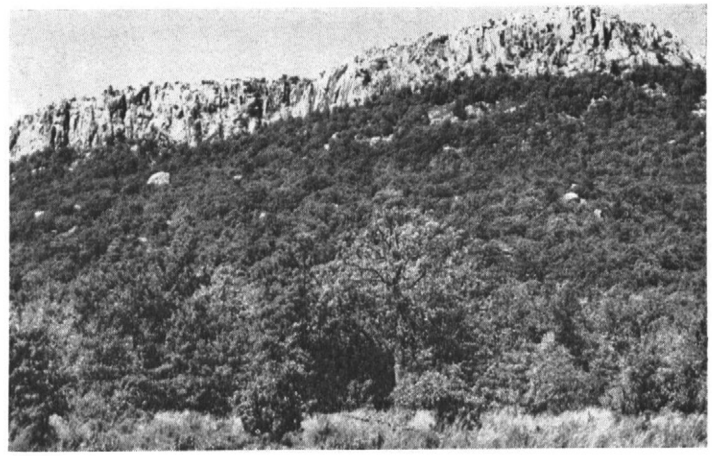

Figure 5.—**Vertical escarpments in area of Granite outcrop.**

Hollister Series

The Hollister series consists of deep, nearly level, dark-colored, loamy soils on uplands. These soils developed under a cover of mid and tall grasses. They occur in the mountainous area in the northwestern part of the county, generally along or near drains.

The surface layer is brown to dark grayish-brown silt loam. It is 6 to 16 inches thick, has granular structure, and it is friable when moist and hard when dry. It is neutral in reaction. The subsoil is grayish-brown to brown clay or silty clay. It has a moderate, medium, blocky structure and is very firm when moist and very hard when dry. It is neutral in reaction. The underlying material consists of brownish, clayey sediments.

Hollister soils are associated with Foard and Lawton soils. They are darker colored than Lawton soils and have a more clayey subsoil. They differ from Foard soils in having a transition zone between the surface layer and the subsoil.

Hollister silt loam, 0 to 2 percent slopes (HoB).—This soil is in the northern part of the county. It has good structure and favorable physical properties, is moderately fertile, responds to management, and is highly productive. It is one of the more drought-resistant upland soils in the county. Erosion is not a serious hazard.

Most of the acreage is cultivated, mainly to small grain and alfalfa. A few small areas are in native pasture. The vegetation consists of tall grasses, such as big and little bluestem, indiangrass, and switchgrass. (Capability unit IIe-1; tree-planting group III; Hardland range site)

Konawa Series

The Konawa series consists of deep, very gently sloping to sloping loamy fine sands on uplands. These soils developed under scrub oak forest.

The surface layer is 10 to 20 inches thick, has granular structure or is structureless, and is soft when dry and very friable when moist. To a depth of about 8 inches, this layer is brown to grayish brown, free of lime, and easily worked. The lower part is light brown to brown and light reddish brown. The subsoil is reddish sandy clay loam. Its structure is weak coarse blocky to weak coarse prismatic. This layer is hard when dry and friable when moist. It is slightly acid or medium acid. It is underlain by old alluvium that is sandy loam in texture, is very friable, and is slightly acid in reaction.

Konawa soils are associated with Cobb, Eufaula, and Windthorst soils.

As compared with Cobb soils, they are light colored in the lower part of the surface layer and they overlie old alluvium instead of sandstone bedrock. They differ from Eufaula soils in having a thinner, lighter colored surface layer over the more clayey subsoil. They have a more sandy surface layer and a less clayey subsoil than Windthorst soils.

Konawa soils are well drained and have medium capacity to hold water. They are subject to both wind and water erosion.

Konawa loamy fine sand, 1 to 3 percent slopes (KoB).—This soil is in the northeastern and southwestern parts of the county. Included in mapping were small areas of Cobb, Windthorst, and eroded Konawa soils; minor areas of loamy sands and fine sands that lack a textural subsoil; and larger areas of a soil that has a surface layer more than 20 inches thick but is otherwise similar to Konawa soils.

This soil is easily tilled and responds well to management. It is used for both pasture and cultivated crops. Cultivated areas are highly susceptible to wind and water erosion. Small grain, cotton, sorghum, peanuts, and watermelons are the main crops. The native vegetation is generally a mixture of trees and tall grasses. Cover cropping, stubble mulching, and establishing perennial vegetation in natural drains help to control erosion and conserve moisture. (Capability unit IIIe–5; tree-planting group I; Deep Sand Savannah range site)

Konawa loamy fine sand, 3 to 5 percent slopes (KoC).—This soil is in the northeastern and southwestern parts of the county. Included in mapping were a few small areas of Cobb fine sandy loam, of Eufaula fine sand, and of a soil that has a surface layer more than 20 inches thick but is otherwise similar to Konawa soils.

This soil is easily tilled and responds to management. It is used for both pasture and cultivated crops. Cultivated areas are highly susceptible to wind and water erosion. Runoff is moderate. Small grain, cotton, sorghum, peanuts, and watermelons are the main crops. The pastures are generally forested. Cover cropping, stubble mulching, and establishing perennial vegetation in natural drains help to control erosion. (Capability unit IVe–4; tree-planting group II; Deep Sand Savannah range site)

Konawa loamy fine sand, 3 to 5 percent slopes, eroded (KoC2).—This soil is in the northeastern part of the county. It is similar to Konawa loamy fine sand, 3 to 5 percent slopes, but 30 to 50 percent of it has been eroded to the degree that the present plow layer is a mixture of the original surface layer and the original subsoil. About 20 to 30 percent of the acreage consists of soils that have a surface layer 6 to 10 inches thick, and another 20 to 30 percent consists of deposits of loamy fine sand and sand 1 to 2 feet deep.

This soil is used for both pasture and cultivated crops. The main crops at present are cotton, sorghum, and peanuts, but the soil is better suited to close-growing crops. Management should include stubble mulching and establishing perennial vegetation in the natural drains. Runoff is moderate. (Capability unit IVe–5; tree-planting group IV; Deep Sand Savannah range site)

Konawa soils, 2 to 8 percent slopes, severely eroded (KnB3).—Wind and water erosion have removed most or all of the original surface layer of these soils. Gullies more than 1 foot deep are common. The plow layer consists predominantly of subsoil and substratum material. Most of the acreage has been cultivated but is no longer suitable for cultivation because of erosion. These soils are in permanent grass and are used as range. Excess water should be controlled and grazing should be regulated. (Capability unit VIe–4; tree-planting group IV; Eroded Sandyland range site)

Lawton Series

The Lawton series consists of very gently sloping and gently sloping soils on uplands. These soils are deep, brown, and loamy. They developed in a subhumid climate, in noncalcareous granitic outwash from the Wichita Mountains. They occur along the courses of former drainageways that spread out from the mountains onto the plains (fig. 6) in the western part of the county.

The surface layer is brown to reddish-brown loam and is 6 to 14 inches thick. It has moderate, medium, granular structure and is friable when moist and hard when dry. It is slightly acid or neutral in reaction. This layer grades to reddish-brown clay loam that has weak, medium, granular structure and extends to a depth of 14 to 18 inches. The subsoil is dark reddish-brown to yellowish-red heavy clay loam. It has moderate, medium, blocky structure and is firm when moist and very hard when dry. It is neutral in reaction. Yellowish-red sandy loam to clay loam is at a depth of 45 to 60 inches.

In most places these soils have granitic sand and pebbles throughout the profile, but not enough to impair the moisture-holding capacity. Beds of gravel occur at a depth of 60 to 90 inches or, in the areas near the Wichita Mountains, nearer to the surface.

Lawton soils are associated with Foard, Tillman, and Vernon soils. They are less clayey and less alkaline than either Foard or Tillman soils.

Some areas are in native grass pasture. The vegetation consists of mid and tall grasses, such as big and little bluestem, switchgrass, and indiangrass. Bermudagrass and blue panicgrass do well as tame pasture.

Lawton loam, 1 to 3 percent slopes (LaB).—This soil is in the western part of the county. Most of it is cultivated; the rest is used as range. All crops grown in the area are suitable, but small grain and cotton are the main crops. All crops respond well to fertilization and good management. Water erosion is a moderate hazard. Terraces and a soil-conserving cropping system are needed. (Capability unit IIe–1; tree-planting group III; Loamy Prairie range site)

Lawton loam, 3 to 5 percent slopes (LaC).—This soil is on uplands, along former drainageways in the western part of the county. It has a 6- to 12-inch surface layer. It is suitable for cultivation, but most of it is in pasture. Small grain is the main crop. Cotton and sorghum are grown also. Management should include terraces, contour farming, or similar practices that conserve moisture and protect the soil from erosion. The native vegetation consists of big and little bluestem, switchgrass, and indian-

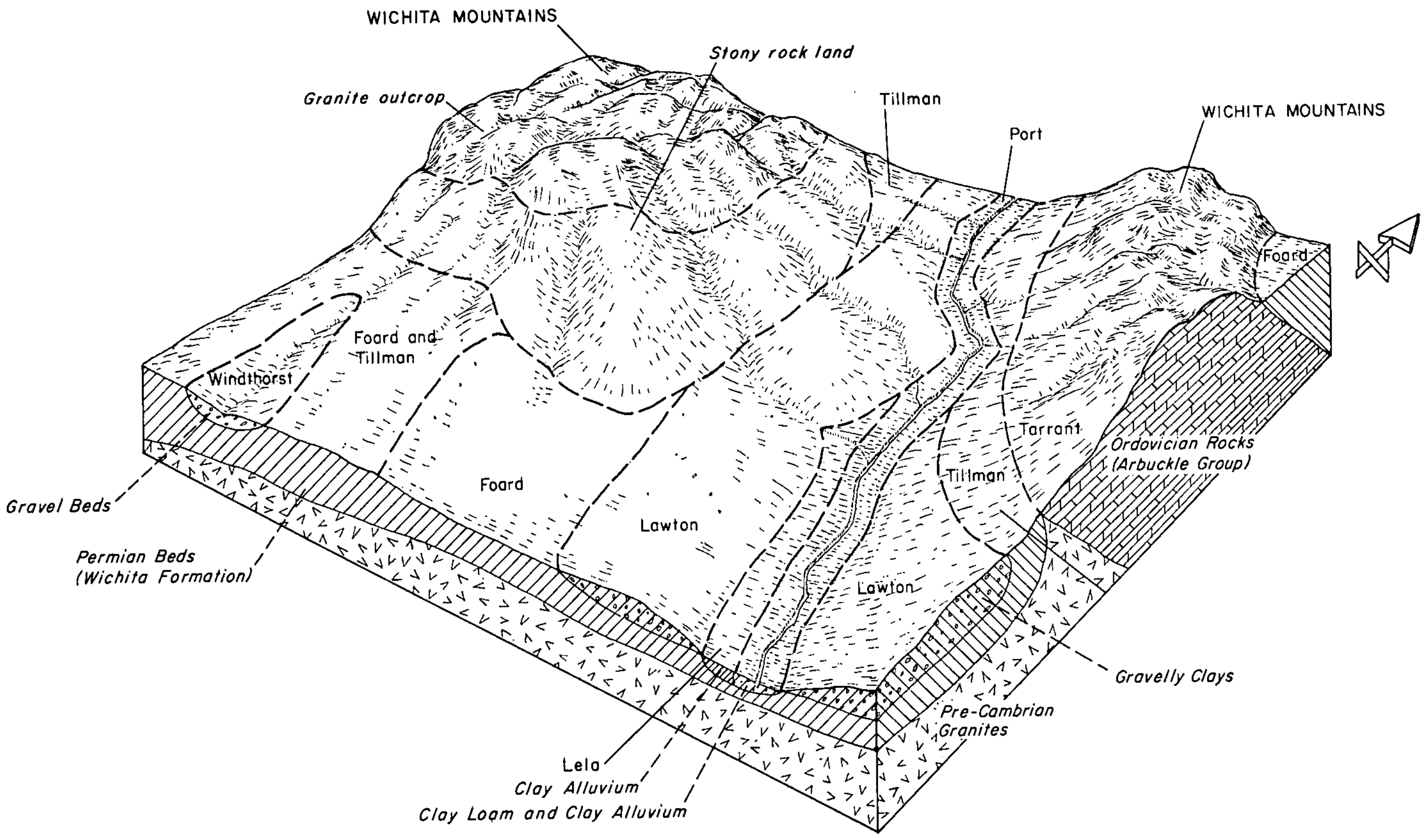

Figure 6.—**Topography and underlying material of Lawton soils and other extensive soils in northwestern part of county.**

grass. (Capability unit IIIe-2; tree-planting group III; Loamy Prairie range site)

Lawton loam, 3 to 5 percent slopes, eroded (LaC2).—This soil is on uplands. Its surface layer is less than 5 inches thick and in many areas is mixed with material from the subsoil. Small rills and shallow gullies are common.

All of the acreage is or has been cultivated to such crops as small grain, cotton, and sorghum. Some areas have been reseeded to native grass, and good stands of tall grasses have been obtained. Crops respond to good management and fertilization. Intensive conservation measures, including terraces and contour farming, are needed to reduce the hazard of erosion. (Capability unit IVe-6; tree-planting group III; Loamy Prairie range site)

Lawton-Foard complex, 3 to 5 percent slopes (LfC).—This complex is 60 to 80 percent Lawton loam and 20 to 40 percent Foard soils. Included in mapping were small areas of Tillman soils, some scattered rock outcrops, and a few slickspots.

The Foard soils in this complex differ in gradient and in texture and thickness of the surface layer from those described under the heading "Foard Series." Their surface layer ranges from silt loam to clay loam in texture. In thickness it ranges from 8 to 14 inches, but ordinarily it is about 12 inches thick.

Most of this complex is in native pasture. Tall and mid grasses grow on Lawton loam, and short and mid grasses on Foard soils. Most of the cultivated acreage is in small grain. If cultivated, these soils should be terraced and farmed on the contour to help control water erosion and conserve moisture. If pastured, they should be properly grazed and well managed. (Capability unit IVe-2; tree-planting group III; Loamy Prairie and Hardland range sites)

Lela Series

The Lela series consists of deep, dark-colored, noncalcareous clayey soils that formed in alluvium. These soils are on very slowly drained parts of infrequently inundated flood plains along some of the larger creeks in the southern part of the county.

The surface layer of these soils is dark-gray to very dark gray clay and is 6 to 22 inches thick. It has moderate, fine, granular structure and is very firm when moist, very sticky when wet, and very hard when dry. The reaction is neutral to moderately alkaline. The surface is likely to crust. The subsoil is dark-brown clay. It either has weak, medium, blocky structure or is massive. This layer is very firm when moist and extremely hard when dry. It is moderately alkaline in reaction. The underlying material is brown to very dark brown clay that has a few, fine, distinct mottles of reddish brown. It is very firm when moist and extremely hard when dry. It contains a few soft lime concretions, but the fine earth, though moderately alkaline, is noncalcareous.

Lela soils are associated with Miller and Port soils. They are less red than Miller soils and are noncalcareous. They are finer textured than Port soils.

The native vegetation consists of mid and tall grasses, such as big and little bluestem, indiangrass, switchgrass, sideoats grama, and vine-mesquite.

Lela clay (Lc).—Most of this soil is cultivated, and the rest of it is in pasture. It is moderately well suited to small grain and alfalfa. The surface tends to bake and crust. Good management, including the use of crop residue, is needed. A few diversion terraces may be needed to control overhead water. (Capability unit IIIs–1; tree-planting group IV; Heavy Bottomland range site)

Limestone Cobbly Land

Limestone cobbly land (Lm) consists of limestone cobblestones and strongly sloping to steep, dark-colored soils that are shallow to very shallow over limestone, limestone conglomerate, or, in some small areas, caliche. The gradient is 20 percent or more. This land type occurs on ridges in the northwestern part of the county, north of the Wichita Mountains.

The soil is 3 to 20 inches thick. The surface layer ranges from loam to clay loam in texture; it is 15 to 75 percent limestone gravel and cobblestones. The substratum consists of limestone, limestone conglomerate, or caliche.

This land type is excessively drained and has excessive runoff. Permeability is moderate. The vegetation consists of short, mid, and tall grasses; the tall grasses grow on the deeper soils. This land type is suitable for use as range but has low carrying capacity. It is also suitable as a habitat for wildlife. Control of grazing and protection from fire are needed. (Capability unit VIIs–3; tree-planting group IV; Limestone Ridge range site)

Lucien Series

The Lucien series consists of shallow, sloping to strongly sloping soils on uplands. These are reddish-brown, noncalcareous, loamy soils that developed from Permian sandstone.

The surface layer is reddish-brown loam and is 10 inches thick. It has weak, fine, granular structure and is very friable when moist and soft when dry. It is neutral in reaction. The underlying material is dark reddish-brown, consolidated, fine-grained sandstone.

The thickness of these soils ranges from as little as 5 inches near rock outcrops to as much as 20 inches. The texture of the surface layer is mainly loam but ranges from silt loam to fine sandy loam. The color ranges from dark reddish brown to reddish brown. The reaction is neutral to medium acid.

Lucien soils are closely associated with Zaneis and Vernon soils. They are less clayey than the calcareous Vernon soils. They are shallower to bedrock than Zaneis soils and lack a developed textural subsoil such as those soils have.

Lucien soils are in native pasture. The vegetation consists of tall and mid grasses. A few small areas have been cultivated but have now been seeded to grass.

Lucien-Zaneis-Vernon complex, 5 to 12 percent slopes (LzD).—This complex consists of sloping to strongly sloping soils on dissected, erosional uplands. It is 30 to 60 percent Lucien soils, 10 to 30 percent Zaneis loam, 20 to 50 percent Vernon soils, and 5 to 15 percent rock outcrops. Included in mapping were alluvial soils on valley floors less than 100 feet wide and small areas of Minco loam. The Zaneis soil is similar to the one described for the Zaneis series except that the depth to bedrock in this soil ranges from 20 to 36 inches. The Vernon soil is described under the heading "Vernon Series."

This complex is suitable for use as range and as a wildlife habitat. Small areas have been cultivated but are now reseeded to native grasses. The vegetation consists of tall and mid grasses, such as big and little bluestem and sideoats grama. (Capability unit VIe–6; tree-planting group IV; Loamy Prairie and Red Clay Prairie range sites)

Miller Series

The Miller series consists of deep, level, reddish-brown, calcareous clayey soils that formed in alluvium and have recently deposited material on the surface. These soils are on the flood plains of some of the larger creeks, mainly in the southern part of the county.

The entire profile is calcareous and clayey. The color ranges from red to dark reddish brown. The surface layer is reddish-brown clay and is 10 to 25 inches thick. It is firm when moist and very hard when dry. It either has weak, medium, blocky structure or is massive. The subsoil is massive, reddish-brown clay that is very firm when moist and extremely hard when dry. The underlying material is massive, red clay that is very firm when moist and extremely hard when dry and contains salt crystals. The depth to free carbonates is less than 15 inches.

Miller soils are associated with Lela and Port soils. They are redder than Lela soils and are calcareous at or near the surface.

Miller soils are moderately well drained. They are flooded occasionally, but damaging floods are not frequent. The native vegetation consists of mid and tall grasses, such as big and little bluestem, indiangrass, switchgrass, sideoats grama, and vine-mesquite.

Miller clay (Mc).—This is a moderately productive soil. Most of it is cultivated, and part is in pasture. Alfalfa, small grain, and sorghum are the main crops.

The surface of this soil tends to bake and crust. Good management that includes stubble mulching, minimum tillage, and proper use of crop residue is needed. A few diversion terraces may be needed to control overhead water. (Capability unit IIIs–1; tree-planting group IV; Heavy Bottomland range site)

Minco Series

The Minco series consists of deep, well-drained, reddish-brown soils on foot slopes in the northeastern part of the county.

The texture throughout the profile (fig. 7) is principally loam but ranges from fine sandy loam to silt loam. The surface layer is ordinarily reddish-brown loam, but the color ranges from brown to dark reddish brown. This layer is friable when moist and hard when dry and has moderate, fine to medium, granular structure. The thickness ranges up to 18 inches or more. The reaction is slightly acid or neutral. The subsoil is red to yellowish-red loam and is 60 to 80 or more inches thick. It is friable when moist and slightly hard when dry. Its

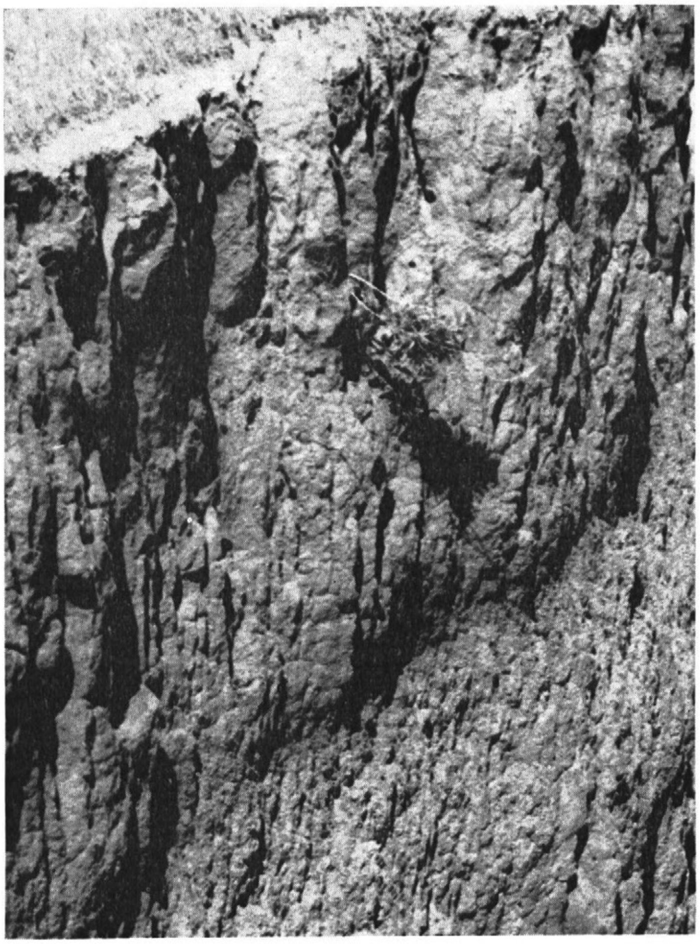

Figure 7.—**Profile of Minco loam.**

structure is weak medium granular to moderate coarse prismatic. The reaction is medium acid. The underlying material is loamy alluvium.

Minco soils are associated with Lucien soils and also with Zaneis soils, which have a developed textural profile.

Minco loam, 3 to 8 percent slopes (MnC).—This soil occurs on foot slopes above flood plains. It has good structure and favorable physical properties, is moderately fertile, is easily tilled, and responds well to management.

Because of the slope, most of the acreage is in native pasture. The vegetation consists of big and little bluestem, switchgrass, and indiangrass. The lesser slopes are in cultivated crops, mainly small grain, cotton, grain sorghum, and alfalfa.

This soil is highly susceptible to water erosion. Terracing, contour farming, and good management of crop residue are needed for control of erosion. (Capability unit IVe-1; tree-planting group III; Loamy Prairie range site)

Port Series

The Port series consists of nearly level, brown to dark reddish-brown soils on flood plains. These soils occur in nearly all parts of the county. They formed in loam and clay loam sediments under deciduous trees and tall grasses.

The surface layer of these soils is either loam or clay loam. Where the texture is loam, the surface layer ranges from 10 to 25 inches in thickness and from brown to reddish brown in color. It has granular structure and is friable when moist and slightly hard when dry. The reaction is slightly acid or neutral. The subsoil in these places is reddish-brown, granular loam. It is friable when moist and slightly hard when dry. The underlying material ranges from loam to light clay loam in texture and from dark brown to yellowish red in color.

Where the texture is clay loam, the surface layer is 14 to 30 inches thick. It is generally dark brown but ranges from reddish brown to dark grayish brown. It is friable or firm and has medium granular structure. The subsoil is reddish-brown clay loam that is firm and is neutral to alkaline in reaction. It ranges from brown through reddish brown to yellowish red in color. The underlying material is calcareous, reddish-brown, massive, firm clay loam. Darkened layers of buried soils at a depth of 36 to 60 inches are common. The depth to free carbonates ranges from 15 to 50 inches.

Port soils are associated with Lela and Miller soils but differ from them in texture. Lela and Miller soils are clay throughout the profile.

Port soils are moderately fertile and have good tilth and structure. Port loam is easier to work and is more permeable than Port clay loam, but its subsoil stores less moisture for plants.

These are among the most productive soils of the county. They are suited to wheat, cotton, alfalfa, forage sorghum, and grain sorghum, to pecan trees, and to tame and native pasture. The tame pasture grasses are mainly blue panicgrass, King Ranch bluestem, and bermudagrass. The native grasses are mainly big and little bluestem, switchgrass, and indiangrass.

Port clay loam (Pc).—This is the most extensive bottom-land soil in the county and one of the most productive. It is suited to all crops grown in the area. Almost all of it is cultivated. Maintaining the supply of plant nutrients is the main management requirement. (Capability unit IIw-2; tree-planting group I; Loamy Bottomland range site)

Port loam (Po).—This is the second most extensive bottom-land soil in the county and also one of the most productive. It is suited to all crops grown in the area. More than half of it is cultivated. The areas in native or tame pasture are productive of forage. Maintaining the supply of plant nutrients is the main management requirement. (Capability unit IIw-2; tree-planting group I; Loamy Bottomland range site)

Port-Slickspots complex (Ps).—This complex consists of Port soils and slickspots. Included in mapping were small areas of Lela and Miller soils. Slickspots make up 10 to 25 percent of the acreage. They occur as clusters that total more than 5 acres in size. Each slickspot is less than 30 feet in diameter.

The surface layer of the slickspots ranges from loam to clay loam in texture, is 2 to 20 inches thick, and has a crust that is 1/8 to 1 inch thick and is glazed and whitish when dry. In many areas, most or all of the surface layer has been removed through erosion. The boundary between this layer and the subsoil is abrupt. The subsoil consists of weak blocky to massive clay to clay loam. The color of the surface layer and subsoil ranges from grayish brown to reddish brown. The substratum consists of earths that vary in color and range from sandy loam to clay in texture. The reaction in all horizons ranges from neutral to moderately alkaline. The calcareous material occurs anywhere from the surface down to a depth of 30 inches.

This complex is subject to flooding. Where floods are frequent, scour channels have formed. These channels are generally intermittent and have only sparse vegetation. Floodwater stands for only a short time and seldom damages native grasses.

Most of this complex is in native pasture. It is not suitable for cultivation. The vegetation on Port soils consists of tall grasses, such as big and little bluestem, indiangrass, and switchgrass. The vegetation on the slickspots consists of mid and short grasses, such as alkali sacaton, white triodia, saltgrass, and buffalograss, and in some areas of encroaching French tamarisk (saltcedar) and mesquite. Some slickspots are barren, or nearly so. (Capability unit Vs-1; tree-planting group IV; Loamy Bottomland and Alkali Bottomland range sites)

Rock Land

Rock land (Ro) is 35 to 90 percent Granite outcrop and 10 to 50 percent gently sloping to moderately steep soils that are very shallow over granite bedrock. Included in mapping were deeper soils, which make up 10 to 12 percent of the acreage of this land type.

Rock land is associated with Granite outcrop and Stony rock land. It has a smaller percentage of rock outcrops than Granite outcrop and a smaller percentage of deep stony soils than Stony rock land.

Rock land is suitable for use as range and as a wildlife habitat. The vegetation is a sparse cover of short and mid grasses. Control of grazing and protection from fire are the main management requirements. (Capability unit VIIs-5; tree-planting group IV; Hilly Stony range site)

Slickspots

The land type Slickspots (Sc) is 40 to 90 percent slickspots and 10 to 60 percent nearly level and gently sloping, loamy to clayey soils. It occurs on old terraces. A slight degree of gilgai microrelief is typical. Included in mapping were small areas of Port-Slickspots complex and Foard-Slickspots complex.

The slickspots have a crusty surface that is glazed and whitish when dry. They are similar to the slickspots in Foard-Slickspots complex, Port-Slickspots complex, and Zaneis-Slickspots complex. The soils in this land type vary; it is difficult to find any two profiles alike.

This land type is not suitable for cultivation. The severely affected areas are barren of vegetation. The less seriously affected areas have a cover of mid grasses and mesquite trees. Pastures have low carrying capacity. Management should include control of grazing and protection from fire. (Capability unit VIs-2; tree-planting group IV; Slickspots range site)

Stamford Series

The Stamford series consists of reddish-brown, calcareous, clayey soils on very gently sloping plains. A slight degree of gilgai microrelief is typical. These soils developed from calcareous red clays.

The surface layer is friable clay and is 5 to 15 inches thick. The color is ordinarily reddish brown but ranges to dark reddish brown or brown. All of these colors typically appear in pockets, bands, or layers that occur throughout the surface layer and to a depth of as much as 3 feet. The surface layer has strong, medium, granular structure. It is calcareous and is moderately alkaline in reaction. The subsoil is reddish-brown, calcareous firm silty clay. It has weak to moderate, medium to fine, blocky structure and is extremely hard when dry. Tongues of subsoil extend to a depth of 40 inches or more. The underlying material is calcareous, massive clay. Free lime occurs at the surface and throughout the profile.

Stamford soi's are associated with Vernon and Port soils. They differ from Vernon soils in being more than 30 inches deep to a substratum of compact red clay that has not been modified by the shrinking and swelling caused by changes in moisture content.

Stamford soils are well drained and moderately fertile. They have very slow permeability and release moisture to plants rather slowly.

Stamford clay, 1 to 3 percent slopes (SmA).—This soil occupies colluvial slopes below areas of Vernon soils, mostly in the southern part of the county. Included in mapping were small areas of gently sloping Vernon soils.

Most of this soil is cultivated. Small grain is the main crop, and some alfalfa is grown in favorable years. The native vegetation consists mainly of short and mid grasses and partly of tall grasses and mesquite trees. Maintaining the supply of plant nutrients and preserving favorable soil structure are the main management requirements. (Capability unit IIIe-1; tree-planting group IV; Red Clay Prairie range site)

Stony Rock Land

Stony rock land (St) is hilly to very steep (fig. 8). It is 15 to 50 percent Granite outcrop, 10 to 30 percent very shallow soils over granite, and 15 to 70 percent deep stony soils. The slope range is 15 to 50 percent.

Stony rock land is associated with the mapping units Granite outcrop and Rock land. It has a smaller percentage of outcrops than Granite outcrop and a larger percentage of deep stony soils than Rock land.

This land type is used as range and as a wildlife habitat. The vegetation is a sparse cover of short and mid grasses on the very shallow soils and tall grasses and scrub oak on the deep stony soils. Control of grazing and protection from fire are the main management requirements. (Capability unit VIIs-6; tree-planting group IV; Hilly Stony and Hilly Stony Savannah range sites)

Tarrant Series

The Tarrant series consists of gently sloping to steep, loamy soils that are very shallow over limestone. These soils are on uplands in the northwestern part of the county.

The surface layer is grayish-brown to very dark grayish-brown silt loam to silty clay loam. It is ordinarily 5 to 8 inches in thickness but ranges from 3 to 12 inches. This layer is friable, has moderate, medium, granular structure, and is soft when dry. It is calcareous and contains many fragments of limestone. The underlying material is bedrock.

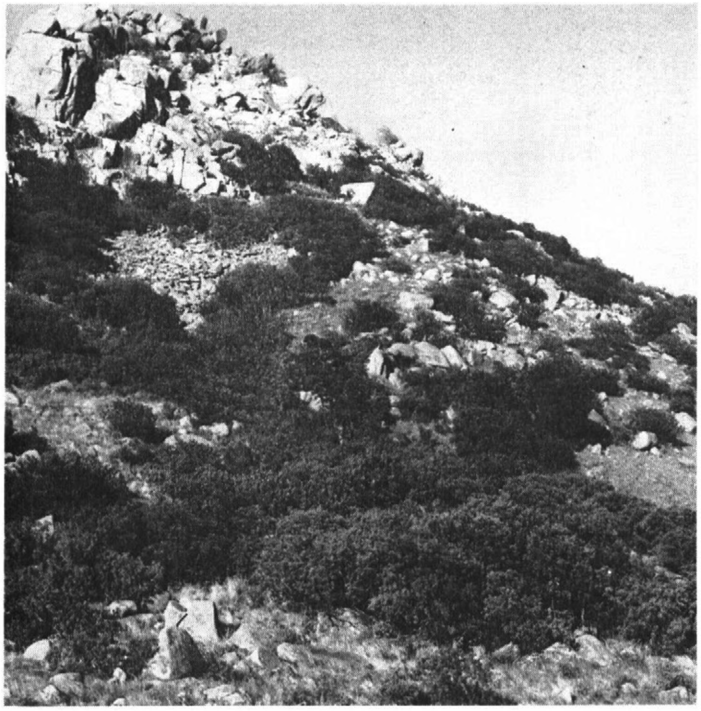

Figure 8.—**Area of Stony rock land.**

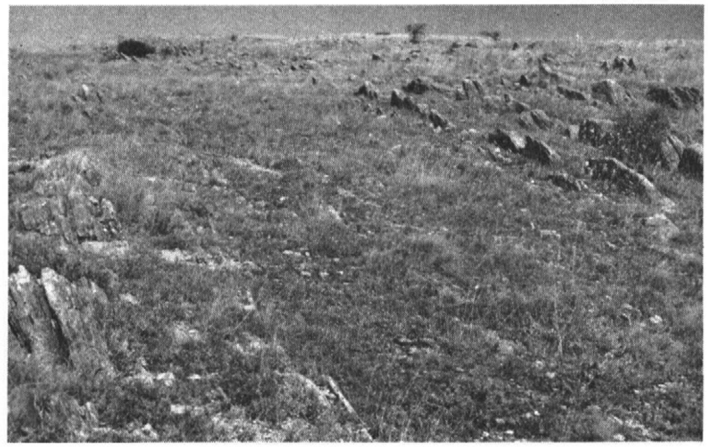

Figure 9.—**Limestone outcrops in Tarrant-Rock outcrop complex. The area shown is the Edgerock range site.**

Tarrant soils are excessively drained and are moderately permeable as far down as bedrock. They are not suitable for cultivation and are used for native pasture. The vegetation consists of short and mid grasses.

Tarrant-Rock outcrop complex (Ta).—This complex consists of Tarrant soils and limestone outcrops. The slope range is 3 to 25 percent. The tilted ledges of limestone (fig. 9) protrude as much as 2 feet above the surface and occupy about 40 percent of the total area. Films of fine earth extend to a considerable depth, probably several feet, along the tilted bedding planes and joints.

This complex is suitable for use only as range and as a wildlife habitat. The vegetation consists of short and mid grasses and furnishes limited grazing. Management should include fire protection, control of grazing, and reseeding of grazed-out areas. (Capability unit VIIs–2; tree-planting group IV; Edgerock range site)

Tillman Series

The Tillman series consists of deep, very gently sloping and gently sloping, reddish-brown soils on uplands. These soils are calcareous below a depth of 13 inches.

The surface layer is brown to dark reddish-brown friable clay loam and is 5 to 10 inches thick. It has fine granular structure. In most places, this layer is underlain by 2 to 8 inches of reddish-brown clay loam that has moderate, fine, granular structure and grades to weak, fine, blocky structure with increasing depth. The subsoil is compact and blocky. The texture is either light clay or silty clay. The color is ordinarily reddish brown but ranges to dark reddish brown. This layer is very firm when moist and extremely hard when dry. The underlying material is yellowish-red, highly calcareous, massive clay.

Tillman soils are associated with Foard, Waurika, Vernon, Stamford, Zaneis, and Lawton soils. They are more reddish than Foard soils and have a transition zone between the surface layer and the subsoil. They are deeper over the undeveloped red-bed clays than Vernon soils, and they have a well-differentiated subsoil, which Vernon soils lack. Their surface layer is less loamy than that of Zaneis and Lawton soils and their subsoil is more clayey.

Tillman soils are somewhat excessively drained and have very slow permeability. They are used to some extent for cotton and sorghum but are better suited to cool-season crops, such as small grain. Some areas are in native pasture of short and mid grasses, such as buffalograss, blue grama, sideoats grama, and little bluestem.

Tillman clay loam, 3 to 5 percent slopes (TmC).—This soil is mainly in the southern part of the county. Included in mapping were Vernon soils, a few scattered slickspots, and small areas of soils that are similar to Tillman soils but are calcareous above a depth of 12 inches.

Most of this soil is in native pasture, and part of it is cultivated to small grain, sorghum, and cotton. Droughtiness and erosion are the major limitations. Terracing and crop-residue management are needed to reduce the risk of erosion and to conserve moisture. Crops respond to fertilizer if the moisture supply is adequate. (Capability unit IVe–2; tree-planting group III; Hardland range site)

Vanoss Series

The Vanoss series consists of nearly level and very gently sloping, brown to dark-brown, loamy soils on uplands. These soils developed under tall bunchgrass. They are 5 to 7 feet thick and are underlain by silty or sandy red beds. They occur in the northeastern part of the county.

The surface layer ranges from 8 to 18 inches in thickness. It has moderate granular structure and is friable when moist. It is neutral in reaction. The subsoil is friable to firm clay loam. It is brown to yellowish brown in color, has granular or prismatic structure, and is medium acid in reaction. The underlying material consists of old alluvial sediments that range from heavy fine sandy loam to clay loam in texture. The alluvium is underlain by red beds.

Vanoss soils are associated with Zaneis and Cobb soils. They have a thicker and darker colored surface layer and a less reddish subsoil than Zaneis soils. They differ from Cobb soils in having a loam surface layer and a clay loam subsoil.

Vanoss soils are among the most productive in the county. They absorb water readily, have moderate water-holding capacity, and are easy to work. They are susceptible to wind erosion only when the surface is not protected with crop residue.

The native vegetation consists of tall grasses, such as big and little bluestem, indiangrass, and switchgrass.

Vanoss loam, 0 to 1 percent slopes (VaA).—This is a well-drained soil on the broader ridgetops.

This soil has good structure and favorable physical properties, is moderately fertile, and responds to management. It is one of the more drought-resistant of the upland soils. Erosion generally is easily controlled.

Most of the acreage is cultivated. Wheat, oats, sorghum, cotton, and peanuts are the main crops. A small acreage is in native pasture. (Capability unit I–1; tree-planting group I; Loamy Prairie range site)

Vanoss loam, 1 to 3 percent slopes (VaB).—This is a well-drained soil on the broader ridgetops. It lies above the more reddish, sloping Zaneis soils, which extend towards the drainageways. Its surface layer is 2 to 4 inches thinner than that of Vanoss loam, 0 to 1 percent slopes. Included in mapping were small areas of Cobb and Zaneis soils.

Most of this soil is used for cultivated crops, such as wheat, oats, sorghum, and cotton. A small acreage is used for native pasture. (Capability unit IIe–1; tree-planting group I; Loamy Prairie range site)

Vernon Series

The Vernon series consists of shallow, reddish, calcareous soils. These soils developed in red, calcareous Permian clays that are compact and nearly impervious. They occur mostly in the southern part of the county.

The surface layer is red to dark reddish-brown, friable clay to clay loam and is 2 to 8 inches thick. It has strong, fine, granular structure. This layer is calcareous. The subsoil is red, very firm clay. It either has medium, fine, blocky structure or is massive. It is extremely hard when dry. This layer is calcareous and contains many small lime concretions. Red, calcareous, massive clay is at a depth of 5 to 20 inches. These soils are moderately alkaline. Free lime generally occurs in the surface layer and throughout the profile.

Vernon soils are associated with Foard, Tillman, Stamford, Zaneis, and Lucien soils. They are more clayey than Lucien soils and are more shallow over the nearly impervious substratum of raw clay than Stamford soils.

Except for some small areas on lesser slopes, these soils are used for native pasture. The native cover consists of short and mid grasses, such as buffalograss, blue grama, hairy grama, sideoats grama, and little bluestem.

Vernon soils, 3 to 5 percent slopes (VeC).—These soils are on erosional uplands, mostly in the southern part of the county. Their surface layer is calcareous, granular clay to clay loam 4 to 12 inches thick. The depth to the substratum is 9 to 20 inches. In areas mapped near the Wichita Mountains, these soils have a loamy mantle, but in some areas most of this has been removed by erosion. Included in mapping were spots of Stamford clay.

These soils are used for cultivated crops and for range. They are better suited to range than to crops. Cultivated areas are in small grain, mainly wheat. Water erosion is a serious hazard. Terraces and the use of crop residue are most important in controlling erosion and conserving moisture. (Capability unit IVe–2; tree-planting group IV; Red Clay Prairie range site)

Vernon soils, 5 to 12 percent slopes (VeD).—These soils are on erosional uplands, mostly in the southern part of the county. In places the gradient is as much as 15 percent. The surface layer is 2 to 8 inches thick, and the depth to the substratum is 5 to 20 inches. Included in mapping were small areas of Lucien soils, small areas that have a gravelly or rocky surface layer, and small eroded areas.

These soils will erode unless well managed. Nearly all of the acreage is in native range. (Capability unit VIe–5; tree-planting group IV; Red Clay Prairie range site)

Waurika Series

The Waurika series consists of nearly level to concave, dark-colored soils on uplands. These soils developed from Permian clays. They occur in the southeastern part of the county (fig. 10).

The surface layer is friable silt loam 10 to 16 inches thick. The upper part is grayish brown and has weak, medium, granular structure. The lower 2 to 4 inches is light brownish gray. This layer is slightly acid or neutral. An abrupt boundary separates the surface layer and the subsoil. The subsoil is a claypan. It is brown, very firm clay having fine to medium blocky structure. It is neutral to moderately alkaline. The underlying material is mottled, reddish-yellow and yellowish-brown, massive clay loam. It is mildly or moderately alkaline. The depth to free lime ranges from 24 to 48 inches.

Waurika soils are associated with Foard and Vanoss soils. They differ from Foard soils in having a distinct whitish or gray layer that rests abruptly on the compact claypan subsoil.

Waurika soils are moderately well drained and have very slow permeability. Some spots may be wet for long periods after heavy rains; water is held in shallow, circular depressions until it evaporates.

Waurika soils are somewhat droughty and are only moderately productive. They tend to crust. Controlling erosion is not a problem. Small grain, grain sorghum, and cotton are the main crops. Some areas are in native pasture consisting of buffalograss, sideoats grama, and blue grama.

Waurika silt loam (Wa).—This soil is on slightly concave flats in the southeastern part of the county. Most of it is cultivated to small grain, grain sorghum, and cotton. Maintaining the supply of plant nutrients, preserving the soil structure, increasing the water intake, and preventing surface crusting are the main management requirements. Crops respond to fertilizer if the moisture supply is adequate. (Capability unit IIs–1; tree-planting group III; Hardland range site)

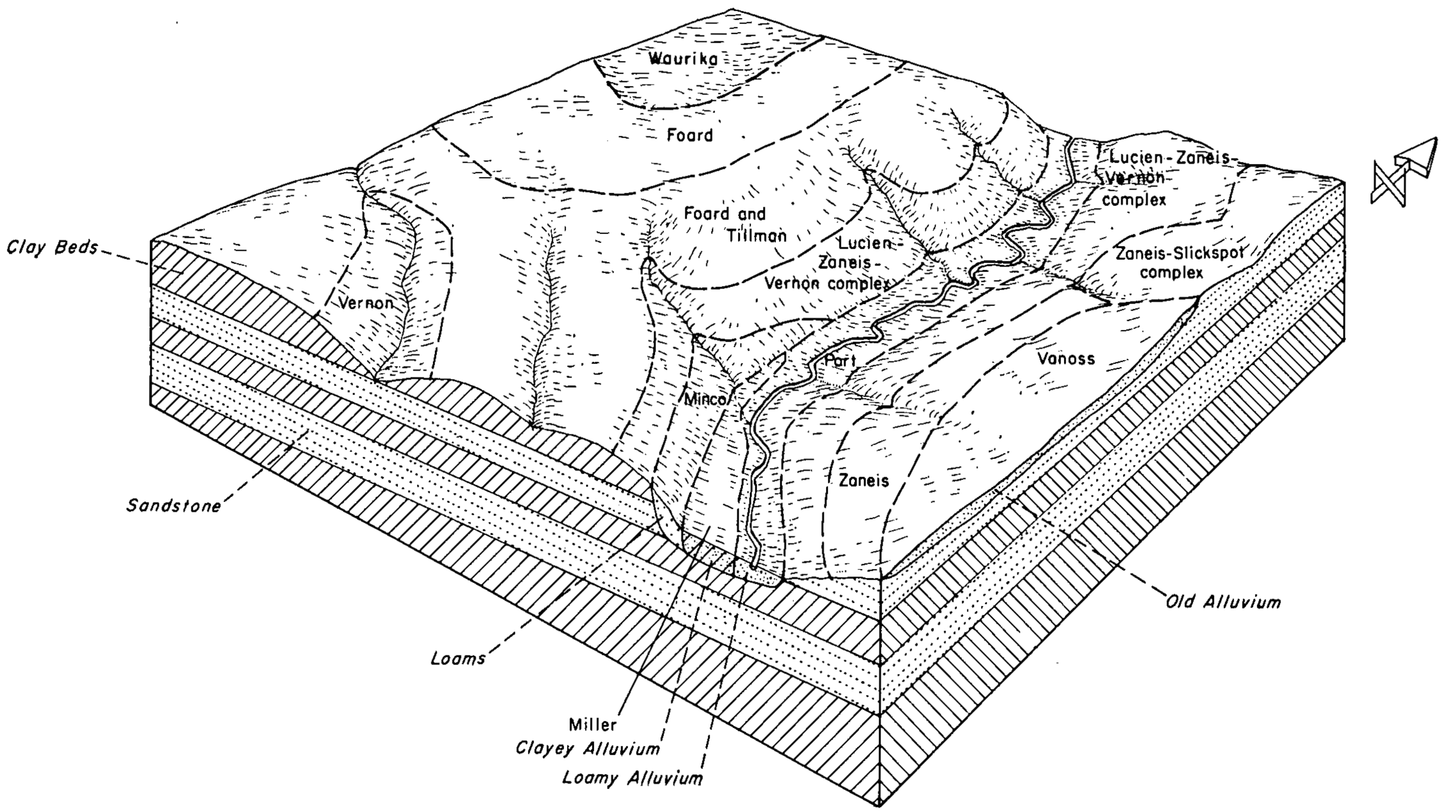

Figure 10.—**Topography and underlying material of Waurika soils and other extensive soils in southeastern part of county.**

Wet Alluvial Land

Wet alluvial land (We) consists of light-colored, poorly drained, alluvial soils on narrow flood plains along streams that have little or no channel. These soils are level to undulating and are concave in some areas. They are in the northeastern part of the county. The water table is a few inches to 2 feet below the surface.

The surface layer ranges from loamy sand to loam in texture and from dark brown to grayish brown in color. The subsoil ranges from loam to sand in texture and from brown to pale brown in color.

These soils are suitable for use as range and pasture and as a habitat for wildlife. Open areas provide abundant grazing. The native vegetation consists of willow, cottonwood, and elm trees, of shrubs, and of tall grasses, such as big and little bluestem, switchgrass, indiangrass, and bermudagrass. Timbered areas have low value for grazing. The trees should be thinned to allow the grasses to increase. (Capability unit Vw–2; tree-planting group IV; Subirrigated range site)

Windthorst Series

The Windthorst series consists of moderately deep, very gently sloping and gently sloping soils. These soils developed in thin deposits of noncalcareous, granitic outwash over Permian red beds. They occur in the southwestern part of the county on uplands along streams that flow from the Wichita Mountains (fig. 11).

The surface layer is friable sandy loam and is 6 to 14 inches thick. The upper part is grayish brown and has weak, medium, granular structure. The lower 2 to 5 inches is very pale brown. The boundary between the surface layer and the subsoil is abrupt. The subsoil ranges from reddish brown to yellowish red in color and from heavy sandy clay loam through sandy clay to light clay in texture. Below a depth of 21 inches it has red to gray mottles. This layer is very firm and has moderate, medium and coarse, blocky structure. The underlying material is noncalcareous, granitic outwash over mottled, reddish-brown to grayish-brown, massive clay. The solum is generally medium acid to neutral, and the substratum is generally neutral to calcareous. The depth to the Permian red beds is 2 to 4 feet.

Windthorst soils are associated with Lawton and Konawa soils. They have a more clayey subsoil than Konawa soils and are shallower over the red beds.

Windthorst soils are well drained and have slow to very slow permeability. They are susceptible to both wind erosion and water erosion and are only slightly or moderately productive.

Windthorst sandy loam, 1 to 3 percent slopes (WhB).—This soil is highly susceptible to wind erosion and water erosion. Terracing, contour farming, and the use of cover crops and crop residue are needed for control of erosion and conservation of moisture. Most of the acreage is in native pasture made up of tall grasses under an open canopy of scrub post oak and blackjack oak. (Capability unit IIIe–6; tree-planting group III; Sandy Savannah range site)

Windthorst sandy loam, 3 to 5 percent slopes (WhC).—This soil is closely associated with Windthorst sandy loam,

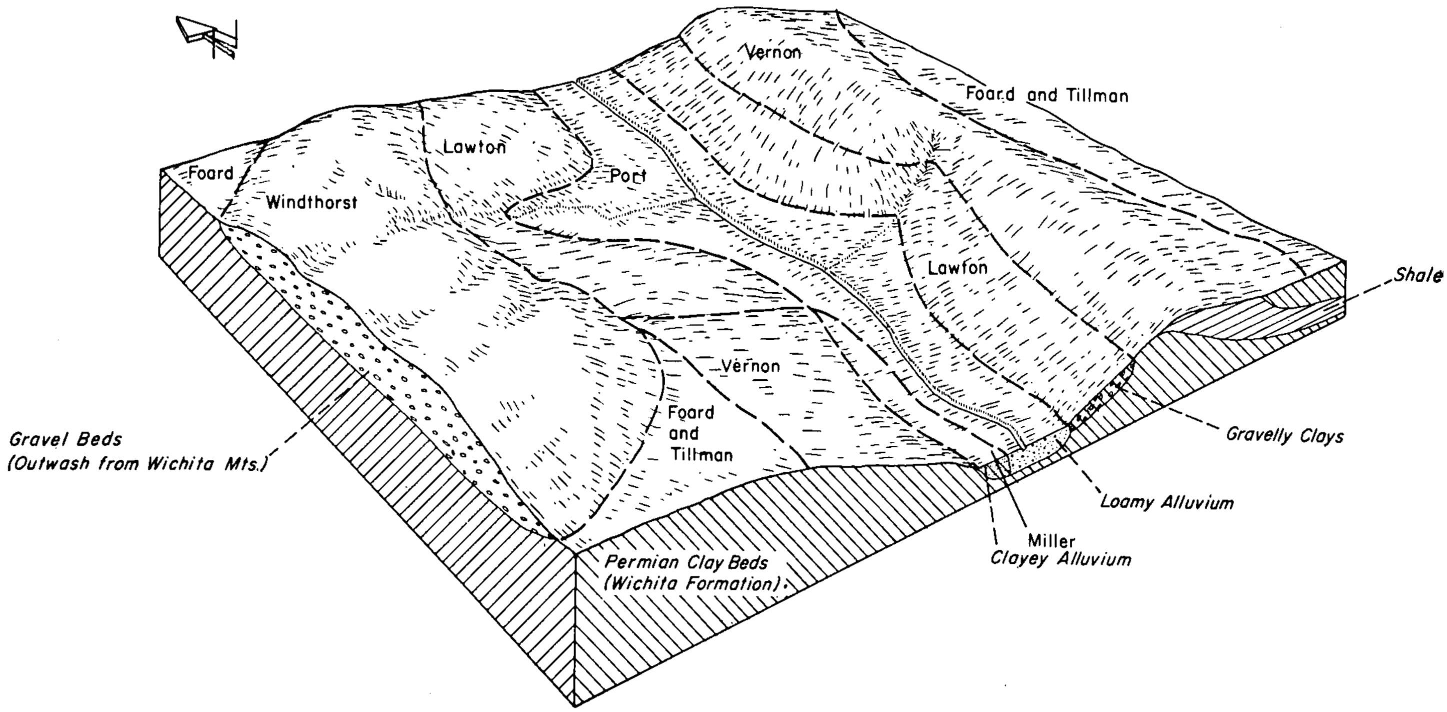

Figure 11.—**Topography and underlying material of Windthorst soils and other extensive soils in southwestern part of county.**

1 to 3 percent slopes, and, like it, is highly susceptible to wind erosion and water erosion.

Terracing, contour farming, and the use of cover crops and crop residue are needed for control of erosion and conservation of moisture. Three-fourths or more of the acreage is uncleared forest pasture that affords only sparse grazing. The vegetation consists of tall grasses and an open canopy of scrub post oak and blackjack oak. Most of the cultivated areas have been returned to grass, but some small areas are in small grain, grain sorghum, and cotton. (Capability unit IIIe–6; tree-planting group III; Sandy Savannah range site)

Zaneis Series

The Zaneis series consists of very gently sloping and gently sloping, loamy soils that are moderately deep, reddish brown, and noncalcareous. These soils developed in material weathered from noncalcareous or weakly calcareous Permian red beds. They are on uplands in the eastern part of the county.

The surface layer is brown to reddish brown, friable loam and is 5 to 12 inches thick. It has weak, medium, granular structure. It is slightly acid or neutral. This layer grades to reddish-brown, firm, blocky light clay loam at a depth of 6 to 12 inches. The subsoil ranges from heavy clay loam to light clay in texture and from red to reddish brown in color. It is firm and has moderate, medium, blocky structure. It is slightly acid to mildly alkaline in reaction. The underlying material is red or red and gray shaly silty clay loam that is mildly or moderately alkaline. Permian red beds occur at a depth of 24 to 50 inches or more. Free lime is generally at a depth of 24 to 50 inches.

Zaneis soils are associated with Vanoss, Cobb, Foard, Tillman, Vernon, and Lucien soils. They are redder and shallower than Vanoss soils. They are less sandy in the surface layer and more clayey in the subsoil than Cobb soils. They lack the subsoil of compact blocky clay that is characteristic of both the Foard and Tillman soils, and they are deeper and less clayey than Vernon soils.

Zaneis soils are among the most productive in the county. They absorb water readily, are easy to work, and have a moderate capacity to hold water that plants can use. Permeability is slow. The sloping areas are subject to runoff and erosion. Gullies form easily because the subsoil erodes readily.

Many of the eroded areas have been seeded to native grasses, and others have been terraced and are now farmed on the contour. The native pastures contain many undesirable grasses and weeds and produce only fair amounts of forage. The native grasses are big and little bluestem, switchgrass, and indiangrass.

Zaneis loam, 1 to 3 percent slopes (ZaB).—Included with this soil in mapping were small areas of Vanoss and Tillman soils, a few rock outcrops, and a few isolated slickspots. This soil is moderately susceptible to water erosion. Most of it is cultivated, but part of it is used as pasture. Stubble mulching, terracing, and contour farming help to control erosion and conserve moisture. Small grain, grain sorghum, and cotton are the main crops. All crops respond to fertilization and good management. (Capability unit IIe–1; tree-planting group III; Loamy Prairie range site)

Zaneis loam, 3 to 5 percent slopes (ZaC).—Included with this soil in mapping were small areas of Lucien and Vernon soils and a few rock outcrops. This soil is highly susceptible to water erosion. Most of the acreage is in native pasture consisting of mid and tall grasses. Cultivated areas are mostly in small grain and grain sorghum.

Protecting this soil from erosion and conserving moisture are the main management requirements. Terracing and contour cultivating are advisable. Crop residue is needed to keep the soil porous, so that water will soak in readily. (Capability unit IIIe-2; tree-planting group III; Loamy Prairie range site)

Zaneis loam, 3 to 5 percent slopes, eroded (ZaC2).—This soil has a thinner surface layer than Zaneis loam, 3 to 5 percent slopes. In most places the surface layer is less than 5 inches thick. There are patches in which the plow layer consists wholly of the original surface layer and others in which it consists wholly of subsoil material. Small rills and shallow gullies occur in places.

This soil responds to good management and fertilization. All of it is cultivated or has been cultivated to such crops as small grain, cotton, and sorghum. Intensive conservation measures, mainly terracing and contour tillage, are needed to reduce erosion. Good stands of tall grasses have been obtained in areas that have been reseeded to native grass. (Capability unit IIIe-7; tree-planting group III; Loamy Prairie range site)

Zaneis-Slickspots complex, 1 to 3 percent slopes (ZsB).—This complex is 30 to 50 percent Zaneis loam, 10 to 50 percent slickspots, and 10 to 50 percent intermediate soils. It is in the eastern part of the county. Included in mapping were small areas of Vernon, Foard, and Tillman soils and a few minor spots of rock outcrops.

The surface layer of the slickspots is loam to clay loam, is 2 to 10 inches thick, and has a crust that is ⅛ to 1 inch thick and is glazed and whitish when dry. This layer rests abruptly on a subsoil of dense, massive clay. The colors of the surface layer and subsoil range from grayish brown to reddish brown. The reaction in both layers is mildly alkaline or moderately alkaline. The depth to calcareous material ranges from 10 to 30 inches.

The surface layer of the intermediate soils is loam to clay loam and is 10 to 18 inches thick. The subsoil ranges from clay loam to clay in texture. Adjacent to the slickspots it is generally massive clay. Adjacent to Zaneis loam it is generally blocky clay loam. The colors of the surface layer and subsoil range from grayish brown to reddish brown. The reaction is slightly acid to mildy alkaline in the surface layer and neutral to moderately alkaline in the subsoil.

This complex is difficult to till, and plant emergence is retarded because the surface tends to crust and moisture is not readily available. Erosion is a serious limitation.

This complex is used for cultivated crops, mainly small grain, sorghum, and cotton, and for pasture. Many areas are returned to grass each year. The native vegetation on Zaneis loam consists of tall and mid grasses, and that on the slickspots of short grasses. Some slickspots are barren.

Constructing diversion terraces, establishing perennial vegetation in drainageways, using a cropping system that consists largely of close-growing plants, and using stubble-mulch tillage are some of the practices needed to conserve moisture and to help control erosion. (Capability unit IVs-1; tree-planting group IV; Loamy Prairie and Slickspots range sites)

Zavala Series

The Zavala series consists of dark-colored, nearly level, loamy soils on the flood plains of the Little Washita River, in the northeastern part of the county. These soils formed in sediments of fine sandy loam texture, under deciduous trees and tall grasses. They are neutral or mildly alkaline, but noncalcareous.

The surface layer is brown to dark grayish-brown, very friable fine sandy loam. It is stratified with slightly coarser textured and slightly finer textured layers. This layer is structureless and is 12 to 24 inches thick. The subsoil is brown to dark-brown, very friable, soft fine sandy loam that has moderate, fine, granular structure. It is stratified with darker colored and less sandy layers.

Zavala soils are associated with Konawa, Eufaula, and Cobb soils, all of which are on uplands.

Zavala soils are fertile, have good tilth and structure, and are among the most productive soils of the county. They are suited to small grain, cotton, and alfalfa, to pecan trees, and to tame and native pasture. The native grasses are big and little bluestem, switchgrass, and indiangrass.

Zavala fine sandy loam (Zv).—Included with this soil in mapping were areas, as much as 1 acre in size, that have an overwash of loamy fine sand and fine sand up to 18 inches thick.

This soil is highly productive, and most of it is cultivated. It is suited to all crops commonly grown and is used mainly for small grain, cotton, and alfalfa. Maintaining the supply of plant nutrients is the main management requirement. (Capability unit IIw-1; tree-planting group I; Loamy Bottomland range site)

Use and Management of the Soils

The soils of Comanche County are used mainly for dryland crops and for pasture or range. This section describes how the soils can be managed for these purposes, and also for trees, wildlife habitats, and engineering structures, including highways. It also gives predicted yields of the principal crops.

Management of Cultivated Soils [1]

Current management problems indicate the kind of conservation practices needed in Comanche County. Wind erosion and water erosion must be controlled. Poor distribution of rainfall must be offset by moisture conservation practices. Preserving and improving tilth is a serious problem, for the supply of organic matter has declined to a low level. Surface crusting and problems resulting from excessive tillage are common. Minor problems include a high water table in places, wind erosion of sandy soils in the northeastern part of the county, saline-alkali areas, overgrazing of plant residue that is needed for soil management purposes, and overflow of bottom lands along the major streams.

Among the measures that would be effective in helping to control erosion and in managing all cultivated soils in Comanche County are soil-conserving cropping systems,

[1] Prepared by M. D. Gamble, conservation agronomist, Soil Conservation Service.

minimum tillage, cover crops, stripcropping, terracing, contour farming, inclusion of grass and legumes in long rotations, grassed waterways, stubble mulching, and fertilization.

Soil-conserving cropping system

A soil-conserving cropping system is one that helps to protect cropland from erosion, preserves or improves soil tilth and soil structure, and controls weeds, insects, and plant diseases. Fertility declines if the cropping system used year after year lacks soil-conserving crops, such as sweetclover, alfalfa, Austrian Winter peas, or hairy vetch. The kind of soil-conserving crop to be grown varies with the soil and the farming enterprise. Alfalfa is generally beneficial, particularly if the last cutting is returned to the soil. Low rainfall and poor distribution of rainfall are adverse factors to be considered in the production of legumes.

Low-residue, or soil-depleting, crops leave less than 2,000 pounds of air-dry residue per acre annually. High-residue, or soil-conserving, crops leave more than 2,000 pounds of air-dry residue per acre annually. If legumes are properly managed, a minimum of 12 inches top growth is returned to the soil during the life of the stand. Under certain conditions, small grain or other nonlegumes can be used as soil-conserving crops. To utilize small grain for soil improvement, it is generally necessary to apply nitrogen fertilizer, which speeds decomposition of the straw left on the surface.

Minimum tillage

Tillage breaks down soil structure. If excessive, it forces the soil particles together and reduces air space. The surface of the soil is then likely to puddle and crust; as a consequence, less water and air are taken into the soil and less moisture is available for plants.

Tilling repeatedly to the same depth is likely to result in the formation of a plowpan. This layer of compacted soil just below plow depth interferes with aeration, reduces the moisture-storage capacity, and restricts normal growth of roots. Plants can use only the moisture and nutrients above the pan, or to the depth of normal tillage. The Cobb, Foard, Konawa, Lawton, Minco, and Vanoss soils are most likely to develop a plowpan. To reduce the risk of formation of a plowpan, it is advisable to vary the depth of tillage.

Stubble mulching

Stubble mulching is a method of keeping protective amounts of residue on the surface of the soil from harvest-time until the next crop has made sufficient growth to protect the soil against wind erosion. It usually requires the use of sweeps, rod weeders, or blades that undercut the soil and leave most of the crop residue on the surface. Seeding equipment must be capable of drilling through the trashy cover. Wind erosion is a major problem on the Cobb, Eufaula, Konawa, Minco, and Vanoss soils.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

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

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

- Class I. Soils have few limitations that restrict their use.
- Class II. Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Class III. Soils have severe limitations that reduce the choice of plants, or require special conservation practices, or both.
- Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.
- 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 food and cover.
- Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production 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 subclasses indicated by *w*, *s*, and *c*, because the soils in it 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–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages each of the capability units in Comanche County is described, and suggestions for use and management are given.

Capability unit I–1

This unit consists of a deep, well-drained, loamy soil on uplands. This soil is fertile, is easily worked, and is well suited to most crops commonly grown in the county. Small grain, peanuts, cotton, and sorghum are the main crops.

Preserving the soil structure and maintaining fertility are the main management problems. Terraces are needed in a few places on long slopes where water is likely to concentrate.

A suitable cropping system keeps soil-conserving crops on the soil at least one-fourth of the time and does not allow growing of soil-depleting crops for more than 6 years in succession.

This soil is suited to any of the tame grasses commonly grown. The native vegetation consists of big and little bluestem, indiangrass, and switchgrass.

Capability unit IIe–1

This unit consists of deep to moderately deep, nearly level and very gently sloping, loamy soils on uplands. These soils are slowly to moderately permeable. They are productive, are easily farmed, and are well suited to most crops commonly grown in the county. Small grain, cotton, alfalfa, and sorghum are the main crops.

Preserving the soil structure, maintaining fertility, and controlling water erosion are the most important management problems. A complete system of field terraces is needed; diversion terraces are needed in a few places. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soils at least half the time and does not allow growing of low-residue, or soil-depleting, crops for more than 3 years in succession.

These soils are suited to the tame grasses commonly grown and to mid and tall native grasses.

Capability unit IIe–2

This unit consists of a moderately deep, very gently sloping and gently sloping fine sandy loam on uplands. The subsoil is sandy clay loam. This soil absorbs water readily. Small grain, cotton, sorghum, and peanuts are the main crops.

Preserving the soil structure, maintaining fertility, and controlling wind and water erosion are the most important management problems. A complete terrace system and contour tillage are advisable. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional. During the windy season, this soil should be protected either by a close-growing crop or by adequate crop residue. If it is used for summer crops, tillage should be delayed in spring until near the end of the windy season. Drainageways should be kept in sod.

A suitable cropping system keeps soil-conserving crops on the soil at least one-fourth of the time and does not allow growing of soil-depleting crops for more than 6 years in succession.

This soil is well suited to mid and tall native grasses and to bermudagrass, lovegrass, and other tame grasses commonly grown.

Capability unit IIs–1

This unit consists of deep, loamy soils on uplands. These soils have a heavy, compact, clayey subsoil that absorbs water very slowly, restricts growth of roots and movement of air, and limits the amount of water available to plants. These soils are difficult to till, because they are hard when dry and sticky when wet. If dry and bare of vegetation, they are susceptible to wind erosion. In places surface drainage is very slow. Small grain, cotton, and sorghum are the main crops.

Increasing the water intake and preserving the soil structure are the main problems. Growing deep-rooted legumes is advisable.

A suitable cropping system provides high-residue, or soil-conserving, crops at least half the time and requires that low-residue, or soil-depleting, crops be grown not more than 3 consecutive years.

Suitable for tame pasture are King Ranch bluestem. Suitable native range plants include sideoats grama, blue grama, buffalograss, big and little bluestem, indiangrass and switchgrass.

Capability unit IIw–1

This unit consists of a deep, well-drained, nearly level fine sandy loam on bottom lands. The subsoil also is fine sandy loam. This soil is fertile, is easily farmed, is suited to all crops commonly grown, and is one of the most productive soils in the county. Small grain, cotton, and alfalfa are the main crops.

Maintaining fertility and preserving the soil structure are the most important management problems. Overflow can be expected occasionally, but it damages crops only slightly. Diversion terraces are needed in a few places for protection against runoff from adjacent areas.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soil at least half the time and does not allow growing of low-residue, or soil-depleting, crops for more than 4 years in succession.

This soil is suited to any of the tame grasses commonly grown and to native tall grasses, such as big and little bluestem, indiangrass, and switchgrass.

Capability unit IIw–2

This unit consists of fertile, deep, well-drained, loamy soils on bottom lands. These soils are easily farmed, are well suited to all crops commonly grown, and are the most productive in the county. Small grain, cotton, alfalfa, and sorghum are the main crops.

Flooding is the major hazard, but damage to crops normally is not serious. Diversion terraces are needed in a few places for protection against runoff from adjacent areas. These soils would be in capability class I if they were protected from flooding. Flood control structures would be effective.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soils half the time and does not allow growing of low-residue, or soil-depleting, crops for more than 4 years in succession.

These soils are suited to any of the tame grasses commonly grown. The native vegetation consists of big and little bluestem, indiangrass, and switchgrass.

Capability unit IIIe-1

This unit consists of deep, very gently sloping, loamy and clayey soils on uplands. These soils have a heavy, compact, clayey subsoil that absorbs water very slowly. Runoff is moderate, and erosion has removed part of the surface layer, particularly in cultivated, poorly managed areas. Tillage is difficult. There are a few slickspots. Small grain and sorghum are the main crops, but some cotton is grown.

Preserving the soil structure, maintaining fertility, controlling runoff, and conserving moisture are the most important management problems. Terraces and contour tillage are needed. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soils at least two-thirds of the time and does not allow growing of low-residue, or soil-depleting, crops for more than 2 years in succession.

King Ranch bluestem is a suitable pasture grass. Suitable native grasses are big and little bluestem, blue grama, hairy grama, sideoats grama, indiangrass, switchgrass, and buffalograss.

Capability unit IIIe-2

This unit consists of deep, gently sloping, loamy soils on uplands. These soils have a clay loam subsoil. They are easily tilled, have good moisture-holding capacity, and are moderately productive if well managed. Small grain, cotton, and sorghum are the main crops.

Controlling runoff and erosion, preserving the soil structure, and maintaining fertility are the most important management problems. These soils are ordinarily terraced and farmed on the contour. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional. Growing legumes helps to maintain the organic-matter content, improves the soil structure, and increases the water intake. Varying the depth of tillage each year delays the formation of a plowpan.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soils at least two-thirds of the time and does not allow growing of low-residue, or soil-depleting, crops for more than 2 years in succession.

These soils are suited to bermudagrass and King Ranch bluestem and to such native grasses as big and little bluestem, indiangrass, switchgrass, and sideoats grama.

Capability unit IIIe-3

This unit consists of a deep, gently sloping fine sandy loam on uplands. The subsoil is sandy clay loam. This soil is moderately fertile and easily tilled. Small grain, cotton, sorghum, and peanuts are the main crops.

Controlling runoff and wind erosion, maintaining fertility, and preserving the soil structure are the most important management problems. Terraces and contour tillage are advisable. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional. During the windy season, this soil should be protected either by a close-growing crop or by adequate crop residue. If it is used for summer crops, tillage should be delayed in spring until near the end of the windy season.

A suitable cropping system keeps soil-conserving crops on this soil at least half the time and does not allow the growing of soil-depleting crops for more than 3 years in succession.

This soil is well suited to bermudagrass and lovegrass and to mid and tall native grasses.

Capability unit IIIe-4

This unit consists of a gently sloping, eroded fine sandy loam on uplands. This soil is moderately fertile and easily tilled. If cultivated and not protected by an adequate vegetative cover, it is subject to wind erosion. In all plowed fields, subsoil material is mixed with the surface layer, and many rills and small gullies are forming on the more sloping areas. Small grain, sorghum, and peanuts are the main crops.

Controlling runoff and wind erosion, maintaining fertility, and preserving the soil structure are the most important management problems. This soil should be terraced and farmed on the contour. During the windy season, it should be protected either by a close-growing crop or by adequate crop residue. If it is used for summer crops, tillage should be delayed in spring until near the end of the windy season.

A suitable cropping system keeps soil-conserving crops on the soil at least three-fourths of the time and does not allow growing of soil-depleting crops for more than 2 years in succession.

This soil is well suited to bermudagrass and lovegrass and to mid and tall native grasses.

Capability unit IIIe-5

This unit consists of a deep loamy fine sand on uplands. The subsoil is sandy clay loam. This soil is loose, friable, and easily tilled. It absorbs water readily. It is subject to moderate or severe wind erosion, particularly early in spring. In unprotected fields it blows and drifts during high winds. The natural fertility is low. Small grain, such as oats or barley, sorghum, cotton, peanuts, and watermelons are the main crops.

Maintaining fertility and controlling erosion are the most important management problems. Perennial vegetation should be established in the natural drains. During the windy season, the soil should be protected either by close-growing crops or by adequate crop residue. Seedbed preparation should be delayed until near planting time.

A suitable cropping system keeps soil-conserving crops on the soil at least half the time and does not allow growing of soil-depleting crops for more than 3 years in succession.

Suitable pasture plants are bermudagrass and lovegrass. Native tall grasses, such as big and little bluestem, sand bluestem, switchgrass, indiangrass, and sand lovegrass are well suited as range plants.

Capability unit IIIe-6

This unit consists of moderately deep sandy loams on uplands. The subsoil is sandy clay. The soil material is loose in the surface layer and tight in the subsoil. These soils are hard to till and are subject to moderate or severe wind and water erosion. They absorb water slowly. Their natural fertility is low. Small grain, sorghum, and cotton are the main crops.

Controlling wind erosion and water erosion and maintaining fertility are the most important management problems. Proper use of crop residue or stubble mulching is important. Terraces and contour tillage are needed to control water erosion. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional.

A suitable cropping system provides soil-conserving crops half the time and requires that soil-depleting crops be grown not more than 3 consecutive years.

Suitable for pasture are bermudagrass, weeping lovegrass, and King Ranch bluestem. Native mid and tall grasses are well suited as range plants.

Capability unit IIIe-7

This unit consists of a moderately deep, loamy soil that is moderately eroded. This soil has considerable runoff; consequently, erosion is a serious hazard. Small grain, cotton, and sorghum are the main crops.

Controlling runoff, maintaining fertility, and preserving the soil structure are the most important management problems. Terraces and contour tillage are advisable.

A suitable conservation cropping system provides soil-conserving crops at least three-fourths of the time and requires that soil depleting crops be grown not more than 2 consecutive years.

Bermudagrass and King Ranch bluestem are suitable pasture grasses. Big and little bluestem, indiangrass, switchgrass, and sideoats grama are suitable native grasses.

Capability unit IIIs-1

This unit consists of deep, clayey soils on bottom lands. These soils have a heavy clayey subsoil that absorbs water very slowly, restricts growth of roots and movement of air, and limits the amount of water available to plants. If these soils are clean tilled, the surface material tends to run together when wet and to form a hard crust when dry. In places surface drainage is very slow. Small grain, sorghum, and cotton are the main crops.

Good management of crop residue increases water intake, reduces surface crusting, conserves soil moisture, and helps to preserve soil structure and to maintain the supply of organic matter and plant nutrients. Leveling improves surface drainage.

A suitable cropping system provides high-residue crops at least half the time and requires that low-residue crops be grown not more than 2 consecutive years.

Suitable pasture grasses are bermudagrass and King Ranch bluestem. The native grasses are mainly little bluestem, indiangrass, blue grama, and buffalograss.

Capability unit IIIs-2

This unit consists of a droughty soil and slickspots. The surface layer is subject to severe crusting, and the heavy, compact subsoil absorbs water very slowly. Small grain is the main crop, but some cotton and sorghum are grown. Yields of small grain are more dependable than yields of the other crops but are good only in years of ample rainfall.

Salinity, droughtiness, slow water intake, surface crusting, and weak soil structure are the main limitations. The use of agricultural gypsum improves soil structure, reduces surface crusting and runoff, and increases water intake.

A suitable cropping system keeps high-residue, or soil-conserving, crops on the soils at least two-thirds of the time and does not allow growing of low-residue, or soil-depleting, crops for more than 2 years in succession.

These soils are suited to King Ranch bluestem and to native tall, mid, and short grasses.

Capability unit IVe-1

This unit consists of a deep, slightly eroded, loamy soil on foot slopes. The subsoil is about the same texture as the surface layer. Small grain, sorghum, and cotton are the main crops, but some alfalfa is grown on the lower slopes.

Preserving the soil structure and controlling water erosion are the most important management problems. This soil should be terraced and farmed on the contour. If low-residue crops are grown, cover cropping and proper use of crop residue are important. If sown crops are grown all the time and are managed so that they produce a large amount of residue, stubble mulching, stripcropping, and contour tillage are essential but terraces are optional.

A suitable cropping system provides soil-conserving crops at least three-fourths of the time and requires that soil-depleting crops be grown not more than 1 year at a time.

This soil is suitable for any of the tame grasses commonly grown in the county. The native vegetation consists of big and little bluestem, indiangrass, and switchgrass.

Capability unit IVe-2

This unit consists of shallow to deep, loamy to clayey soils on uplands. These soils have a heavy clayey subsoil that absorbs water very slowly, restricts growth of roots and movement of air, and limits the amount of water available to plants. They are difficult to till, because they are hard when dry and very sticky when wet. Small grain and forage sorghum are the main crops.

Droughtiness, shallowness, water erosion, and weak soil structure are the main limitations. Terraces are needed to help control water erosion, and proper residue management is essential.

A suitable cropping system provides high-residue, or soil-conserving, crops at least three-fourths of the time and requires that low-residue, or soil-depleting, crops be grown no more than one-fourth of the time.

The native vegetation consists of big and little bluestem, sideoats grama, blue grama, and buffalograss.

Capability unit IVe-3

This unit consists of a droughty soil and many slickspots. The surface layer is subject to severe crusting.

The subsoil is heavy and compact and absorbs water very slowly. Small grain and forage sorghum are the main crops. Yields of small grain are the more dependable.

Salinity, droughtiness, slow water intake, surface crusting, and weak soil structure are the main limitations. If row crops are grown, contour tillage and proper use of crop residue are essential. If sown crops are grown, stubble mulching is essential. Minimum tillage is important, and the depth of tillage should not exceed 4 inches. The use of agricultural gypsum improves soil structure, reduces runoff and surface crusting, and increases water intake.

A suitable cropping system provides high-residue, or soil-conserving, crops at least two-thirds of the time and requires that low-residue, or soil-depleting, crops be grown not more than 2 consecutive years.

These soils are suited to native short and mid grasses.

Capability unit IVe-4

This unit consists of a deep loamy fine sand on uplands. The subsoil is sandy clay loam. This soil is loose, friable, and easily tilled. It absorbs water readily. It is subject to moderate or severe wind erosion, particularly early in spring. In unprotected fields it blows and drifts during high winds. The natural fertility is low. Small grain, sorghum, cotton, peanuts, and watermelons are the main crops.

Wind erosion, water erosion, and low fertility are the main limitations. This soil should be used for sown crops that provide large amounts of residue. Natural drains should be planted to perennial vegetation. Seedbed preparation should be delayed until near planting time.

Suitable pasture plants are bermudagrass and lovegrass. Also suitable are native tall grasses, such as big and little bluestem, sand bluestem, switchgrass, indiangrass, and sand lovegrass.

Capability unit IVe-5

This unit consists of a deep, eroded loamy fine sand on uplands. The subsoil is sandy clay loam. This soil is friable and easily tilled but is susceptible to moderate to severe wind and water erosion. If it lacks cover or is improperly tilled, the hazard of wind erosion increases. In all plowed fields, subsoil material is mixed with the surface layer. Fertility is low. Small grain and sorghum are the main crops.

Controlling wind erosion and water erosion and maintaining fertility are the most important management problems. If cultivated, this soil needs intensive management. It should be planted only to sown crops that provide large amounts of residue. Perennial vegetation should be established in the natural drains. Seedbed preparation should be delayed until near planting time.

Suitable pasture plants are bermudagrass (fig. 12) and lovegrass. Also suitable are such native tall grasses as big and little bluestem, sand bluestem, switchgrass, indiangrass, and sand lovegrass.

Capability unit IVe-6

This unit consists of a deep, moderately sloping, eroded, loamy soil on uplands. This soil is easily tilled, has good moisture-holding capacity, and is moderately productive if well managed. Small grain and sorghum are the main crops.

Figure 12.—Bermudagrass on Konawa loamy fine sand, 3 to 5 percent slopes, eroded.

Controlling water erosion, preserving the soil structure, and maintaining fertility are the most important management problems. This soil should have high-residue, or soil-conserving, crops on it all the time. Also, it should be terraced and farmed on the contour. If sown crops, including biennial and perennial crops, are grown all the time and are managed so that they produce a large amount of residue, stubble mulching is essential but terraces are optional.

This soil is suited to bermudagrass and King Ranch bluestem, and to such native grasses as big and little bluestem, indiangrass, switchgrass, and sideoats grama.

Capability unit IVs-1

This unit consists of slickspots and a deep, droughty, gently sloping, loamy soil. These areas have severe limitations resulting from surface crusting, salt concentrations, and slow water intake. Little moisture is available to plants. Small grain and sorghum are the main crops.

Sown crops, including high-residue crops, should be grown year after year. Stubble-mulch tillage and fertilizer are needed. All tillage should be shallow. Slickspots should be mulched with cotton burs, straw, or hay. Mulching also is important if gypsum is applied.

King Ranch bluestem is a suitable pasture plant. Suitable native grasses are big and little bluestem, switchgrass, indiangrass, alkali sacaton, white tridens, tall dropseed, and blue grama.

Capability unit Vs-1

This unit consists of slickspots and a loamy soil on bottom land. The texture ranges from loam to clay. Most of the slickspots are less than 30 feet in diameter, and many have lost most or all of their thin surface layer through erosion. The substratum consists of earths of various colors and geologic origin and ranges from sandy loam to clay in texture.

Overflow, droughtiness, and salinity are the most serious limitations. Maintaining a surface mulch protects these areas and increases water intake.

Grazing should be regulated to protect the native grasses or tame grasses. If needed, native grasses should be reseeded or bermudagrass should be established.

Capability unit Vw–1

This unit consists of broken slopes and channeled areas on alluvial flood plains.

These areas are loamy and fertile but are of limited agricultural value because they are very steep and are flooded frequently. The native vegetation consists of deciduous forest and, in the open areas, tall grasses.

Grazing should be regulated to protect the native grasses. The less sloping areas should be cleared and seeded to native grasses or to bermudagrass. A few small areas are suitable for gardens.

Capability unit Vw–2

This unit consists of frequently flooded areas of light-colored soils that range from loam to sand in texture. The water table is a few inches to 2 feet below the surface. The vegetation consists of trees, such as willow, cottonwood, and elm, of shrubs, and of tall grasses in open areas. All of the acreage is used as pasture or range. Most of it could be cleared of trees and seeded to grasses. It is well suited to bermudagrass. Yields of forage are good.

Capability unit VIe–1

This unit consists of loamy to clayey soils on broken and moderately steep slopes along upland drainageways and of alluvial soils on narrow bottom lands between the broken slopes.

Nearly all of the acreage is in range; only a small part is cultivated. The native vegetation consists of short and mid grasses on the side slopes and tall grasses and deciduous trees on the bottom lands.

Good management that will protect the grass and prevent erosion is needed. Grazing should be controlled, and barren areas should be reseeded.

Capability unit VIe–2

This unit consists of deep, very gently sloping to sloping, clayey soils on uplands. These soils have been severely eroded by water. In places erosion is still active.

These soils are no longer suitable for cultivation. They should be seeded to native grasses, either in a stubble cover or in a properly prepared seedbed. A suitable grass mixture consists of big bluestem, little bluestem, switchgrass, indiangrass, vine-mesquite, alkali sacaton, sideoats grama, buffalograss, and blue grama. After grass has been established, grazing should be regulated and runoff should be controlled.

Capability unit VIe–3

This unit consists of deep, severely eroded, loamy soils on uplands. In places erosion is still active.

These soils are no longer suitable for cultivation and should be managed as range. They should be seeded to native grasses, either in a stubble cover or in a properly prepared seedbed. A suitable grass mixture consists of big bluestem, little bluestem, indiangrass, switchgrass, sideoats grama, tall dropseed, and Canada wildrye. Grazing should be controlled. Runoff should be controlled by diversions or by some other means.

Capability unit VIe–4

This unit consists of a deep, severely eroded, sandy soil on uplands. Wind erosion and water erosion are still active in many places.

This soil is no longer suitable for cultivation and therefore should be used as range. Either a cover or a mulch should be established, and then native grasses should be seeded. A suitable grass mixture consists of big bluestem, little bluestem, sand bluestem, indiangrass, switchgrass, sand lovegrass, and wildrye. Grazing should be regulated. Runoff should be controlled by diversions or by some other method.

Capability unit VIe–5

This unit consists of shallow, sloping to strongly sloping, loamy to clayey soils on uplands. These soils are droughty and are not suitable for cultivation. They erode readily, and runoff is excessive. If well managed, these soils furnish moderate amounts of grass forage and cover for wildlife. Grazed-out areas should be reseeded to suitable grasses, and grazing should be regulated.

Capability unit VIe–6

This unit consists of deep to shallow, sloping to strongly sloping, loamy to clayey soils on uplands. These soils are so irregular and sloping that they are unsuitable for cultivation. Also, they are susceptible to erosion. If well managed, they produce moderate to large amounts of grass forage and good cover for wildlife. Grazed-out areas should be reseeded to suitable grasses, and grazing should be controlled.

Capability unit VIs–1

This unit consists of a deep, rolling fine sand that is rapidly permeable. This soil is subject to severe wind erosion. It is not suitable for cultivation. The native vegetation is a mixture of blackjack oak and post oak trees, some brush, and tall grasses. If properly managed, this soil would support a thick stand of tall grasses, such as big and little bluestem, indiangrass, switchgrass, and sand lovegrass. Good management includes reseeding grazed-out areas, protecting blowouts with mulches or other protective cover, regulating grazing, and controlling brush and trees.

Capability unit VIs–2

This unit consists mostly of slickspots. Slickspots have a crusted surface that is glazed and whitish when dry. The most severely affected areas are barren of vegetation. The less affected areas have a cover of short and mid grasses and mesquite trees. The entire acreage is unsuitable for cultivation and is unproductive as range. Good management would include controlling grazing, reseeding barren areas, mulching slickspots, and eradicating the mesquite.

Capability unit VIIs–1

This unit consists of deep soils that are 25 to 70 percent granitic cobblestones. There are also a few scattered boulders. These soils occur on rolling to steep, dissected hills and ridges, mainly in the Wichita Mountains. Grazed-out areas should be reseeded to suitable grasses. The range should be managed carefully, so as to allow vigorous growth that will leave enough residue each year to provide a surface mulch.

Capability unit VIIs–2

This unit consists of soils and limestone outcrops on the north side of the Wichita Mountains. The outcrops are tilted on edge, protrude as much as 2 feet above the surface, and occupy about 40 percent of the total area. The soil between the outcrops is silt loam that ranges in depth from 3 to as much as 12 inches over bedrock. Good management would include controlled grazing and protection from fire.

Capability unit VIIs-3

This unit consists of a shallow to very shallow soil that contains limestone cobblestones and overlies limestone conglomerate. Small areas overlie caliche. The acreage occurs in the northwestern part of the county, north of the Wichita Mountains. Good management includes control of grazing and protection from fire.

Capability unit VIIs-4

This unit consists of very shallow, droughty soils over gypsum. Gypsum outcrops cover 15 to 30 percent of the acreage. These soils occur only in the northeastern part of the county. Runoff is rapid, and water intake is very slow. Even if well managed, these soils furnish only small amounts of forage. They need to be managed carefully to allow vigorous growth that will leave a mulch on the surface. Grazed-out areas need to be reseeded to suitable grasses.

Capability unit VIIs-5

This unit consists of granite rock outcrops and very shallow soils over granite bedrock. The outcrops make up 35 to 90 percent of the acreage. These areas occur on gently sloping to moderately steep slopes in the northwestern part of the county. The vegetation consists of a sparse cover of short and mid grasses. Management should include controlled grazing. Even under the best management, these areas produce only small amounts of forage.

Capability unit VIIs-6

This unit consists of granite outcrops, very shallow soils over granite, and deep stony soils. The outcrops make up 15 to 50 percent of the acreage, the very shallow soils over granite make up 10 to 30 percent, and the deep stony soils 15 to 70 percent. These areas occur on hilly to very steep slopes in the Wichita Mountains. The vegetation on the very shallow soils is a sparse cover of short and mid grasses, and that on the deep, stony soils is tall grasses and scrub oak. Good management is needed. Grazing should be regulated so as to allow vigorous growth of both the tops and the roots of grasses. Enough residue should be left each year to mulch the surface and provide cover for wildlife.

Capability unit VIIIs-1

This unit consists of barren, granitic mountain peaks, cliffs, and escarpments and is 90 percent exposed bedrock. It occurs in the northwestern part of the county. There is little or no vegetation. Most of the acreage is inaccessible to livestock and has no agricultural value, but it is scenic and is suitable for recreation and watershed projects.

Predicted Yields [2]

Predicted yields of the main crops grown in Comanche County, under two levels of management, are shown in table 2. The predictions are averages for a period long enough to include both dry and wet years. Yields are considerably higher than these averages in years when the moisture supply is favorable, and lower in years when the moisture supply is unfavorable.

The predictions are based partly on records of fertility studies, crop variety tests, and rotation and tillage trials made by the Oklahoma Agricultural Experiment Station, and partly on information obtained, during the course of the soil survey, by observation and by personal communication with farmers. If the information about a given soil was insufficient, predictions were made by comparison with a similar soil about which adequate information had been obtained. No predictions are given for soils not normally considered suitable for crops.

The "A" columns in table 2 show the yields that can be expected under common management, or that followed by a substantial number of farmers in the county, which includes (1) proper seeding rates, dates of planting, and efficient harvesting methods; (2) sufficient control of weeds, insects, and plant diseases to insure normal plant growth; (3) terracing and contour farming if appropriate; (4) deep plowing if appropriate; (5) fertilizer, in relatively small amounts, applied to cash crops; and (6) widespread use of one-way and moldboard plows.

The "B" columns show the yields that can be expected under improved management. It includes the first four practices listed under common management plus (1) application of the kinds and amounts of fertilizer indicated by soil analysis; (2) the use of adapted, improved crop varieties; (3) growing cover crops or stripcropping on sandy soils that tend to blow; and (4) residue management and tillage by methods designed to control erosion, preserve the soil structure, increase water intake, and favor seedling emergence.

Specific conservation practices are described under the heading "Management of Cultivated Soils." Recommendations for use of fertilizer and selection of crop varieties can be obtained from local agricultural technicians.

Rangeland [3]

Approximately 53 percent of Comanche County, or 367,693 acres, is rangeland.

For the purposes of the soil survey report and for planning effective range management, soils that produce about the same kind and amount of forage are grouped together. These groups are called range sites. Each site has its own potential for producing native plants. Nineteen range sites are recognized in the county. These have been grouped as follows: *clayey land*, which makes up 40 percent of the rangeland and includes the Hardland, Red Clay Prairie, Eroded Clay, and Slickspots range sites; *loamy land*, which makes up 23 percent of the rangeland and includes the Loamy Prairie and Gyp range sites; *granite and limestone mountains*, which make up 18 percent of the rangeland and include the Boulder Ridge, Edgerock, Limestone Ridge, Hilly Stony, and Hilly Stony Savannah range sites; *bottom land*, which makes up 13 percent of the rangeland and includes the Heavy Bottomland, Loamy Bottomland, Subirrigated, and Alkali Bottomland range

[2] Prepared by Roy M. Smith, assistant professor, Oklahoma State University.

[3] Prepared by Fred L. Whittington, range conservationist, Soil Conservation Service.

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

[The ratings in columns A indicate yields under common management; those in columns B indicate yields under improved management. Absence of a rating indicates the crop is not commonly grown on the particular soil]

Soil	Wheat		Oats		Grain sorghum		Forage sorghum (ovendry [1])		Cotton		Alfalfa		Peanuts	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Lb. of lint*	*Lb. of lint*	*Tons*	*Tons*	*Lb.*	*Lb.*
Cobb fine sandy loam, 1 to 3 percent slopes	14	20	24	34	20	30	2.0	2.8	215	290			1,000	1,500
Cobb fine sandy loam, 3 to 5 percent slopes	12	17	18	28	17	25	1.5	2.3	150	225			800	1,300
Cobb fine sandy loam, 3 to 5 percent slopes, eroded	10	15	16	25	15	22	1.4	2.2					700	1,100
Foard silt loam, 0 to 1 percent slopes	14	20	22	35	16	25	1.6	2.4	175	265				
Foard-Slickspots complex, 0 to 1 percent slopes	11	15	15	24	12	17	1.3	1.8	125	175				
Foard-Slickspots complex, 1 to 3 percent slopes	8	12	12	20			1.0	1.5						
Foard and Tillman soils, 1 to 3 percent slopes	11	16	18	28	13	18	1.2	1.8	125	185				
Hollister silt loam, 0 to 2 percent slopes	15	22	25	38	22	32	2.0	2.8	215	315	1.0	2.0		
Konawa loamy fine sand, 1 to 3 percent slopes			18	30	20	30	1.8	2.8	150	285	1.0	2.0	1,000	1,500
Konawa loamy fine sand, 3 to 5 percent slopes			14	26	15	25	1.5	2.3	100	200			700	1,100
Konawa loamy fine sand, 3 to 5 percent slopes, eroded			14	24	14	23	1.2	2.2						
Lawton loam, 1 to 3 percent slopes	14	21	25	38	22	32	2.1	2.8	225	315	1.2	2.0		
Lawton loam, 3 to 5 percent slopes	11	17	20	28	15	24	1.6	2.3	150	230				
Lawton loam, 3 to 5 percent slopes, eroded	9	15	18	25			1.5	2.0						
Lawton-Foard complex, 3 to 5 percent slopes	9	14	16	26			.8	1.4						
Lela clay	16	20	25	35	18	25	2.0	3.0	225	300				
Miller clay	16	20	25	35	18	25	2.0	3.0	225	300				
Minco loam, 3 to 8 percent slopes	13	19	17	28	15	22	1.5	2.0						
Port clay loam	22	32	40	55	35	50	3.0	4.0	340	450	2.8	3.8		
Port loam	22	32	40	55	35	50	3.0	4.0	340	450	2.8	3.8		
Stamford clay, 1 to 3 percent slopes	10	14	16	26	12	16	1.2	1.8	125	175				
Tillman clay loam, 3 to 5 percent slopes	9	13	16	24			.6	1.2						
Vanoss loam, 0 to 1 percent slopes	20	30	38	50	32	48	2.8	3.8	300	400	2.2	3.2	900	1,400
Vanoss loam, 1 to 3 percent slopes	18	26	34	44	28	44	2.6	3.6	275	375	2.0	3.0	700	1,200
Vernon soils, 3 to 5 percent slopes	7	10	10	18										
Waurika silt loam	14	21	22	37	16	26	1.5	2.5	175	275				
Windthorst sandy loam, 1 to 3 percent slopes	10	16	20	30	17	27	1.2	2.2	125	250			700	1,100
Windthorst sandy loam, 3 to 5 percent slopes	8	14	16	24	12	22	.8	1.8	75	175				
Zaneis loam, 1 to 3 percent slopes	14	21	26	38	22	32	2.0	2.8	235	315	1.2	2.0		
Zaneis loam, 3 to 5 percent slopes	11	17	20	30	17	25	1.5	2.2	165	240				
Zaneis loam, 3 to 5 percent slopes, eroded	10	15	17	26			1.4	2.0	150	200				
Zaneis-Slickspots complex, 1 to 3 percent slopes	9	15	16	25	13	18	1.5	2.0						
Zavala fine sandy loam	15	23	30	42	28	40	2.5	3.4	275	390	2.0	3.0		

[1] Multiply ovendry weight by 3 to get approximate green weight.

sites; and *sandy land*, which makes up 6 percent of the rangeland in the county and includes the Deep Sand Savannah, Sandy Savannah, Sandy Prairie, and Eroded Sandyland range sites.

Range condition

Range condition is determined mainly by comparing the kinds and amounts of plants that make up the vegetative cover with those in the potential native plant cover, or the climax vegetation, for the same site.

Climax vegetation is the stabilized plant community on a particular site; it reproduces itself and does not change as long as the environment remains unchanged. *Decreasers* are species in the climax vegetation that tend to decrease under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock. *Increasers* are species in the climax vegetation that increase 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 invade the site after the climax vegetation has been reduced by grazing. Many invaders 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 to which the composition of the present plant community differs from that of the climax vegetation.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is the same kind as that in the original stand; it is in *good* condition if the percentage is between 51 and 75; in *fair* condition if the percentage is between 26 and 50; and in *poor* condition if it is 25 or less.

Descriptions of range sites

In the following pages is a description of each range site, including an estimate of potential yield. Yields are given in air-dry weight. The yields are based on plot clippings taken from sites in excellent condition.

HARDLAND RANGE SITE

This site consists of nearly level and gently sloping clay loams and silt loams that have a heavy clayey subsoil. These soils absorb water very slowly, and much of the moisture taken in is not readily available to plants. Moisture seldom penetrates to a depth of more than 2 feet during the growing season.

The vegetation is mainly blue grama and buffalograss. The taller grasses, such as vine-mesquite, sideoats grama and little bluestem, grow in the drainageways and in other areas that receive extra moisture. Mesquite and pricklypear are common invaders.

The potential yield of air-dry herbage varies between 3,300 pounds per acre in years of favorable moisture supply and 1,700 pounds per acre in years of unfavorable moisture supply.

RED CLAY PRAIRIE RANGE SITE

This site consists of very gently sloping to strongly sloping, reddish, calcareous, clayey soils. The surface layer is somewhat granular but is underlain by dense clay. Water intake is fair to good if a good cover is maintained, but the soils become droughty if vegetation is sparse.

Little bluestem is the principal decreaser, and sideoats grama is the most productive increaser. Annual three-awn, Japanese brome, little barley, red three-awn, and other weedy grasses and forbs are common invaders. Continued overuse often results in many barren areas and invasion by pricklypear and mesquite trees.

The potential yield of air-dry herbage varies between 2,500 pounds per acre in years of favorable moisture supply and 1,300 pounds per acre in years of unfavorable moisture supply.

ERODED CLAY RANGE SITE

This site consists of clayey soils that have been cultivated and are now excessively eroded and gullied.

The vegetation consists of blue grama, buffalograss, vine-mesquite, sideoats grama, and little bluestem. Mesquite and pricklypear are common invaders.

The potential yield of air-dry herbage varies between 1,000 pounds per acre in years of favorable moisture supply and 400 pounds per acre in years of unfavorable moisture supply.

SLICKSPOTS RANGE SITE

This site is on uplands. The slickspots are loam to clay loam in texture and have a crusty surface that is glazed and whitish when dry. The subsoil is dense clay.

This site supports plants that have a high tolerance for salt. The dominant vegetation varies according to the degree of alkalinity. From the most tolerant to the least tolerant, the range plants are rhombopod, whorled dropseed, inland saltgrass, alkali sacaton, tumblegrass, Texas grama, and blue grama. The most severely affected areas are likely to be barren.

The potential yield of air-dry herbage varies between 1,800 pounds per acre in years of favorable moisture supply and 800 pounds per acre in years of unfavorable moisture supply.

LOAMY PRAIRIE RANGE SITE

This site consists of nearly level to moderately steep, productive, loamy soils. In good condition (fig. 13), it has a cover that is largely tall grasses, such as sand bluestem, indiangrass, little bluestem, and switchgrass. If it is overgrazed, blue grama and buffalograss increase and the tall and mid grasses decrease.

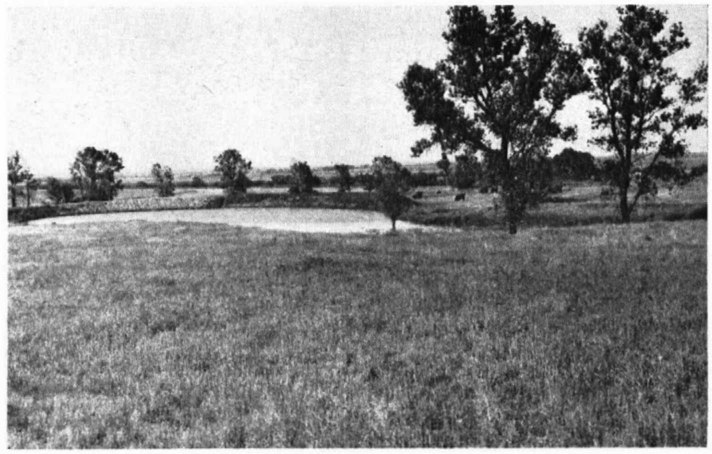

***Figure 13.*—Loamy Prairie range site in good condition. Farm pond provides water for livestock and encourages proper grazing use.**

The potential yield of air-dry herbage varies between 4,400 pounds per acre in years of favorable moisture supply and 2,700 pounds per acre in years of unfavorable moisture supply.

GYP RANGE SITE

This is an inextensive site in the northeastern part of the county. It consists of sloping to strongly sloping loamy soils that are very shallow over gypsum. There are many gypsum outcrops.

Little bluestem is the principal decreaser. Sideoats grama and blue grama are the principal increasers. Unless well managed, the site is invaded by hairy goldaster, sand dropseed, hairy tridens, and pricklypear.

The potential yield of air-dry herbage varies between 1,800 pounds per acre in years of favorable moisture supply and 1,000 pounds per acre in years of unfavorable moisture supply.

BOULDER RIDGE RANGE SITE

This site (fig. 14) consists of rolling to steep, dissected hills and ridges. The soils are deep and loamy and con-

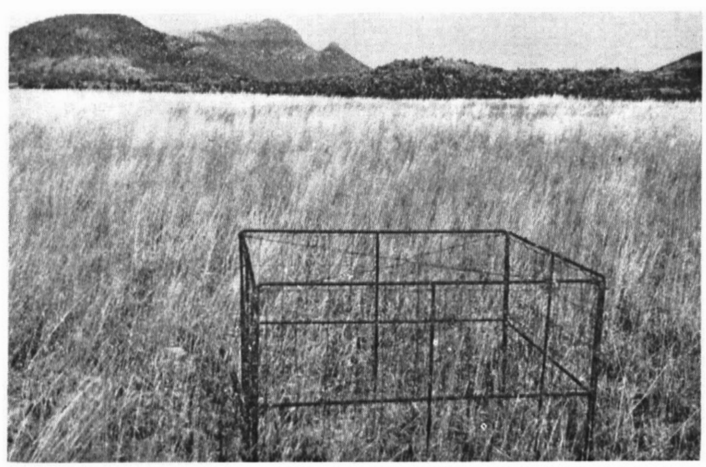

***Figure 14.*—Boulder Ridge range site in excellent condition. The estimates of herbage yield are based on clippings taken from within this type of exclosure.**

tain many cobblestones, a few scattered boulders, and an appreciable amount of gravel.

The principal decreasers are little bluestem, big bluestem, indiangrass, switchgrass, and wildrye. The principal increasers are sideoats grama, blue grama, and hairy grama. The most common invaders are annual three-awn, Japanese brome, silver bluestem, and buffalograss.

The potential yield of air-dry herbage varies between 4,000 pounds per acre in years of favorable moisture supply and 2,000 pounds per acre in years of unfavorable moisture supply.

EDGEROCK RANGE SITE

This site is in the northern part of the county. It is 40 percent limestone outcrop. The soils are loamy and very shallow.

Little bluestem and sideoats grama are the principal grasses. Other common plants are hairy grama, buffalograss, sand dropseed, puffsheath dropseed, hairy tridens, and pricklypear.

The potential yield of air-dry herbage varies between 2,400 pounds per acre in years of favorable moisture supply and 1,300 pounds per acre in years of unfavorable moisture supply.

LIMESTONE RIDGE RANGE SITE

This site (fig. 15) consists of shallow to very shallow, dark-colored soils that contain limestone cobblestones and are underlain by limestone conglomerate. The vegetation consists dominantly of short grasses, such as hairy grama, tall grama, blue grama, and sideoats grama.

The potential yield of air-dry herbage varies between 3,000 pounds per acre in years of favorable moisture supply and 1,500 pounds per acre in years of unfavorable moisture supply.

HILLY STONY RANGE SITE

This site (fig. 16) is made up of gently sloping to very steep, very shallow to deep soils and granite outcrops over granite bedrock. Hairy grama is the major decreaser on south-facing slopes. Annual forbs make up a high percentage of the vegetation.

The potential yield of air-dry herbage varies between 1,800 pounds per acre in years of favorable moisture supply and 1,000 pounds per acre in years of unfavorable moisture supply.

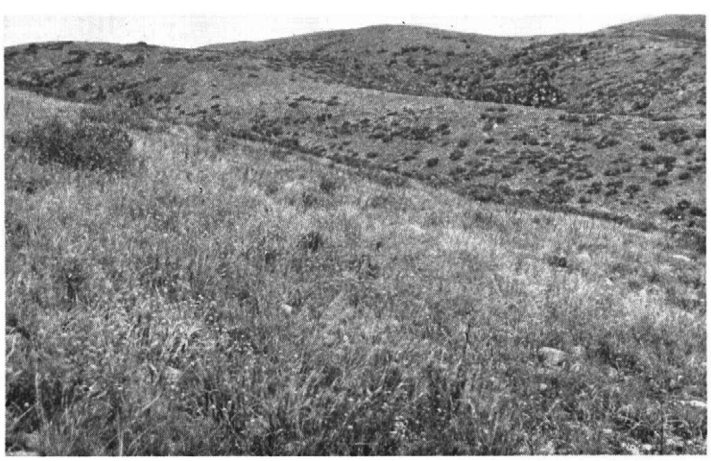

***Figure 15.*—Limestone Ridge range site in good condition.**

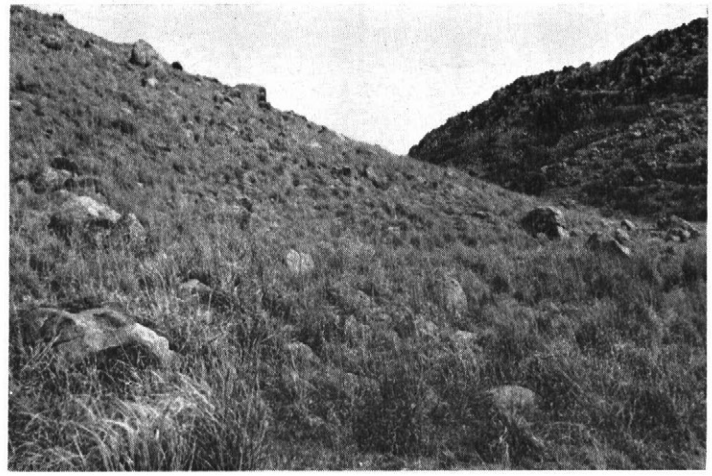

***Figure 16.*—Hilly Stony range site in excellent condition.**

HILLY STONY SAVANNAH RANGE SITE

This site consists of hilly to very steep, very shallow to deep, stony soils. Big bluestem, little bluestem, and sideoats grama are the principal decreasers. Blue grama and hairy grama are the principal increasers.

The potential yield of air-dry herbage varies between 3,500 pounds per acre in years of favorable moisture supply and 1,700 pounds per acre in years of unfavorable moisture supply.

HEAVY BOTTOMLAND RANGE SITE

This site is on bottom lands. It consists of somewhat droughty, clayey soils that have a clay subsoil. These soils occasionally receive extra moisture from overflow.

The climax vegetation includes switchgrass, indiangrass, big bluestem, and sand bluestem. Sedges are also common. Sumpweed is likely to grow in poorly drained areas. Trees and brush grow where overflow is most frequent.

The potential yield of air-dry herbage varies between 5,000 pounds per acre in years of favorable moisture supply and 2,500 pounds per acre in years of unfavorable moisture supply.

LOAMY BOTTOMLAND RANGE SITE

This site consists of deep loam to clay loam soils on bottom lands. These soils occasionally receive additional moisture from overflow.

The climax vegetation consists of tall and mid grasses, such as big bluestem, eastern gamagrass, indiangrass, switchgrass, Canada wildrye, Virginia wildrye and western wheatgrass. Woody plants include pecan, elm, oak, hackberry, and cottonwood.

The potential yield of air-dry herbage varies between 7,000 pounds per acre in years of favorable moisture supply and 3,500 pounds per acre in years of unfavorable moisture supply.

SUBIRRIGATED RANGE SITE

This range site is inextensive. It consists of light-colored alluvial soils. The surface layer ranges from loamy sand to loam in texture, and the subsoil from sand to loam. These soils are productive because the water table is a few inches to 2 feet below the surface. The water table fluctuates with the seasons, but in most years there is enough moisture for the deep-rooted plants.

The principal decreasers are switchgrass, wildrye, prairie cordgrass, and eastern gamagrass.

The potential yield of air-dry herbage varies between 10,000 pounds per acre in years of favorable moisture supply and 6,000 pounds per acre in years of unfavorable moisture supply.

ALKALI BOTTOMLAND RANGE SITE

This site is inextensive and consists of slickspots on bottom lands. The slickspots are loam to clay loam in texture and have a crusty surface that is glazed and whitish when dry. The subsoil is dense clay.

The vegetation is limited to plants that are tolerant of drought and salt. The dominant vegetation varies according to the degree of alkalinity. Whorled dropseed, inland saltgrass, western wheatgrass, alkali sacaton, and white tridens are the common grasses.

The potential yield of air-dry herbage varies between 3,200 pounds per acre in years of favorable moisture supply and 1,800 pounds per acre in years of unfavorable moisture supply.

DEEP SAND SAVANNAH RANGE SITE

This site consists of very gently sloping to rolling, deep loamy fine sands and fine sands. The vegetation consists of tall and mid grasses, mainly bermudagrass, sand bluestem, indiangrass, and little bluestem, and post oak and blackjack oak. The woody plants become dominant if the range is not properly managed.

The potential yield of air-dry herbage varies between 4,200 pounds per acre in years of favorable moisture supply and 1,750 pounds per acre in years of unfavorable moisture supply.

SANDY SAVANNAH RANGE SITE

This site consists of very gently sloping and gently sloping sandy loams that erode severely if they are not protected. Forage production is low. Most of this site is in poor to fair condition, and the vegetation consists largely of post oak and blackjack oak.

The dominant decreasers are little bluestem, sand bluestem, and switchgrass. Common increasers are sideoats grama, post oak, and blackjack oak.

The potential yield of air-dry herbage varies between 4,600 pounds per acre in years of favorable moisture supply and 2,500 pounds per acre in years of unfavorable moisture supply.

SANDY PRAIRIE RANGE SITE

This site consists of very gently sloping and gently sloping, deep, friable fine sandy loams that have a sandy clay loam subsoil.

Sand bluestem, indiangrass, and little bluestem are the principal decreasers. Blue grama is one of the major increasers. Sandplum and skunkbush are common woody invaders.

The potential yield of air-dry herbage varies between 4,400 pounds per acre in years of favorable moisture supply and 2,200 pounds per acre in years of unfavorable moisture supply.

ERODED SANDYLAND RANGE SITE

This site (fig. 17) consists of deep, sandy soils that have been cultivated and are now eroded and commonly gullied.

The original vegetation consisted mainly of tall and mid grasses and partly of legumes, forbs, and woody plants. Except in areas that have been seeded, the present vegetation consists largely of annual three-awn and other low-quality grasses and weeds.

Figure 17.—**Eroded Sandyland range site in fair condition.**

The potential yield of air-dry herbage varies between 2,800 pounds per acre in years of favorable moisture supply and 1,500 pounds per acre in years of unfavorable moisture supply.

Woodland, Windbreaks, and Post Lots [4]

Native woodland and planted windbreaks and post lots cover 45,800 acres in Comanche County. Native woodland occurs along the bottom lands, in the Wichita Mountains, and in sandy areas in the southwestern and northeastern parts of the county. American elm, cottonwood, willow, ash, pecan, western walnut, hackberry, mesquite, redcedar, and oak are the most common native species. Live oak and bigtooth maple, which occur nowhere else in Oklahoma, are to be found on the slopes of the Wichita Mountains. No commercial use is made of these two species.

Most sites in the county would not produce timber of commercial quality. Trees are planted only to provide windbreaks and to supply fenceposts. Most of the trees in the native stands are of cull quality. Some are cut for firewood and fenceposts. Bottom lands that would support good-quality hardwoods have been cleared and are used intensively for cultivated crops. The remaining native woodland, especially that in the Wichita Mountains, has esthetic and recreational value and provides food and shelter for wildlife and shelter for farmsteads and livestock.

Windbreaks

Field windbreaks are for the protection of soils and crops. The suitability of soils for these plantings depends on their capacity to produce trees of maximum height and a high degree of vigor. The depth, texture, and structure of the soils need to be such that good infiltration and retention of moisture can be expected.

Two- to four-row windbreaks spaced as far apart as 15 to 20 times the average height of the trees in the tall row are adequate for protection of soils and crops. For example: A row of trees in which the average height is 30 feet

[4] Prepared by CHARLES P. BURKE, woodland conservationist, Soil Conservation Service.

would give a satisfactory degree of protection up to 450 to 600 feet. The distance between the rows of the windbreak must accommodate equipment but should be no less than 10 feet and no more than 16 feet.

Broad-leafed trees, such as cottonwood, American elm, Siberian elm, and sycamore, reach a height of 70 to 80 feet and are suitable for the tall row in windbreaks. They should be spaced about 6 to 10 feet apart in the row. Evergreens, such as pine and cedar, particularly eastern redcedar, reach a height of 20 to 30 feet and are suitable for the intermediate-height row. They should not be planted in the same row with the broad-leafed species. It is advisable to leave the maximum recommended space between the row of evergreens and the row of broad-leafed trees, so that the evergreens will not be overtopped. The windward side of the planting should consist of shrubs or of shrublike, dense-growing trees, such as tamarisk, desert willow, and low-growing strains of arborvitae. Russian mulberry planted at shrub spacing and top pruned to inhibit growth and to thicken the foliage is effective in the shrub row. Trees in this row should be spaced about 4 to 5 feet apart.

Windbreaks for protection of farmsteads and livestock do not need to be as high as field windbreaks, and the soil requirements are accordingly less demanding. Since the plantings are less extensive, extra cultivation and other special practices can be justified, and supplemental water can often be supplied if needed. Generally, the suggestions for selection of species, spacing, and management do not differ greatly from those applicable to field windbreaks. A windbreak of at least three rows is advisable. Minimum care includes fire protection, elimination of grazing, and cultivation until the tree crowns nearly close over the rows.

Post lots

Only soils well suited to trees should be considered for production of fenceposts, for a post crop is usually needed as soon as possible after the seedlings are planted. It is often necessary to sacrifice an acreage of high-quality agricultural soils in order to establish a satisfactory post lot.

Post-lot planting and windbreak plantings should not be combined. The principal post-producing species, for example, black locust, catalpa, and bois d'arc, lack the qualities needed for windbreaks, and removal of trees from within a windbreak impairs the effectiveness of the wind barrier.

Suitability of soils for windbreak and post-lot plantings

The soils of Comanche County have been placed in four groups according to their suitability for windbreak and post-lot plantings. Each group consists of soils that have about the same potential for producing similar kinds of trees under similar management. Considered in these groupings were the expected rate of growth and the life and vigor of the plantings. The groups are described in the following paragraphs.

Group I consists of deep, nearly level and very gently sloping soils. These soils have high moisture-storage capacity and slow runoff. Their suitability for windbreak and post-lot plantings is good to excellent. Trees are still vigorous at age 20 to 25 years. The trees suitable for the tall row in windbreaks on these soils include Siberian elm, American elm, cottonwood, and sycamore. These trees reach a height of 70 to 80 feet in 20 years. Evergreens that are likely to be successful on these soils include Austrian pine, ponderosa pine, and eastern redcedar. These trees reach a height of 20 to 30 feet in 20 years and are suitable for the intermediate-height row. Russian mulberry can be used in the intermediate-height row also or in the outside shrub row if the top is pruned to thicken the foliage. Other possible shrub-row trees are desert willow, tamarisk, and low-growing varieties of arborvitae. Black locust, catalpa, and bois d'arc are suitable for fenceposts. Bois d'arc should be grown only on loams and clay loams. From 1,500 to 2,000 fenceposts per acre can be produced in 4 to 6 years.

Group II consists of deep, gently sloping to rolling, well-drained, coarse-textured soils. The suitability of these soils for windbreak and post-lot plantings is fair to good. Trees are likely to decline in vigor when they are about 20 years old, and the height they can be expected to reach is 15 to 20 percent less than that of trees on the soils of group I. From 1,250 to 1,500 fenceposts per acre can be produced in 6 to 8 years. The soils in this group are better suited to farmstead windbreaks than to field windbreaks and post lots. Wide spacing between rows and extra cultivation are needed on these coarse-textured soils. Cultivating and planting on the contour is advisable on extensive 4- to 5-percent slopes. Moderate to high mortality can be expected in years of subnormal rainfall. Siberian elm, American elm, cottonwood, and sycamore are suitable for the tall row in windbreaks. Austrian pine, ponderosa pine, and eastern redcedar are suitable for the intermediate-height row. Russian mulberry can be used in the intermediate-height row also, or in the shrub row if it is pruned. Desert willow, tamarisk, and low-growing varieties of arborvitae are suitable as shrub-row plantings. Black locust is suitable for fenceposts.

Group III consists of deep and moderately deep, nearly level to sloping soils. These soils are moderately coarse textured, and medium textured. Runoff is slow to very rapid. Permeability is moderate to very slow. These soils are poor to fair for most plantings. They are generally unsuitable for field windbreaks and fenceposts but can be used for farmstead windbreaks if no great height is needed and if the trees can be watered during droughts. Trees on these soils are short lived, with the possible exception of eastern redcedar, and replanting is necessary after 20 to 25 years.

Group IV consists of very shallow to deep, nearly level to steep soils. Salinity, erosion, extreme rockiness, or shallowness make these soils unsuitable for field windbreaks, farmstead windbreaks, or post lots.

Wildlife [5]

A large part of Comanche County is cultivated and lacks suitable wildlife habitats. Prairie uplands, mountainous areas, timbered uplands, and bottom lands are the dominant wildlife areas. The prairie uplands are well distributed throughout the county. The mountainous areas are in the northwestern part. The timbered uplands occur in the northeastern and southwestern parts. The

[5] Prepared by JEROME F. SYKORA, biologist, Soil Conservation Service.

bottom lands occur as narrow bands along the three major streams and the tributaries that drain the county.

The most important kinds of wildlife are bobwhite quail, mourning dove, hawk, owl, waterfowl, turkey, fox squirrel, cottontail, jackrabbit, raccoon, fox, mink, opossum, skunk, deer, coyote, fox, and bobcat. There is a wide variety of songbirds. The Wichita Mountains Wildlife Refuge maintains herds of bison, elk, and longhorn cattle, and flocks of wild turkey.

Fish are scarce. The principal kinds are bass, bluegill, bullhead, channel catfish, and several species of small sunfish and carp. Many farm ponds have been built for stock water. Those in intensively cultivated areas, where runoff is from cropland, are likely to be turbid much of the time and are not well suited to fish.

Bobwhite quail are the most sought after of the game birds in the county. Doves are hunted in stubble fields and near farm ponds. Jackrabbits and cottontails provide some hunting in winter. Coyotes and raccoons are hunted for sport, but seldom are the skins pelted and sold in the fur trade. The harvest of opossums, skunks, muskrats, and mink is of little importance. Waterfowl are of only moderate importance, though clear ponds and lakes, in which aquatic plants grow in abundance, provide some hunting opportunities.

Availability of food and cover for wildlife coincides in a general way with the geographic grouping of soils into soil associations. Detailed descriptions of the associations are in the section "General Soil Map."

Association 1, which consists of Foard and Tillman soils and a small acreage of Waurika soils, makes up 18 percent of the county. This association provides little in the way of food and shelter for wildlife. Most of the acreage is used for small grain, some is used for sorghum, and a little is used for cotton. The small tracts that are uncultivated support short and mid grasses. Elm, ash, hackberry, soapberry, and mesquite trees grow along drainageways, but intensive use of the soils for crops leaves little shrubby vegetation, and the potential for habitat plantings is poor. Waste grain and small-grain forage provide some food for doves and waterfowl. Ponds in association 1 are generally turbid and consequently are unsuitable for fish.

Association 2, which consists of Zaneis, Lawton, and Lucien soils and small acreages of Vanoss, Minco, Vernon, and Cottonwood soils, occupies about 19.4 percent of the county. The Zaneis, Lawton, and Vanoss soils are intensively cultivated to small grain, sorghum, and cotton. The small grain and sorghum crops furnish some food for waterfowl and doves, but otherwise these cultivated areas, under current use, are poorly suited to wildlife habitats. The Lucien-Zaneis-Vernon complex, 5 to 12 percent slopes, is used as range. In these areas there is some shrubby cover, which provides a low-quality habitat for rabbits, quail, and songbirds. Lawton, Minco, and Vanoss soils have some potential for habitat plantings. Ponds generally need special treatment to keep the water clear enough to be suitable for fish.

Association 3, which consists of Foard-Slickspots complex, Zaneis-Slickspots complex, and Slickspots, occupies about 9 percent of the county. These soils are generally not well suited to cultivated crops. The range vegetation consists of short and mid grasses and is a poor habitat for all wildlife except jackrabbits and coyotes. Ponds in association 3 generally need special treatment to keep the water clear enough to be suitable for fish.

Association 4, which consists of Port, Zavala, and Lela soils and a small acreage of Miller soils, occupies about 11 percent of the county. Much of it is used for small grain, alfalfa, sorghum, and cotton, but narrow timbered areas near streams and small drainageways provide good habitats for deer, turkeys, squirrels, quail, doves, raccoons, and songbirds. The vegetation consists of elm, oak, cottonwood, pecan, soapberry, hackberry, ash, redbud, sumac, dogwood, and other small shrubs and forbs. The potential for supplemental plantings of all types is good. Ponds in association 4 generally need special treatment to keep the water clear enough to be suitable for fish.

Association 5, which consists of Stony rock land, Granite cobbly land, Rock land, and Granite outcrop, makes up about 12 percent of the county. This association is used exclusively for range. The vegetation consists of mid and short grasses and a woody cover that ranges from scattered solitary trees to dense stands. Blackjack oak, elm, sumac, hackberry, redcedar, and skunkbush are the principal woody plants. The varied cover pattern provides habitat of moderate quality for deer, turkeys, and quail, and for squirrels and other furbearers. Winged elm (fig. 18) is an acceptable browse plant for deer. Granite outcrop produces a moderate amount of vegetation, but it is so rough and inaccessible that it is desirable only for such wildlife as cottontail, quail, and songbirds. Ponds usually are clear (fig. 19) and well suited to fish.

Association 6, which consists of Konawa and Windthorst soils and a small acreage of Eufaula soils, makes up about 4 percent of the county. The vegetation consists predominantly of blackjack oak, sumac, and plum, and a sparse cover of mid and tall grasses. Small grain, cotton, sorghum, peanuts, and watermelons are the main crops. This association provides good-quality habitat for quail, deer, turkeys, doves, and songbirds, and for rabbits and other furbearers. Since the fields are rather small, there is a considerable amount of edge vegetation. Konawa and Eufaula soils are suitable for habitat plantings, and Windthorst soils somewhat less so. Ponds generally need special treatment to keep the water clear enough to be suitable for fish.

Figure 18.—Winged elm on association 5.

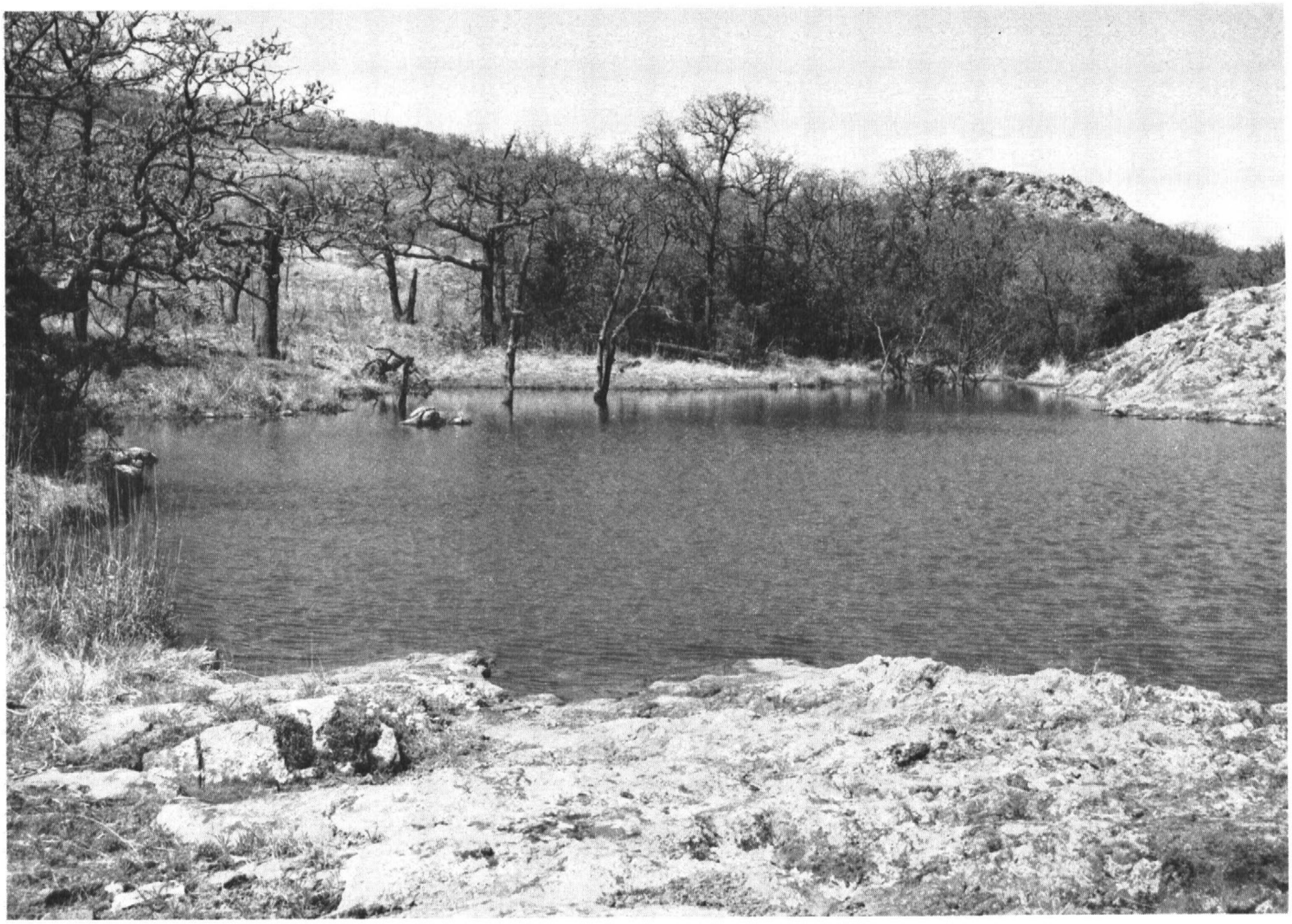

Figure 19.**—Clear pond in association 5 has high potential for fish production.**

Association 7, which consists of Vernon soils and a small acreage of Stamford soils, makes up about 8 percent of the county. It is used predominantly as range. The natural vegetation consists mainly of short and mid grasses. The main crop is small grain. Unless well managed, the rangeland is invaded by mesquite trees. This association provides poor-quality habitat for rabbits and other furbearers, quail, and doves. Ponds need special treatment to keep the water clear enough to be suitable for fish.

Association 8, which consists of Tarrant soils and Limestone cobbly land, occupies 3 percent of the county. It is used exclusively as range. It commonly lacks a woody cover but provides some food and cover for doves and certain songbirds. It is unsuitable for habitat plantings. Ponds in association 8 usually are clear and well suited to fish.

Association 9, which consists of Cobb soils, makes up only 2 percent of the county. Part of it is used as range, and part for cultivated crops. The main crops are small grain, sorghum, peanuts, and watermelons. The natural vegetation consists of mid and tall grasses. There is little woody vegetation. This association provides some food and cover for doves, rabbits, and songbirds. It is suitable for habitat plantings that benefit rabbits and other furbearers and quail. Ponds generally need special treatment to keep the water clear enough to be suitable for fish.

Engineering Properties of the Soils [6]

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

The information in the report can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.

[6] Prepared by BOB DAY, civil engineer, and HARRY ELAM, agricultural engineer, Soil Conservation Service.

2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for conservation of soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in planning engineering practices and in designing and maintaining engineering structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes.

With the soil map for identification of soil areas, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that these interpretations may 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. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Although the tables in the following pages and the detailed soil map at the back of this report serve as guides for evaluating most soils, a detailed investigation at the site of the proposed construction is needed. As much as 15 percent of an area designated as a specific soil on the map may consist of areas of other soils too small to be shown on the published map. By comparing the information in the section "Descriptions of the Soils" with the results of investigations at the site, the presence of an included soil can usually be determined.

Engineering classification systems

Two systems of classifying soils for engineering purposes are in general use: the AASHO system and the Unified system.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO).[7]

[7] American Association of State Highway Officials. Standard specifications for highway materials and methods of sampling and testing. Part 1, ed. 8. 1961.

Table 3.—*Estimated physical*

Soil name and map symbol	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	In.			
Breaks-Alluvial land complex (Bk)	(2)	(2)	(2)	(2)
Broken alluvial land (Br)	(2)	(2)	(2)	(2)
Cobb (CoB, CoC, CoC2)	0 to 10	Fine sandy loam	SM	A-4
	10 to 27	Sandy clay loam	SC	A-4
	27 to 35	Fine sandy loam	CL, SC	A-4
	35+	Soft sandstone		
Cottonwood (CtD)	0 to 6	Loam	ML, CL	A-4
	6 to 10+	Hard white gypsum		
Eroded clayey land (Es)	(2)	(2)	(2)	(2)
Eroded loamy land (Et)	(2)	(2)	(2)	(2)
Eufaula (EuD)	0 to 5	Fine sand	SM	A-2
	5 to 80	Fine sand	SP-SM	A-2, A-3
Foard (FaA, FsA, FsB, FtB)	0 to 7	Silt loam	ML, CL	A-4, A-6
For Slickspots part of FsA and FsB, see Slickspots.	7 to 60	Clay	MH, CH	A-7
For Tillman part of FtB, see Tillman series.				
Granite cobbly land (Gc)	(2)	(2)	(2)	(2)
Granite outcrop (Go)	(2)	(2)	(2)	(2)
Hollister (HoB)	0 to 8	Silt loam	ML-CL	A-4
	8 to 30	Silty clay	ML, MH	A-7
	30 to 48	Silty clay loam	CL	A-6

See footnotes at end of table.

In this system, all soil materials are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils that have high bearing capacity, to A–7, which consists of clayey soils that have low strength when wet. Within each group, the relative engineering value of soils may be indicated by group index numbers. These numbers range from 0 for the best material to 20 for the poorest. They are given only for the soils that were sampled and tested.

Some engineers prefer to use the Unified classification system.[8] This system is based on identification of soils according to their texture and plasticity and on their performance as engineering construction material. Soil materials are identified as coarse-grained—gravels (G) and sands (S); fine-grained—silts (M) and clays (C); and highly organic soils (O). SW and SP identify clean sands; SM and SC, sands that include fines of silt and clay; ML and CL, silts and clays that have a low liquid limit; and MH and CH, silts and clays that have a high liquid limit.

Soil properties significant in engineering

Table 3 shows the estimated physical and chemical properties that affect engineering works. These estimates are based on available test data for modal, or typical, profiles. Estimates of properties of soils not tested are based on test data for similar soils in this county or other counties and on past experience in engineering construction. Since the estimates are for modal soils, considerable variation from the values shown in table 3 should be anticipated. More information on the range of properties of the soils can be obtained from the section "Description of the Soils." Complete profile descriptions are given in the section "Genesis, Classification, and Morphology of the Soils."

The column headed "Available water capacity" gives estimates of the amount of capillary water in soil that is wet to field capacity. If soil moisture is at the wilting point for plants, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction (pH) refers to the degree of acidity or alkalinity of a soil. The degrees of acidity or alkalinity are described under "Reaction" in the Glossary.

The column headed "Shrink-swell potential" indicates the volume change to be expected of the soil material with changes in moisture content. For example, soil material from the A horizon of Stamford soils is very sticky when wet and develops extensive shrinkage cracks when dry; hence, it has high shrink-swell potential. Conversely, material from the A horizon of Eufaula soils is structureless and nonplastic, and it therefore has a low shrink-swell potential.

[8] WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS. UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3–357, v. 1. 1953.

and chemical properties of soils

Percentage passing sieve			Available water capacity	Reaction	Shrink-swell potential	Permeability [1]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			In. per in. of depth	*pH*		
(2)	(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	36 to 45	0.14	6.5 to 7.3	Low	
100	100	40 to 50	.12	6.5 to 7.3	Low	Moderate.
100	100	45 to 55	.14	6.0 to 7.0	Low	
100	100	60 to 75	.14	6.6 to 7.3	Low	Moderate.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	30 to 35	.05	5.6 to 6.5	Low	Rapid.
100	100	5 to 15	.05	5.6 to 6.5	Low	
100	100	90 to 98	.14	6.1 to 7.3	Low to moderate	Very slow.
100	100	90 to 98	.17	7.4 to 8.4	High	
(2)	(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	75 to 90	.14	6.6 to 7.3	Low	
100	100	90 to 98	.17	6.6 to 7.3	Moderate	Slow.
100	100	85 to 95	.17	7.4 to 8.4	Moderate	

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TABLE 3.—*Estimated physical and*

Soil name and map symbol	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	In.			
Konawa (KoB, KoC, KoC2, KnB3)	0 to 17	Loamy fine sand	SM	A-2
	17 to 41	Sandy clay loam	SC	A-4
	41 to 60	Fine sandy loam	SM	A-4
Lawton (LaB, LaC, LaC2, LfC) For Foard part of LfC unit, see Foard series.	0 to 11	Loam	ML, CL	A-4
	11 to 47	Clay loam	CL	A-6, A-7
	47 to 72	Sandy loam	CL	A-4, A-6
Lela (Lc)	0 to 60	Clay	CL or CH	A-7
Limestone cobbly land (Lm)	(2)	(2)	(2)	(2)
Lucien (LzD) For Zaneis and Vernon parts of this unit, see Zaneis series and Vernon series.	0 to 10	Loam	ML, CL	A-4
	10+	Fine grained sandstone		
Miller (Mc)	0 to 60	Clay	CL or CH	A-7
Minco (MnC)	0 to 78	Loam	ML or CL	A-4
Port (Pc, Po, Ps):				
Pc	0 to 60	Clay loam	CL	A-6
Po	0 to 60	Loam	ML or CL	A-4
Port part of Ps is like either Pc or Po; for Slickspots, see Slickspots.				
Rock land (Ro)	(2)	(2)	(2)	(2)
Slickspots (Sc)	(2)	(2)	(2)	(2)
Stamford (SmA)	0 to 14	Clay	MH, CH	A-7
	14 to 50	Silty clay	CL	A-6, A-7
Stony rock land (St)	(2)	(2)	(2)	(2)
Tarrant (Ta) Unit includes outcrops of tilted limestone.	0 to 7	Silt loam	ML or CL	A-4
	7+	Limestone bedrock		
Tillman (TmC)	0 to 13	Silty clay loam	CL	A-6
	13 to 50	Clay	CL or CH	A-7
Vanoss (VaA, VaB)	0 to 18	Loam	SM, ML	A-4
	18 to 36	Clay loam	ML-CL	A-4
	36 to 48	Sandy clay loam	SC	A-4
	48 to 80	Fine sandy loam	SM	A-4
Vernon (VeC, VeD)	0 to 4	Clay loam or clay	CL or CH	A-7
	4 to 50	Clay	CL or CH	A-7
Waurika (Wa)	0 to 14	Silt loam	ML	A-4
	14 to 45	Clay	CL or CH	A-7
	45 to 55	Clay loam	CL	A-6
Wet alluvial land (We)	(2)	(2)	(2)	(2)
Windthorst (WhB, WhC)	0 to 8	Sandy loam	SM	A-4
	8 to 48	Sandy clay	SC or CL	A-6
	48 to 60	Clay	CL or CH	A-7
Zaneis (ZaB, ZaC, ZaC2, ZsB) For Slickspots part of ZsB, see Slickspots.	0 to 6	Loam	ML or CL	A-4
	6 to 28	Clay loam	CL	A-6
	28 to 37	Silty clay loam (shaly)	CL	A-6
Zavala (Zv)	0 to 60	Fine sandy loam	SM	A-4

[1] Rating applies to the least permeable layer in profile.
[2] Variable.

chemical properties of soils—Continued

Percentage passing sieve — No. 4 (4.7 mm.)	Percentage passing sieve — No. 10 (2.0 mm.)	Percentage passing sieve — No. 200 (0.074 mm.)	Available water capacity	Reaction	Shrink-swell potential	Permeability [1]
			In. per in. of depth	*pH*		
90 to 100	90 to 100	12 to 35	.07	5.6 to 7.3	Low	Moderate.
100	100	36 to 50	.12	5.6 to 7.3	Low	
100	100	36 to 50	.14	5.6 to 7.3	Low	
100	100	70 to 80	.14	6.1 to 7.3	Low	Moderately slow.
100	100	80 to 90	.17	6.6 to 7.3	Moderate	
100	100	35 to 50	.14	7.4 to 7.8	Moderate	
100	100	90 to 98	.17	7.4 to 8.4	High	Very slow.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	55 to 70	.14	5.6 to 7.3	Low	Moderate.
100	100	90 to 98	.17	7.8 to 8.3	High	Very slow.
100	100	60 to 75	.14	6.0 to 7.0	Low	Moderate.
100	100	75 to 95	.17	6.5 to 8.3	Moderate	Moderately slow.
100	100	65 to 80	.14	6.3 to 8.3	Low	Moderate.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	90 to 98	.17	7.9 to 8.4	Moderate to high	Very slow.
100	100	85 to 95	.17	7.9 to 8.4	Moderate	
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	75 to 90	.14	7.9 to 8.4	Low to moderate	Moderately slow.
100	100	85 to 95	.17	6.6 to 7.3	Moderate	Very slow.
100	100	90 to 98	.17	7.4 to 8.4	High	
100	100	45 to 60	.14	6.6 to 7.3	Low	Moderate.
100	100	55 to 65	.14	6.0 to 6.5	Low to moderate	
100	100	40 to 50	.14	6.0 to 7.0	Low	
100	100	40 to 50	.14	6.5 to 7.0	Low	
100	100	75 to 98	.17	7.4 to 8.4	Moderate to high	Very slow.
100	100	90 to 98	.17	7.9 to 8.4	High	
100	100	75 to 90	.14	5.6 to 6.5	Low to moderate	Very slow.
100	100	90 to 98	.17	7.4 to 8.4	High	
100	100	75 to 95	.17	7.4 to 8.4	Moderate	
(2)	(2)	(2)	(2)	(2)	(2)	(2).
100	100	36 to 50	.14	5.6 to 7.3	Low	Slow.
100	100	36 to 55	.14	5.6 to 7.3	Low to moderate	
100	100	90 to 98	.17	6.6 to 8.4	Moderate to high	
100	100	55 to 85	.14	6.1 to 7.3	Low	Moderately slow.
100	100	75 to 95	.17	6.1 to 7.3	Moderate	
100	100	85 to 95	.17	6.6 to 8.4	Moderate	
100	100	36 to 50	.14	6.6 to 7.8	Low	Moderately rapid.

The column headed "Permeability" indicates the rate at which water moves through undisturbed soil material. The estimates are based on soil structure and porosity. Mechanically developed features, such as plowpans and surface crusting, have not been considered.

Engineering interpretations

Table 4 lists for each soil in Comanche County, interpretations of specific properties that might affect the suitability of the soils for various engineering purposes. These interpretations are based on the information in table 3, on test data, and on field experience and performance.

Normally, only the surface layer of a soil is rated for topsoil. The suitability of this layer depends largely on its texture and depth. Topsoil material must be capable

TABLE 4.—*Interpretation of engineering*

Soils and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Select grading material	Road fill	Highway location	Sewage disposal fields
Breaks-Alluvial land complex (Bk).	Poor	Unsuitable	Poor; broken topography.	Broken topography	Steep slopes; slow permeability
Broken alluvial land (Br).	Good, but amount of material limited.	Poor; too clayey	Fair; inaccessible	Frequent overflow; mostly stream channels.	Frequent overflow
Cobb (CoB, CoC, CoC2).	Poor to fair; moderately coarse.	Good; total profile suitable.	Good; total profile suitable.	Soft sandstone at a depth of 2 to 4 feet.	Features favorable
Cottonwood (CtD)	Poor; shallow	Unsuitable	Poor; shallow over gypsum.	Gypsum outcrops	Strongly sloping; shallow over rock.
Eroded clayey land (Es).	Unsuitable; limited amount of material; too plastic.	Unsuitable; highly plastic.	Poor; high shrink-swell potential; unstable when wet.	Unstable material; high shrink-swell potential.	Clayey; very slow permeability.
Eroded loamy land (Et).	Poor; limited amount of material.	Poor; local areas highly plastic.	Fair; local areas unstable when wet.	Features generally favorable; soft sandstone in some areas.	Variable permeability.
Eufaula (EuD)	Poor; soil material too coarse and easily eroded.	Good; total profile suitable.	Good if slopes are stabilized.	Cuts easily eroded	Unfiltered sewage a hazard to water supply.
Foard (FaA)	Poor; shallow over dense clay.	Poor	Very poor; high shrink-swell potential; unstable when wet.	High shrink-swell potential; unstable.	Very slow permeability.
Foard-Slickspots complex (FsA, FsB).	Poor	Poor	Very poor; dispersed; high shrink-swell potential.	Highly unstable; dispersed; high shrink-swell potential.	Very slow permeability.
Foard and Tillman (FtB).	Poor	Poor	Very poor; high shrink-swell potential; unstable when wet.	High shrink-swell potential; unstable.	Very slow permeability.
Granite cobbly land (Gc).	Unsuitable; cobbly	Unsuitable; cobbly.	Poor; cobblestones and boulders.	Rough, broken topography.	Rocky profile
Granite outcrop (Go)	Unsuitable; mostly rock.	Unsuitable; mostly rock.	Poor; mostly rock	Granite outcrops and cliffs.	Mostly rock
Hollister (HoB)	Poor	Unsuitable; highly plastic.	Poor; unstable when wet.	Level topography; unstable.	Slow permeability

of being worked into a good seedbed for seeding or sodding, yet be clayey enough to resist erosion on steep slopes. The depth of suitable material determines whether or not it is economical or wise to remove it.

The suitability rating for select grading material depends mainly on the grain size and the amount of silt and clay. Soils that are predominantly sand are good if a binder is added for cohesion. Clay soils compress under load and rebound when unloaded; thus, they are rated unsuitable.

Most kinds of soil material are used as road fill. Some soils, such as sandy clays and sandy clay loams, offer few problems in placement or compaction. Clays with a high shrink-swell potential require special compaction techniques and close moisture control both during and after

properties of soils

Soil features affecting—Continued							Hydrologic soil group
Farm ponds		Low buildings	Irrigation	Terraces and diversions	Waterways		
Reservoir area	Embankment						
Unsuitable	Unsuitable	Soils variable; steep slopes.	Nonarable	Nonarable	Nonarable	C.	
Moderate to slow seepage.	Fairly stable; moderate to slow seepage.	Frequent overflow; mostly stream channels.	Nonarable	Nonarable	Nonarable	C.	
Shallow over sandstone; moderately slow seepage.	Fairly stable fill	Features favorable	Favorable intake rate and water-holding capacity.	Features favorable.	Subject to windblown deposits and water erosion.	B.	
Shallow over rock.	Limited borrow material.	Strongly sloping; shallow over rock.	Nonarable	Nonarable	Nonarable	C.	
Slow seepage	Impervious; high volume change; high fills unstable.	High shrink-swell potential.	Severely eroded; infertile; slow intake rate.	Nonarable	Infertile; lack of topsoil; droughty.	D.	
Moderate to slow seepage; soft sandstone in some areas.	Fair to good stability.	Some areas of moderate shrink-swell potential.	Unsuitable; severely eroded; infertile.	Nonarable	Infertile; lack of topsoil.	C.	
Excessive seepage	Unstable sand; rapid seepage.	Features favorable.	Low water-holding capacity; rapid intake rate.	Rapid permeability; subject to wind erosion.	Infertile, unstable sand.	A.	
Slow seepage; nearly level topography.	High volume change; high fills unstable.	High shrink-swell potential.	Slow intake rate	Very slowly permeable subsoil.	Droughty; low fertility in subsoil.	D.	
Slow seepage	High volume change; highly unstable.	High shrink-swell potential.	Slow intake rate; slickspots unproductive.	Poor stability where dispersed.	Vegetation difficult to establish; droughty; erodible.	D.	
Slow seepage	High volume change; high fills unstable.	High shrink-swell potential.	Slow intake rate	Very slowly permeable subsoil.	Droughty; low fertility in subsoil.	D.	
Moderate to rapid seepage; rocky profile.	Limited borrow material; rocky.	Profile rocky	Nonarable	Nonarable	Nonarable	C.	
Granite outcrops and cliffs.	No borrow material.	Granite outcrops and cliffs.	Nonarable	Nonarable	Nonarable	D.	
Features favorable.	Features favorable	Moderate shrink-swell potential.	Features favorable.	Feature favorable.	Features favorable.	C.	

TABLE 4.—*Interpretation of engineering*

Soils and map symbols	Suitability as source of— Topsoil	Suitability as source of— Select grading material	Suitability as source of— Road fill	Soil features affecting— Highway location	Soil features affecting— Sewage disposal fields
Konawa (KoB, KoC, KoC2, KnB3).	Poor; coarse, easily eroded.	Surface layer good; other layers fair.	Good if slopes are stabilized.	Features favorable, except cuts easily eroded.	Features favorable.
Lawton (LaB, LaC, LaC2).	Surface layer good; other layers fair to poor.	Poor	Poor; unstable when wet.	Unstable	Moderately slow permeability.
Lawton-Foard complex (LfC).	Poor	Poor	Poor	Slickspots unstable and highly erosive.	Moderately slow permeability; slickspots almost impervious.
Lela (Lc)	Unsuitable; too clayey.	Unsuitable; highly plastic.	Poor; high shrink-swell potential; unstable when wet.	Unstable; occasional overflow.	Very slow permeability; poorly drained; overflow.
Limestone cobbly land (Lm).	Unsuitable; cobbly.	Unsuitable; cobbly.	Poor; very shallow over bedrock.	Rough, broken topography; very shallow over bedrock.	Limestone conglomerate at or near surface; steep.
Lucien-Zaneis-Vernon complex (LzD).	Poor; limited amount of material.	Poor	Fair; shallow over sandstone.	Shallow over soft sandstone; rough topography.	Slow to very slow permeability.
Miller (Mc)	Unsuitable; too clayey.	Unsuitable; highly plastic.	Poor; high shrink-swell potential; unstable when wet.	Unstable; occasional overflow.	Very slow permeability.
Minco (MnC)	Good	Fair; total profile suitable.	Fair to good; total profile suitable.	Rolling topography.	Features favorable.
Port clay loam (Pc)	Good	Unsuitable; plastic.	Poor; unstable when wet.	Level topography; unstable; occasional overflow.	Moderately slow permeability; occasional overflow.
Port loam (Po)	Good	Fair; total profile suitable.	Fair; total profile suitable.	Level topography; occasional overflow.	Occasional overflow.
Port-Slickspots complex (Ps).	Poor; limited amount of material between slickspots.	Unsuitable; dispersed in slickspots.	Poor; dispersed in slickspots.	Level topography; unstable; occasional overflow.	Occasional overflow.
Rock land (Ro)	Unsuitable	Unsuitable	Poor; rocky	Granite mountains	Rocky
Slickspots (Sc)	Unsuitable; dispersed soil material.	Unsuitable; dispersed soil material.	Poor; dispersed	Highly unstable	Slickspots almost impervious.
Stamford (SmA)	Unsuitable; too plastic.	Unsuitable; highly plastic.	Poor; moderate to high shrink-swell potential; unstable when wet.	Unstable	Very slow permeability.
Stony rock land (St)	Unsuitable	Unsuitable	Poor; stony	Granite mountains	Rocky profile

properties of soils—Continued

Soil features affecting—Continued						Hydrologic soil group
Farm ponds		Low buildings	Irrigation	Terraces and diversions	Waterways	
Reservoir area	Embankment					
Moderate seepage; shallow over sandstone in local areas.	Fairly stable; moderate seepage.	Features favorable.	Low water-holding capacity; rapid intake rate; sloping topography.	Subject to severe wind erosion.	Subject to windblown deposits and water erosion.	B.
Features favorable.	Features favorable.	Moderate shrink-swell potential.	Features favorable.	Features favorable.	Features favorable.	C.
Turbid water likely.	Slickspots unstable.	Slickspots unproductive.	Slickspots unproductive.	Slickspots unstable.	Slickspots unstable.	B (Lawton) and D (Foard).
Slow seepage; shallow.	High volume change; high fills.	High shrink-swell potential; poorly drained; overflow.	Very slow intake rate.	Level topography; very slow permeability.	Droughty; surface crusting; subject to cracking.	D.
Rock at or near surface.	Limited material__	Rock at or near surface; steep.	Nonarable________	Nonarable______	Nonarable______	D.
Shallow over soft sandstone.	Fairly poor stability; limited amount of fill material.	Broken topography; steep slopes.	Mostly nonarable.	Shallow over sandstone.	Shallow over sandstone.	C (Lucien and Zaneis) and D (Vernon).
Slow seepage; shallow.	High volume change; high fills unstable.	Poor; high shrink-swell potential; overflow.	Very slow intake rate.	Level topography; very slow permeability.	Droughty; surface crusting; subject to cracking; features unfavorable.	D.
Features favorable.	Reasonably stable fill.	Features favorable.	Sloping topography; moderate permeability.	Features favorable.	Features favorable.	B.
Shallow__________	Features favorable.	Moderate shrink-swell potential.	Slow intake rate.	Level topography.	Level topography.	C.
Little natural storage capacity.	Features favorable.	Occasional overflow.	Features favorable.	Level topography.	Level topography.	B.
Shallow__________	Unstable; dispersed.	Poor; dispersed____	Slickspots unproductive.	Level topography.	Level topography.	C and B (Port).
Rocky___________	Rocky___________	Rocky___________	Nonarable________	Nonarable______	Nonarable______	D.
Slow seepage_____	Unstable; dispersed.	Poor; dispersed; corrosive; unproductive.	Low productivity.	Unstable; dispersed.	Vegetation very difficult to establish.	D.
Slow seepage_____	Impervious; subject to cracking.	Moderate to high shrink-swell potential.	Very slow intake rate.	Very slow permeability.	Features favorable.	D.
Rocky profile_____	Rocky profile_____	Rocky profile_____	Nonarable________	Nonarable______	Nonarable______	D.

TABLE 4.—*Interpretation of engineering*

Soils and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Select grading material	Road fill	Highway location	Sewage disposal fields
Tarrant-Rock outcrop complex (Ta).	Unsuitable; rocky	Unsuitable; shallow over rock.	Poor; shallow over rock.	Rough, broken topography; limestone bedrock at depth of 1 foot or less.	Shallow over rock
Tillman (TmC)	Surface layer fair; other layers too plastic to be suitable.	Unsuitable; highly plastic.	Poor; high shrink-swell potential; unstable when wet.	Unstable	Very slow permeability.
Vanoss (VaA, VaB)	Good	Fair; total profile suitable.	Good; total profile suitable.	Features favorable	Features favorable
Vernon (VeC, VeD)	Unsuitable; limited amount of material; too plastic.	Unsuitable; highly plastic.	Poor; high shrink-swell potential; unstable when wet.	Steep topography; unstable.	Very slow permeability.
Waurika (Wa)	Poor	Unsuitable	Poor; moderate to high shrink-swell potential; unstable when wet.	Level topography; unstable.	Very slow permeability.
Wet alluvial land (We).	Poor; high water table.	Poor; high water table.	Poor; high water table.	Frequent overflow; high water table.	High water table; overflow.
Windthorst (WhB, WhC).	Poor; limited amount of material.	Fair; surface layer suitable.	Poor; moderate to high shrink-swell potential; unstable when wet.	Unstable	Slow permeability
Zaneis (ZaB, ZaC, ZaC2).	Good	Fair; surface layer suitable.	Fair; surface layer suitable; subsurface layers unstable when wet.	Features favorable	Moderately slow permeability.
Zaneis-Slickspots complex (ZsB).	Poor; limited amount of material between slickspots.	Unsuitable; dispersed.	Poor; dispersed	Highly unstable in slickspots.	Slickspots almost impervious.
Zavala (Zv)	Fair; easily eroded	Good; total profile suitable.	Good; total profile suitable.	Level topography; overflow.	Overflow

construction. Sands compact well but are difficult to confine in a fill. The rating reflects the ease with which these problems can be overcome.

The last column in table 4 shows the classification of the soils into four hydrologic soil groups. The entire soil profile is considered, to the greatest depth shown in the column headed "Depth from surface" in table 3. The soils are classified on the basis of intake of water at the end of a long duration storm that occurs after prior wetting and opportunity for swelling and without the protection of vegetation. Group A consists mostly of sandy soils that have the lowest runoff potential. Group D consists mostly of clays that have the highest runoff potential.

Test data

Table 5 contains test data for soil samples collected during the soil survey of the county and tested by the State Highway Department. Samples were collected only from selected soils. Test data for some of the other soils may be found in other published soil survey reports.

As moisture leaves a soil, the soil shrinks and decreases in volume in proportion to the loss in moisture, until a *properties of soils*—Continued

Soil features affecting—Continued						Hydrologic soil group
Farm ponds		Low buildings	Irrigation	Terraces and diversions	Waterways	
Reservoir area	Embankment					
Limestone bedrock at depth of 1 foot or less.	Limited material	Rocks and shallow soils; rough topography.	Nonarable	Nonarable	Nonarable	D.
Slow seepage	High volume change; high fills unstable.	High shrink-swell potential.	Slow intake rate; sloping topography.	Very slowly permeable subsoil.	Droughty; low fertility in subsoil.	D.
Moderate seepage	Fairly stable; moderate to slow seepage.	Features favorable.	Features favorable.	Features favorable.	Features favorable.	B.
Slow seepage	High volume change; high fills unstable.	High shrink-swell potential; some steep slopes.	Slow intake rate; low productivity.	Shallow; slow to very slow permeability.	Infertile; droughty; water erosion.	D.
Slow seepage	Impervious; fairly stable.	Moderate to high shrink-swell potential.	Slow intake rate	Level topography; very slowly permeable subsoil.	Droughty	D.
High water table; normally suitable for dug ponds.	Pervious; easily eroded.	High water table; overflow.	Nonarable	Nonarable	Nonarable	C.
Slow seepage	Features favorable.	Moderate to high shrink-swell potential.	Sloping topography; slow intake rate.	Severe erosion; slowly permeable subsoil.	Droughty; low fertility.	C.
Moderate to slow seepage.	Features favorable.	Features favorable.	Features favorable.	Features favorable.	Features favorable.	C.
Slow seepage	Unstable; slickspots highly dispersed.	Dispersed; corrosive and nonproductive.	Slickspots unproductive.	Poor stability where dispersed.	Vegetation difficult to establish; droughty; erodible.	
Moderately rapid seepage.	Fairly stable	Overflow	Overflow	Overflow	Level topography.	B.

point is reached where shrinkage stops, even though additional moisture may still be removed from the soil. The moisture content at which shrinkage stops is called the shrinkage limit. The shrinkage limit of a soil is a general index of clay content and generally decreases as the clay content increases. The shrinkage limit of sand that contains little or no clay gives a test result that is close to the liquid limit and, therefore, is considered insignificant. As a rule, the load-carrying capacity of a soil is at a maximum when its moisture content is at or below the shrinkage limit. Sand is an exception. If confined, it has a uniform load-carrying capacity within a considerable range in moisture content.

The shrinkage ratio is the volume change resulting from the drying of a soil material, divided by the loss of moisture caused by drying. The ratio is expressed numerically. The volume change used in computing shrinkage ratio is the change in volume that will take place in a soil when it dries from a given moisture content to the point where no further shrinkage takes place.

TABLE 5.—*Engineering*

[Tests performed by Oklahoma Department of Highways in accordance with standard

Soil name and location	Parent material	Oklahoma report number SO—	Depth from surface	Horizon	Shrinkage		Volume change from field moisture equivalent
					Limit	Ratio	
			In.		*Pct.*		*Pct.*
Cobb fine sandy loam	Permian sandstone.	6187	0 to 13	A1	15	1. 81	7
252 ft. south and 30 ft. west of northeast corner of sec. 4, T. 3 N., R. 10 W. (Modal).		6188	17 to 31	B2	16	1. 84	19
		6189	31 to 50	C	14	1. 91	20
Eufaula fine sand	Windblown sand.	6184	0 to 5	A1	[3] NP	NP	NP
2,250 ft. south and 30 ft. west of northeast corner of sec. 27, T. 4 N., R. 9 W. (Modal).		6185	5 to 60	C1	NP	NP	NP
		6186	60 to 80	C2	NP	NP	NP
Foard silt loam	Permian red beds.	6172	0 to 7	A1	18	1. 65	32
360 ft. west and 50 ft. north of southeast corner of sec. 22, T. 1 N., R. 12 W. (Modal).		6173	7 to 21	B2	9	2. 01	77
		6174	26 to 42	Cca	9	2. 10	83
Lawton loam	Granitic mountain outwash over Permian red beds.	6190	0 to 9	A1	15	1. 84	16
885 ft. south and 35 ft. east of west quarter corner of sec. 20, T. 1 S., R. 13 W. (Modal)		6191	13 to 33	B2	11	2. 01	56
		6192	47 to 72	C	9	2. 05	56
Slickspots in Port-Slickspots complex	Alluvium.	6175	0 to 5	A1	17	1. 76	13
2,300 ft. east and 700 ft. south of northwest corner of sec. 28, T. 1 N., R. 13 W. (Modal)		6176	5 to 30	B2	17	1. 78	24
		6177	30 to 48	C	13	1. 89	42
Stamford clay	Permian red beds.	6170	0 to 12	A1	11	1. 97	72
540 ft. west and 20 ft. south of northeast corner of sec. 23, T. 1 N., R. 12 W. (Modal)		6171	20 to 40	C	10	2. 05	41
Vanoss loam	Eolian or alluvial silt and loam.	6181	0 to 11	A1	19	1. 69	17
1,900 ft. west and 30 ft. north of southeast corner of sec. 3, T. 3 N., R. 9 W. (Modal)		6182	16 to 33	B2	17	1. 81	18
		6183	44 to 65	C	17	1. 77	9
Zaneis loam in Zaneis-Slickspots complex.	Permian clay, silt, and sandstone.	6178	0 to 10	A1	15	1. 86	16
1,800 ft. south and 66 ft. west of northeast corner of sec. 20, T. 1 N., R. 10 W. (Modal)		6179	13 to 22	B2	12	1. 96	53
		6180	28 to 45	C	14	1. 86	27

[1] According to Designation: T 88–57, "Mechanical Analysis of Soils," in "Standard Specifications for Highway Materials and Methods of Sampling and Testing," Pt. 2, Ed. 8 (1961), published by AASHO. Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

The field moisture equivalent is the minimum moisture content at which a smooth soil surface will absorb no more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils. The volume change from field moisture equivalent is the volume change, expressed as a percentage of the dry volume, of the soil mass when the moisture content is reduced from the field moisture equivalent to the shrinkage limit.

In mechanical analysis, the soil components are sorted by particle size. Sand and other granular material are retained on the No. 200 sieve. Silt-clay materials are those soil particles smaller than the openings in a No. 200

test data

procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [1]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—					AASHO	Unified [2]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
							Pct.			
----------	----------	100	40	27	16	15	19	1	A-4(1)	SM.
----------	----------	100	44	37	25	24	29	10	A-4(2)	SC.
----------	----------	100	52	43	28	25	27	9	A-4(3)	CL.
----------	----------	100	33	15	5	4	NP	NP	A-2-3(0)	SM.
----------	----------	----------	7	4	3	3	NP	NP	A-3(0)	SP-SM.
----------	----------	----------	13	9	8	7	NP	NP	A-2-3(0)	SM.
----------	----------	100	96	87	32	27	39	14	A-6(9)	ML-CL.
----------	----------	----------	98	89	49	43	61	32	A-7-6(20)	MH-CH.
100	97	95	93	88	49	42	59	32	A-7-6(20)	CH.
----------	100	94	76	61	22	19	25	6	A-4(8)	ML-CL.
----------	100	96	86	79	42	38	45	21	A-7-6(13)	CL.
100	99	97	81	73	41	36	47	25	A-7-6(15)	CL.
----------	----------	100	93	82	23	17	25	4	A-4(8)	ML-CL.
----------	----------	100	95	85	32	26	34	13	A-6(9)	CL.
100	99	98	90	83	34	29	46	25	A-7-6(15)	CL.
----------	----------	----------	98	94	59	47	53	22	A-7-6(15)	MH.
100	99	96	89	81	40	34	36	17	A-6(11)	CL.
----------	----------	100	49	35	16	13	27	4	A-4(3)	SM-SC.
----------	----------	----------	56	40	22	20	26	6	A-4(4)	ML-CL.
----------	----------	----------	47	29	16	15	23	3	A-4(2)	SM.
----------	----------	----------	76	60	25	21	26	8	A-4(8)	CL.
----------	----------	----------	72	59	43	39	42	17	A-7-6(10)	ML-CL.
----------	----------	----------	50	41	32	29	30	11	A-6(4)	SC.

[2] Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points of the A-line are to be given a borderline classification. Examples of borderline classification obtained by this use are SM-SC, ML-CL, MH-CH, and SP-SM.

[3] Nonplastic.

sieve. Clay is the fraction smaller than 0.005 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.005 millimeter is called silt.

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

Genesis, Classification, and Morphology of the Soils

This section presents the outstanding morphologic characteristics of the soils of Comanche County and relates them to the factors of soil formation. The first part deals with the development of the soils, and the second part with the classification and morphology of the soils.

Factors of Soil Formation

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

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

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

In Comanche County, most of the soils on uplands formed in material weathered from sandstone, siltstone, and clay. Some of the soils on uplands formed in material deposited by wind. Most of the soils on flood plains formed in recent alluvium.

The surface rocks of Comanche County belong to five geologic systems: The Quaternary, the Permian, the Ordovician, the Cambrian, and the Precambrian (see figure 20, page 57).

Quaternary.—The Quaternary system is represented in this county by deposits of alluvium on flood plains along the major streams, which overflow periodically, and by older loamy deposits on uplands. These deposits are mostly loamy and sandy. They vary considerably in thickness but are commonly less than 30 feet thick. The main soils that formed in sediments of this age on flood plains are those of the Port, Zavala, Lela, and Miller series. Soils that formed in sediments of this age on uplands are those of the Vanoss, Minco, Konawa, Windthorst, Eufaula, and Lawton series.

Permian.—About three-fourths of the surface area of this county is underlain by rocks of Permian age. Seven formations of this system are represented in the county: the Cloud Chief formation, Rush Springs sandstone, the Marlow formation, the El Reno group (Chickasha formation and Duncan sandstone), Hennessey shale, the Wichita formation, and Post Oak conglomerate. The main soils that developed over rocks of the Permian system are those of the Cobb, Cottonwood, Foard, Hollister, Lucien, Stamford, Tillman, Vernon, Waurika, and Zaneis series.

Ordovician.—Rocks of the Ordovician system form the limestone ridges along the northern edge of the Wichita Mountains. The main soils derived from these formations are those of the Tarrant series.

Cambrian.—The Cambrian rocks in this county are Signal Mountain limestone, Royer dolomite, and Fort Sill limestone. The main soils derived from these formations are those of the Tarrant series.

Precambrian.—The Precambrian rocks in this county are Meers quartzite, gabbro, anorthosite, granite, and phyllite. They are a part of the Wichita Mountains, which formed during the Wichita uplift early in the Pennsylvanian era. These rocks account for the formation of the land types in the county, but not for the formation of any true soils.

Climate

Comanche County has a dry, subhumid, continental climate. Rainfall is heaviest in spring. Summers are hot and generally dry, and winters are mild, although severe cold spells sometimes occur. The rainfall is often of high intensity. Because of strong winds and high temperature, the rate of evaporation is high; consequently, little water moves through the soils, except for the more permeable sandy soils, and the basic elements are not depleted by leaching. The presence of a lime zone in many soils indicates the average depth to which water moves.

Climate is directly or indirectly the cause of many variations in plant and animal life; thus it affects the changes in soils that are brought about by plant and animal life.

Plant and animal life

Plants, micro-organisms, earthworms, and various other organisms are active agencies in the soil-forming processes. Living organisms affect the chemistry of the soil and hasten soil development. They help to decompose plant residue and help to convert plant nutrients to a form that is readily available to plants. Micro-organisms and burrowing animals aid in mixing the various horizons of soils.

Vegetation provides shade and reduces the loss of water from runoff, wind, and heat. It adds organic matter, thereby influencing the structure and physical condition of the soil. The plant roots help to keep the soil supplied with minerals by bringing elements from the parent material to the surface layer, in a form more usable to plants.

Water passes through soils under deep-rooted vegetation more readily than it does through those under shallow-rooted vegetation. Leaching therefore is more common under deep-rooted vegetation.

The principal types of vegetation in Comanche County are short, mid, and tall grasses, blackjack oak, and post oak. The nearly level to gently sloping, fine-textured soils developed under a sparse to dense cover of short and mid grasses. Most of the shallow and deep, medium-textured soils developed under a dense cover of mid and tall grasses. The sandy soils developed where the vegetation consists of blackjack oak, post oak, and tall grasses. The alluvial soils developed under tall grasses and hardwood trees.

Relief

Relief, or the elevations or inequalities of the land surface, affects the development of soils by its effect on runoff and drainage. In Comanche County, the relief ranges from nearly level or slightly depressed to steep.

Other soil-forming factors being equal, the degree of development in the soil profile depends on the average amount of moisture in the soil. A nearly level soil that has little runoff shows more development than a sloping soil of the same age. Soil-forming processes are retarded in sloping soils by loss of soil material through erosion and runoff. Waurika soils, for example, are nearly level or slightly depressed, are strongly developed, and have a heavy, claypan-type subsoil. Lawton and Zaneis soils are very gently sloping and gently sloping and have a subsoil that is well developed but lacks the pan. Lucien and Vernon are examples of strongly sloping soils that show very little horizon development because the loss of soil material through runoff and erosion almost keeps pace with weathering and soil formation.

Time

The length of time required for the formation of a mature soil depends largely on the other factors involved. The degree of profile development depends on the intensity of the different soil-forming factors, on the length of time these factors have been active, and on the nature of the material from which the soils developed. If the factors of soil formation have not operated long enough to form a soil that contains definite horizons, the soil is considered young, or immature. Soils that have been in place for a long time and have approached equilibrium with their environment tend to have well-expressed horizons and are considered mature.

Classification and Morphology of the Soils

Soils are placed in narrow classes for the organization and application of knowledge about their behavior within farms, ranches, or counties. They are placed in broad classes for study and comparisons of large areas, such as continents. The soil classification used in the United States [9] consists of six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great soil group, the family, the series, and the type.

There are three orders (zonal, intrazonal, and azonal) [10] and thousands of types. The suborder and family categories have never been fully developed and thus have been little used. Attention has been directed largely toward the identification of soil types, series, great soil groups, and orders.

The classification of soil series in Comanche County into great soil groups is shown in the following tabulation.

Order and great soil group	Series
Zonal—	
Reddish Chestnut	Cobb, Hollister, Lawton, Tillman.
Intergrading toward Solonetz	Foard.
Reddish Prairie	Minco, Vanoss, Zaneis.
Red-Yellow Podzolic	Eufaula, Konawa, Windthorst.
Intrazonal—	
Planosol	Waurika.
Azonal—	
Alluvial	Lela, Miller, Port, Zavala.
Lithosol	Cottonwood, Lucien, Tarrant, Vernon.
Regosol	Stamford.

In the following pages are descriptions of the great soil groups represented in Comanche County and a detailed description of a representative soil of each series in the county.

Zonal soils

Zonal soils have well-developed profile characteristics that reflect the influence of the active factors of soil formation, such as climate and living organisms. Zonal soils are represented in Comanche County by Reddish Chestnut soils, Reddish Prairie soils, and Red-Yellow Podzolic soils.

REDDISH CHESTNUT SOILS

Reddish Chestnut soils form in a semiarid or subhumid, warm-temperate climate under mixed grasses. They have a granular, brown to reddish-brown or dark grayish-brown surface layer that is slightly acid or neutral. This layer is underlain by finer textured, red to reddish brown to yellowish red or grayish brown, blocky, slightly acid to moderately alkaline material. The parent material in this county consists of weak to compact, calcareous clay of the red beds and soft, noncalcareous sandstone or moderately gravelly old alluvium washed from nearby granitic mountains.

The Reddish Chestnut soils in Comanche County are those of the Cobb, Hollister, Lawton, and Tillman series. The Foard soils are Reddish Chestnut soils that have some characteristics of Solonetz soils.

Cobb Series

The Cobb series consists of moderately deep soils that have a B2t horizon of reddish sandy clay loam or heavy sandy loam. These soils developed in material weathered from noncalcareous, reddish Permian sandstone that occurs at a depth of 20 to 48 inches.

Profile of Cobb fine sandy loam in a native pasture.

A1—0 to 10 inches, brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, medium, granular structure; friable when moist, slightly hard when dry; pH 6.5; clear boundary.

[9] Baldwin, Mark, Kellogg, Charles E., and Thorp, James. SOIL CLASSIFICATION. U.S. Dept. Agr. Ybk., pp. 979–1001. 1938.

[10] Thorp, James, and Smith, Guy D. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126. 1949.

B21t—10 to 27 inches, reddish-brown (2.5YR 4/4) light sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; weak, medium, subangular blocky structure; friable when moist, hard when dry; pH 6.5; gradual boundary.

B22t—27 to 35 inches, red (2.5YR 4/6) heavy fine sandy loam, red (2.5YR 4/6) when moist; weak, fine, subangular blocky structure; friable when moist, hard when dry; pH 6.5; gradual boundary.

R—35 to 40 inches, red (2.5YR 5/6) soft sandstone, red (2.5YR 4/6) when moist; noncalcareous.

The color of the A horizon ranges from brown to reddish brown in hues of 7.5YR to 5YR, and the thickness from 6 to 14 inches. The color of the B2t horizon ranges from reddish brown through yellowish red to red, and the texture from heavy fine sandy loam to sandy clay loam. The clay content is about 18 to 25 percent. The depth to weakly cemented sandstone ranges from 20 to 48 inches. The reaction in the A and B horizons is slightly acid or neutral.

Hollister Series

The Hollister series consists of well-developed, nearly level, dark grayish-brown soils that have a clay subsoil. These soils developed in brownish, moderately fine textured sediments.

Profile of Hollister silt loam in a cultivated field 200 feet north and 60 feet west of the south quarter corner of sec. 25, T. 4 N., R. 12 W.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure; friable when moist, hard when dry; pH 7.0; clear boundary.

B1—8 to 16 inches, brown (10YR 4/3) light silty clay loam, dark brown (10YR 3/3) when moist; weak, medium, granular structure; firm when moist, very hard when dry; pH 7.0; many worm casts; clear boundary.

B2t—16 to 30 inches, grayish-brown (10YR 5/2) light silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure; very firm when moist, very hard when dry; pH 7.0; clear boundary.

B3—30 to 35 inches, brown (10YR 5/3) heavy silty clay loam, dark brown (10YR 3/3) when moist; weak, blocky structure; firm when moist, very hard when dry; pH 7.0; gradual boundary.

C—35 to 48 inches, yellowish-brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 3/4) when moist; massive; firm when moist, very hard when dry; calcareous; porous.

The thickness of the A horizon ranges from 6 to 16 inches, and the color from dark grayish brown to brown. The texture of the B horizon ranges from light silty clay to clay, and the color from dark grayish brown to brown.

Lawton Series

The Lawton series consists of deep soils that have a clay loam subsoil. These soils developed in a subhumid climate, in noncalcareous granitic outwash, which is most prevalent in areas near the Wichita Mountains. They occur on undulating uplands, mostly along the courses of former drainageways that spread out from the mountains onto the plain. Granitic pebbles and sand occur throughout the profile; the pebbles are most numerous in areas near the mountains.

Profile of Lawton loam in a native pasture 1,600 feet south and 50 feet west of the east quarter corner of sec. 19, T. 1 S., R. 13 W.

A1—0 to 11 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; friable when moist, hard when dry; pH 6.5; clear boundary.

B1—11 to 18 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, granular structure; firm when moist, hard when dry; pH 6.6; few coarse granitic sand grains; gradual boundary.

B2t—18 to 32 inches, reddish-brown (5YR 4/4) heavy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, blocky structure; firm when moist, very hard when dry; pH 7.0; many coarse granitic sand grains and few pebbles; gradual boundary.

B3—32 to 47 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, medium, blocky structure to massive; firm when moist, very hard when dry; pH 7.0; many medium granitic sand grains and few small pebbles; gradual boundary.

C—47 to 72 inches, yellowish-red (5YR 5/6) heavy sandy loam, yellowish red (5YR 4/6) when moist; massive; friable when moist, hard when dry; pH 7.5; numerous granitic sand grains and few small pebbles.

The thickness of the A horizon ranges from 6 to 14 inches, and the color from brown to reddish brown. The texture of the subsoil ranges from clay loam to light clay, and the color from dark reddish brown to yellowish red. In places free carbonates occur below a depth of 60 inches. Beds of gravel occur at a depth of 60 to 90 inches but are nearer the surface in areas near the Wichita Mountains.

Tillman Series

The Tillman series consists of brown to dark reddish-brown soils that have a compact clay subsoil. These soils overlie red beds and are noncalcareous to a depth of more than 12 inches. They occur on uplands, are very gently sloping and gently sloping, and developed under a cover of short and mid grasses.

Profile of Tillman clay loam in a native pasture 2,300 feet north and 50 feet west of the south quarter corner of sec. 5, T. 1 S., R. 12 W.

A1—0 to 6 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; friable when moist, hard when dry; pH 7.0; gradual boundary.

B1—6 to 13 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure grading with depth to weak, fine, blocky; firm when moist, very hard when dry; pH 7.0; gradual boundary.

B21t—13 to 20 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; moderate, fine, blocky structure; very firm when moist, extremely hard when dry; calcareous; gradual boundary.

B22t—20 to 24 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; weak, fine, blocky structure to massive; very firm when moist, extremely hard when dry; calcareous; gradual boundary.

Cca—24 to 40 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; massive; very firm when moist, extremely hard when dry; calcareous because of many calcium carbonate concretions; gradual boundary.

C—40 to 50 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; massive; very firm when moist, extremely hard when dry; calcareous.

The color of the A horizon ranges from brown to dark reddish brown, and the thickness from 5 to 10 inches. The color of the B2t horizon ranges from reddish brown to dark reddish brown, and the texture from light clay to silty clay. The profile is noncalcareous to a depth of more than 12 inches and in places contains small granitic pebbles.

Foard Series

The Foard series consists of brownish, nearly level, claypan soils. These soils intergrade toward Solonetz soils. They formed in a subhumid, warm-temperate climate, under short and mid grasses, over clayey red beds.

Profile of Foard silt loam in a native pasture 1,600 feet north and 50 feet west of the southeast corner of sec. 22, T. 1 N., R. 12 W.

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; friable when moist, hard when dry; pH 6.5; abrupt boundary.

B2t—7 to 24 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; weak, medium, blocky structure; very firm when moist, extremely hard when dry; pH 7.5; gradual boundary.

B3ca—24 to 28 inches, brown (10YR 4/3) light clay, dark brown (10YR 3/3) when moist; massive; very firm when moist, extremely hard when dry; calcareous because of many small calcium carbonate concretions; gradual boundary.

Cca—28 to 48 inches, brown (10YR 5/3) light clay, brown (10YR 4/3) when moist; massive; very firm when moist, extremely hard when dry; calcareous because of many calcium carbonate concretions; gradual boundary.

C—48 to 60 inches, brown (7.5YR 5/4) light clay, brown (7.5YR 4/4) when moist; faintly mottled with redder and yellower colors; massive; very firm when moist, extremely hard when dry; calcareous because of many soft lime concretions.

The color of the A horizon ranges from grayish brown to dark brown, and the thickness from 5 to 10 inches. The color of the B2t horizon ranges from dark grayish brown to dark brown, and the texture from clay to silty clay. The depth to free carbonates ranges from 12 to 24 inches. In places there are very small granitic pebbles scattered throughout the profile.

Following is a description of the profile of Foard silt loam from which the sample described in tables 6 and 7 was taken. This is a nearly level soil on uplands. It is about 800 feet north of an entrenched drainageway 15 feet deep. The slope is smooth, and the gradient is less than 1 percent. The surface is covered with wheat stubble. This profile is in a cultivated field 2 miles northeast of Chattanooga, Okla., 67 feet east and 950 feet north of the southwest corner of sec. 23, T. 1 S., R. 14 W.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; surface tends to be platy and is vesicular; nearly structureless or puddled; friable when moist, hard when dry; abrupt, plowed boundary.

B21t—8 to 14 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, subangular blocky structure; darkened faces in uppermost 1 inch; firm when moist, very hard when dry; thin, continuous clay films; slickenside faces not prominent; clear, wavy boundary; 6 to 12 inches thick.

B22t—14 to 21 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; very firm when moist, very hard when dry; soil mass is calcareous, and about 2 percent of it consists of segregated lime in soft concretions and blotches; few, fine, black pellets; gradual boundary.

Bca1—21 to 30 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; massive; very firm when moist, very hard when dry; 3 percent of this layer consists of hard and soft lime concretions; diffuse boundary.

Bca2—30 to 44 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; massive; very firm when moist, very hard when dry; lime content less than in Bca1 horizon; black pellets, salt seams, and blotches are common; diffuse boundary.

B3—44 to 54 inches, light-brown (7.5YR 6/4) silty clay loam mottled with gray and black blotches, brown (7.5YR 5/4) when moist; weak to moderate, medium, subangular blocky structure; firm when moist, very hard when dry; many black pellets 2 millimeters in diameter; gradual boundary.

C1—54 to 64 inches, light-brown (7.5YR 6/4) clay loam with mottled gray spots and many black blotches, brown (7.5YR 5/4) when moist; vertical seams of gray clay are 2 to 3 inches wide and extend into C2 horizon; weak, coarse, blocky structure; a few slickenside faces; diffuse boundary.

C2—64 to 70 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; weak, coarse, blocky structure; large lime blotches are common; soil is compact and appears to be red-bed material only slightly weathered.

REDDISH PRAIRIE SOILS

The Reddish Prairie soils in Comanche County developed in material weathered from the Permian red beds, under a cover of mid and tall grasses, in a subhumid, warm climate.

The surface layer of these soils is generally brown to reddish-brown loam, is slightly acid or neutral, and has granular structure. The subsoil is brown to red loam to clay loam and has granular to blocky structure. The parent material ranges from sandstone to clay to old alluvium and is slightly acid to moderately alkaline.

The Reddish Prairie soils in Comanche County are those of the Minco, Vanoss, and Zaneis series.

Minco Series

The Minco series consists of reddish, well-drained, alluvial-colluvial soils that are medium textured throughout the profile. These soils have a distinct A1 horizon but no developed textural profile or B horizon. They occur on foot slopes. The parent material is alluvium derived from Lucien and Zaneis soils.

Profile of Minco loam in a cultivated field 400 feet north and 50 feet west of the southeast corner of sec. 15, T. 3 N., R. 9 W.

Ap—0 to 7 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, granular structure; friable when moist, hard when dry; pH 7.0; porous; plow boundary.

A12—7 to 18 inches, reddish-brown (2.5YR 4/4) loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine to medium, granular structure; friable when moist, hard when dry; pH 6.5; gradual boundary.

B—18 to 78 inches, red (2.5YR 4/6) loam, dark red (2.5YR 3/6) when moist; weak, medium, granular structure to moderate, coarse, prismatic; friable when moist, slightly hard when dry; pH 6.0.

The texture throughout the profile is principally loam but ranges to very fine sandy loam and silt loam. The surface layer ranges from brown to dark reddish brown in color, and the subsoil from red to yellowish red.

TABLE 6.—*Physical properties of Foard silt loam*

[Sample number S59 Okla–16–1 (1 to 8), laboratory numbers 11450–57; analyzed by Soil Survey Laboratory, SCS, Lincoln, Nebr.]

Depth from surface	Horizon	Particle-size distribution										Textural class
		Sand					Silt	Clay	International classification		Coarse fragments	
		Very coarse (2 to 1 mm.)	Coarse (1 to 0.5 mm.)	Medium (0.5 to 0.25 mm.)	Fine (0.25 to 0.10 mm.)	Very fine (0.10 to 0.05 mm.)	(0.05 to 0.002 mm.)	(Less than 0.002 mm.)	(0.2 to 0.02 mm.)	(0.02 to 0.002 mm.)	(More than 2 mm.)	
In.		*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	
0 to 8	Ap	[1] 0.2	[1] 0.8	[1] 0.6	2.7	14.1	60.0	21.6	53.3	23.0	----------	Silt loam.
8 to 14	B21t	[1] .2	[1] .5	[1] .4	1.7	9.4	45.4	42.4	35.9	20.3	----------	Silty clay.
14 to 21	B22t	[2] 1.3	[2] 1.4	[3] .7	[3] 2.5	[3] 10.9	49.6	33.6	39.3	23.2	----------	Silty clay loam.
21 to 30	Bca1	[2] 1.6	[2] 1.6	[3] .8	[3] 2.9	[3] 10.0	49.4	33.7	40.3	21.5	[4]	Silty clay loam.
30 to 44	Bca2	[2] 1.6	[2] 1.2	[1] .7	[3] 3.0	[3] 10.0	48.3	35.2	37.1	23.7	[4]	Silty clay loam.
44 to 54	B3	[5] .9	[5] 1.3	[5] .8	[3] 3.6	[3] 11.6	47.4	34.4	39.1	22.9	[4]	Silty clay loam.
54 to 64	C1	[5] .7	[5] 1.3	[5] .7	[3] 3.8	[3] 13.0	47.4	33.1	41.9	21.7	[4]	Silty clay loam or clay.
64 to 70	C2	[5] .7	[5] 1.4	[5] .9	[3] 4.5	[3] 14.4	46.9	31.2	43.5	21.6	[4]	Clay.

[1] Few (Fe–Mn?) concretions.
[2] Few (Fe–Mn?) concretions; many calcareous aggregates.
[3] Trace calcareous aggregates.
[4] Trace.
[5] Few (Fe–Mn?) concretions; few calcareous aggregates.

VANOSS SERIES

The Vanoss series consists of brown to very dark brown, well-drained soils that have a brown or strong-brown, friable subsoil. These soils developed in eolian or alluvial silty or loamy material. They occur on broad, nearly level and very gently sloping ridgetops.

Profile of Vanoss loam in a native pasture 800 feet east and 50 feet north of the south quarter corner of sec. 3, T. 3 N., R. 9 W.

A1—0 to 12 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; friable when moist, slightly hard when dry; pH 7.0; clear boundary.

B1—12 to 18 inches, brown (7.5YR 4/3) heavy loam, dark brown (7.5YR 3/3) when moist; coarse, prismatic structure and weak, medium, granular; friable when moist, hard when dry; pH 6.5; gradual boundary.

B2t—18 to 36 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 3/4) when moist; moderate, medium, granular structure and moderate, coarse, prismatic, friable when moist, hard when dry; pH 6.0; gradual boundary.

B3—36 to 48 inches, strong-brown (7.5YR 5/6) light sandy clay loam, strong brown (7.5YR 4/6) when moist; weak, medium, granular structure and weak, coarse, prismatic; friable when moist, hard when dry; pH 6.0; gradual boundary.

C—48 to 80 inches, strong-brown (7.5YR 5/6) heavy fine sandy loam, strong brown (7.5YR 4/6) when moist; structureless; friable when moist, hard when dry; pH 6.5.

The color of the A horizon ranges from brown to very dark brown, and the thickness from 8 to 14 inches. The texture of the B2t horizon ranges from loam to clay loam, and the color from brown to yellowish brown.

ZANEIS SERIES

The Zaneis series consists of reddish-brown, noncalcareous soils that have a subsoil of red or reddish-brown clay loam. These soils developed over noncalcareous or weakly calcareous red beds. They are 24 to 50 inches deep.

Profile of Zaneis loam in a cultivated field 250 feet east and 125 feet north of the southwest corner of sec. 4, T. 1 N., R. 9 W.

Ap—0 to 6 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; weak, medium, granular structure; friable when moist, slightly hard when dry; pH 6.5; plowed boundary.

B1—6 to 12 inches, reddish-brown (2.5YR 4/4) light clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, subangular blocky structure; firm when moist, hard when dry; pH 6.5; gradual boundary.

B2t—12 to 18 inches, red (2.5YR 4/6) heavy clay loam, dark red (2.5YR 3/6) when moist; moderate, medium, subangular blocky structure; firm when moist, very hard when dry; pH 6.5; gradual boundary.

B3—18 to 28 inches, red (2.5YR 4/6) heavy clay loam, red (2.5YR 4/6) when moist; weak, medium, subangular blocky structure; firm when moist, very hard when dry; pH 6.5; gradual boundary.

C—28 to 37 inches, red (2.5YR 4/8) shaly silty clay loam with gray colors; very firm when moist, very hard when dry; calcareous because of few hard lime concretions.

The thickness of the A horizon ranges from 5 to 12 inches, and the color from brown to reddish brown. The color of the B horizon ranges from reddish brown to red. The texture of the B2t horizon ranges from clay loam to light clay. The Permian red beds occur at a depth of 24 to 50 inches.

RED-YELLOW PODZOLIC SOILS

The Red-Yellow Podzolic soils in Comanche County have a light-colored, leached A2 horizon and a subsoil of yellowish-red, reddish-brown, light-red, or red fine sand containing bands of loamy fine sand, sandy clay loam, or sandy clay. These soils developed in a warm-temperate, subhumid climate, under a cover of post oak and blackjack oak. The parent material was sandy alluvium, clay, and sandstone.

The Red-Yellow Podzolic soils in this county are those of the Eufaula, Konawa, and Windthorst series.

Eufaula Series

The Eufaula series consists of light-colored, deep, loose sands that are slightly acid or medium acid in reaction. These soils have a thick A2 horizon over a B2t horizon. They developed from sandy alluvium, under a mixed cover of tall grasses and trees.

Profile of Eufaula fine sand under native cover of trees and tall grasses 2,640 feet south and 120 feet west of the northeast corner of sec. 27, T. 4 N., R. 9 W.

A1—0 to 5 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) when moist; structureless; very friable when moist, loose when dry; pH 6.0; gradual boundary.

A21—5 to 27 inches, pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) when moist; structureless; very friable when moist, loose when dry; pH 6.0; gradual boundary.

A22—27 to 40 inches, reddish-yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) when moist; structureless; very friable when moist, loose when dry; pH 6.0; clear boundary.

B2t—40 to 60 inches, light-red (2.5YR 6/8) fine sand, red (2.5YR 5/8) when moist; thin bands of red (2.5YR 4/6) (dry and moist) loamy fine sand; structureless; very friable when moist; the fine sand is loose when dry, and the loamy fine sand is slightly hard when dry; pH 5.7.

The color of the A1 horizon ranges from brown to pale brown. The color of the A2 horizon ranges from very pale brown to reddish yellow. This horizon extends to a depth of 40 to 60 inches or more.

Konawa Series

The Konawa series consists of soils that are dark colored in the upper part of the A horizon and light colored in the lower part. The B2t horizon is reddish sandy clay loam and grades to a fine sandy loam substratum. These soils developed in deep, sandy to loamy material deposited over red beds, under a thick cover of tall grasses, blackjack oak, and post oak.

Profile of Konawa loamy fine sand in a native wooded pasture 1,000 feet north and 100 feet west of the southeast corner of sec. 19, T. 4 N., R. 10 W.

A1—0 to 8 inches, brown (7.5YR 4/2) loamy fine sand, dark brown (7.5YR 3/2) when moist; very weak, fine, granular structure to structureless; very friable when moist, soft when dry; pH 6.5; gradual boundary.

A2—8 to 17 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; structureless; very friable when moist, soft when dry; pH 6.0; abrupt boundary.

B2t—17 to 32 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; weak, coarse, blocky structure to weak, coarse, prismatic; friable when moist, hard when dry; pH 6.0; clear boundary.

B3—32 to 41 inches, red (2.5YR 5/6) light sandy clay loam, red (2.5YR 4/6) when moist; massive; friable when moist, slightly hard when dry; pH 6.0; clear boundary.

C—41 to 60 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; structureless; very friable when moist, slightly hard when dry; pH 6.0.

The thickness of the A horizon ranges from 10 to 20 inches. The color of the A1 horizon ranges from brown to reddish brown. The texture of the B2t horizon is sandy clay loam, and the color ranges from reddish brown to red. The reaction of the solum ranges from medium acid to neutral. The parent material is noncalcareous.

Windthorst Series

The Windthorst series consists of soils that have an A horizon of sandy loam and a B2t horizon of sandy clay. These soils developed over clayey red beds, under open-canopied oak forest or under prairie grasses and scattered trees. The parent material consists of thin deposits of noncalcareous granitic outwash material over the red beds. These are very gently sloping and gently sloping soils on uplands. They occur along the streams that drain from the Wichita Mountains.

Profile of Windthorst sandy loam in a native pasture 600 feet west and 120 feet north of the southeast corner of sec. 5, T. 1 N., R. 14 W.

A1—0 to 5 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; friable when moist, slightly hard when dry; pH 6.5; clear boundary.

A2—5 to 8 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 4/3) when moist; weak, medium, granular structure: friable when moist, hard when dry; pH 6.0; abrupt boundary.

B21t—8 to 21 inches, reddish-brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) when moist; moderate, medium and coarse, blocky structure; very firm when moist, extremely hard when dry; pH 6.0; gradual boundary.

B22t—21 to 48 inches, mottled yellowish-red (5YR 5/6) and red (2 5YR 4/6) light sandy clay; weak, medium and coarse, blocky structure; very firm when moist, extremely hard when dry; pH 7.0; gradual boundary.

IIC—48 to 60 inches, mottled reddish-brown and grayish-brown clay; massive; segregated calcium carbonate concretions are common.

The thickness of the A horizon ranges from 6 to 14 inches. In cultivated areas the A2 horizon is generally mixed with the plow layer. The texture of the B2t horizon ranges from heavy sandy clay loam and sandy clay to light clay. The color of the B2t horizon ranges from reddish brown to yellowish red, and at a depth below 21 inches there are red to gray mottles. The solum is generally medium acid to neutral, and the substratum is generally neutral to moderately alkaline. The red beds are at a depth of 2 to 4 feet.

Intrazonal soils

Intrazonal soils have more or less well-developed soil characteristics that reflect the dominant influence of a local factor of relief or parent material over the normal effects of climate and plant and animal life. These soils occur as small areas within larger areas of zonal soils. Intrazonal soils are represented in Comanche County by Planosols and Solonetz soils. The slickspots in areas of the Zaneis, Foard, and Port soils and the Slickspots mapping unit are solonetzic.

PLANOSOLS

The Planosols in Comanche County developed in material weathered from the Permian red beds, under a cover of short prairie grasses. They occur in level or depressed areas that have little or no surface runoff. The parent material contains a large amount of clay. These soils have a grayish-brown surface layer and a compact, blocky clay subsoil.

Soils of the Waurika series represent the Planosols in Comanche County.

TABLE 7.—*Chemical*

[Sample number S 59 Okla–16–1 (1 to 8), laboratory numbers

Depth from surface	Horizon	Reaction			Organic matter			Free from (Fe_2O_3)	Electrical conductivity Ecx10³	$CaCO_3$ equivalent	Bulk density (ovendry)
		1:1 suspension	1:5 suspension	1:10 suspension	Organic carbon	Nitrogen	C/N ratio				
In.		*pH*	*pH*	*pH*	*Pct.*	*Pct.*		*Pct.*	*Mmho./cm. at 25° C.*	*Pct.*	*G./cc.*
0 to 8	Ap	6.6	7.4	7.6	0.59	0.055	11	0.7	0.6	<1	----------
8 to 14	B21t	7.7	8.6	8.9	.70	.067	10	.9	1.0	<1	1.73
14 to 21	B22t	8.3	9.2	9.4	.37	.038	10	.6	1.9	4	----------
21 to 30	Bca1	8.2	8.9	9.4	.21	.022	--------	.6	2.8	3	1.71
30 to 44	Bca2	8.1	8.9	9.2	.14	----------	--------	.6	4.9	3	----------
44 to 54	B3	7.9	8.6	8.9	.08	----------	--------	.8	5.5	<1	----------
54 to 64	C1	8.0	8.8	9.1	.06	----------	--------	.8	4.6	<1	1.77
64 to 70	C2	8.1	9.0	9.4	.04	----------	--------	.8	4.5	3	----------

WAURIKA SERIES

The Waurika series consists of deep, dark-colored soils that developed from Permian clays, on nearly level to concave uplands. These soils have a dark-colored A1 horizon and a thin but distinct A2 horizon abruptly underlain by a B horizon of dense clay.

Profile of Waurika silt loam in a field 1,000 feet west and 400 feet south of the north quarter corner of sec. 22, T. 1 N., R. 10 W.

A1—0 to 11 inches, grayish-brown (10YR 5/2) silt loam, dark brown (10YR 3/3) when moist; weak, medium, granular structure; friable when moist, hard when dry; pH 6.0; clear boundary.

A2—11 to 14 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; friable when moist; slightly hard when dry; pH 7.0; abrupt boundary.

B2t—14 to 32 inches, brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; weak, fine and medium, blocky structure; very firm when moist, extremely hard when dry; few iron concretions; pH 8.0; gradual boundary.

B3ca—32 to 45 inches, brown (10YR 5/3) clay, brown (10YR 4/3) when moist; massive; very firm when moist, extremely hard when dry; calcareous because of soft calcium carbonate concretions; gradual boundary.

C—45 to 55 inches, mottled reddish-yellow and yellowish-brown, massive clay loam.

The color of the A1 horizon ranges from dark brown to grayish brown. The thickness of the A2 horizon ranges from 2 to 4 inches. The depth to the clay B2t horizon ranges from 10 to 16 inches but is ordinarily about 13 inches. The color of the B2t horizon ranges from brown to dark grayish brown. The depth to free carbonates ranges from 24 to 48 inches.

Azonal soils

Azonal soils lack distinct, genetically related horizons, either because the soil material has not been in place long enough for horizons to develop or because the parent material or relief have prevented the development of definite soil characteristics. Azonal soils are represented in Comanche County by Alluvial soils, Lithosols, and Regosols.

ALLUVIAL SOILS

Alluvial soils consist of transported and relatively recently deposited material. They have little profile development. They vary in color, texture, reaction, and drainage.

The Alluvial soils in Comanche County are those of the Lela, Miller, Port, and Zavala series.

LELA SERIES

The Lela series consists of dark-colored, noncalcareous, clayey soils. These soils developed from dark-colored, clayey alluvium. They occur on level, very slowly drained parts of the infrequently inundated flood plains of the larger creeks in the southern part of the county.

Profile of Lela clay in a field 50 feet south and 50 feet west of the northeast corner of sec. 18, T. 1 N., R. 11 W.

A1—0 to 16 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; very sticky when wet, very firm when moist, very hard when dry; pH 7.8; slightly crusty on surface; clear boundary.

AC—16 to 36 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when moist; weak, medium, blocky structure to massive; extremely hard when dry, and deep cracks form; pH 8.0; gradual boundary.

C—36 to 60 inches, brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) when moist; few, fine, distinct mottles of reddish brown; massive; very firm when moist, extremely hard when dry; contains few soft lime concretions, but the fine earth is noncalcareous; pH 8.0.

The A horizon ranges from 6 to 22 inches in thickness and from dark gray to very dark gray in color. The A1 horizon is dominantly clay but ranges to silty clay in texture.

MILLER SERIES

The Miller series consists of reddish-brown, calcareous, clayey soils that have a clay subsoil. These soils developed in recently deposited material on the level flood plains of some of the larger creeks in the county.

Profile of Miller clay in a field 1,600 feet north and 1,000 feet west of the southeast corner of sec. 14, T. 1 S., R. 12 W.

A1—0 to 22 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; weak, medium, blocky structure to massive; firm when moist, very hard when dry; calcareous in thin stratified layers; gradual boundary.

AC—22 to 38 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; massive; very firm when moist, extremely hard when dry; mass is calcareous; gradual boundary.

properties of Foard silt loam

11450–57; analyzed by Soil Survey Laboratory, SCS, Lincoln, Nebr.]

Cation-exchange capacity (NH_4OAc)	Extractable cations (meq./100 grams of soil)					Exchangeable sodium	Saturation extract soluble (meq./liter)					Moisture at saturation
	Ca	Mg	H	Na	K		Na	K	HCO_3	Cl	SO_4	
Meq./100 grams						*Pct.*						*Pct.*
17.0	8.8	5.6	3.1	1.3	0.4	7	4.2	0.1	--------	------	------	33.2
31.8	16.8	13.1	2.4	4.2	.5	12	7.9	.1	--------	------	------	63.8
23.9	------	------	------	4.5	.4	15	14.6	.1	--------	------	------	62.5
24.2	------	------	------	5.8	.4	18	22.8	.1	--------	------	------	64.6
25.4	------	------	------	7.2	.4	18	37.6	.1	2.8	22.0	27.0	67.0
24.6	------	------	------	7.1	.4	18	42.4	.1	2.8	24.9	31.0	63.2
22.6	------	------	------	7.8	.4	24	36.6	.1	3.5	28.6	15.5	65.8
21.0	------	------	------	6.8	.4	20	35.5	.1	1.9	27.8	12.6	69.3

C—38 to 60 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; massive; very firm when moist, extremely hard when dry; calcareous; contains some salt crystals.

The color of the A horizon ranges from red to dark reddish brown, and the thickness from 10 to 25 inches. The depth to free carbonates is less than 15 inches.

Port Series

The Port series consists of brown to dark reddish-brown, noncalcareous soils that range from loam to clay loam in texture. These soils occur on flood plains that are rarely or occasionally inundated. The parent material is reddish, calcareous silty alluvium.

Profile of Port clay loam in a field 600 feet east and 900 feet south of the north quarter corner of sec. 30, T. 1 N., R. 11 W.

A1—0 to 15 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; firm when moist, hard when dry; pH 6.5; gradual boundary.

AC1—15 to 28 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; firm when moist, hard when dry; pH 7.5; gradual boundary.

AC2—28 to 60 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, granular structure to massive; firm when moist, hard when dry; pH 8.0; gradual boundary.

C—60 to 72 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; massive; firm when moist, hard when dry; calcareous.

The thickness of the A horizon ranges from 14 to 30 inches, and the color from reddish brown to dark grayish brown. The texture of the subsoil ranges from clay loam to heavy clay loam, and the color from brown to reddish brown or yellowish red. Darkened horizons of buried soils at a depth of 3 to 5 feet are common. The soil is noncalcareous to a depth of 15 inches or more.

Profile of Port loam in a field 400 feet west and 75 feet north of the southeast corner of sec. 27, T. 2 N., R. 10 W.

A1—0 to 18 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; friable when moist, slightly hard when dry; pH 6.8; diffuse boundary.

AC—18 to 33 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; friable when moist, slightly hard when dry; pH 6.3; diffuse boundary.

C1—33 to 44 inches, reddish-brown (5YR 5/4) heavy loam, reddish brown (5YR 4/4) when moist; massive; friable when moist, hard when dry; pH 6.5; diffuse boundary.

C2—44 to 60 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; massive; friable when moist, hard when dry; weakly calcareous.

The thickness of the A horizon ranges from 10 to 25 inches, and the color from dark grayish brown to reddish brown. The texture is predominantly loam but is silt loam in places. The texture of the C horizon ranges from loam to light clay loam, and the color from dark brown to yellowish red. The depth to free carbonates ranges from 13 to 50 inches.

Zavala Series

The Zavala series consists of dark-colored soils that have a fine sandy loam texture throughout. These soils occur on the flood plains of the Little Washita River.

Profile of Zavala fine sandy loam in a cultivated field 400 feet south and 75 feet west of the northeast corner of sec. 10, T. 4 N., R. 9 W.

A1—0 to 18 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; structureless; very friable when moist; slightly hard when dry; stratified with slightly coarser and slightly finer textured layers; pH 7.0; diffuse boundary.

C—18 to 60 inches, brown (10YR 4/3) light fine sandy loam, dark brown (10YR 3/3) when moist; stratified with darker colored, less sandy layers; moderate, fine, granular structure; much worm activity; very friable when moist, soft when dry; pH 7.5.

The color of the A horizon ranges from brown to dark grayish brown in hues 10YR and 7.5YR. The thickness of this horizon ranges from 12 to 24 inches. The reaction is neutral or mildly alkaline. These soils are noncalcareous.

LITHOSOLS

Lithosols consist mainly of a partly weathered mass of rock fragments, or of nearly bare rock, or of unconsolidated beds of clay. Most Lithosols are gently sloping to steep, and much of the soil material is removed as soon as it forms. The parent material is sandstone, limestone, gypsum, granite, shale, and clay.

The Lithosols in this county are soils of the Cottonwood, Lucien, Tarrant, and Vernon series.

Cottonwood Series

The Cottonwood series consists of very shallow soils that developed from material weathered from gypsum.

Profile of Cottonwood loam in a native pasture 660 feet east and 200 feet south of the north quarter corner of sec. 11, T. 4 N., R. 10 W.

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; friable when moist, soft when dry; pH 7.0; abrupt boundary.

R—6 to 10 inches, white gypsum; hard below a depth of 2 inches.

These soils range from dark grayish brown to grayish brown in color. Few to numerous small fragments of gypsum occur locally on the surface and throughout the thin layer of soil. The A1 horizon ranges from 2 to 10 inches in thickness.

Lucien Series

The Lucien series consists of shallow, reddish-brown, noncalcareous loamy soils. These soils developed in material weathered from Permian sandstone and occur on dissected, sloping to strongly sloping uplands.

Profile of Lucien loam in a native pasture 100 feet south and 150 feet west of the north quarter corner of sec. 14, T. 3 N., R. 9 W.

A1—0 to 10 inches, reddish-brown (5YR 4/4) light loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; very friable when moist, soft when dry; pH 7.0; abrupt boundary.

R—10 inches +, dark reddish-brown (2.5YR 3/4), consolidated, fine-grained sandstone.

The texture of the A horizon is predominantly loam but ranges from silt loam to fine sandy loam. The color of this horizon ranges from dark reddish brown to reddish brown, and the thickness from as little as 5 inches near rock outcrops to as much as 20 inches. The reaction is neutral to medium acid.

Tarrant Series

The Tarrant series consists of very shallow, dark-colored, calcareous, loamy soils. These are gently sloping to steep soils on uplands. They developed over limestone, and in Comanche County they contain outcrops of limestone.

Profile of Tarrant silt loam in a native pasture 300 feet west and 100 feet north of the southeast corner of sec. 26, T. 4 N., R. 12 W.

A1—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; friable when moist, soft when dry; calcareous; many fragments of limestone; abrupt boundary.

R—7 inches +, limestone bedrock.

The thickness of the A horizon ranges from 3 to 12 inches but is ordinarily 5 to 8 inches. The texture of this horizon ranges from silt loam to silty clay loam, and the color from grayish brown to very dark grayish brown.

Vernon Series

The Vernon series consists of shallow, reddish, calcareous clayey soils. These soils developed in red, calcareous Permian clay that is compact and nearly impervious but typically not shaly. The uppermost few inches are slightly darkened and represent an indistinct A horizon.

Profile of Vernon clay in a native pasture 1,320 feet south and 40 feet east of the northwest corner of sec. 3, T. 1 S., R. 13 W.

A1—0 to 4 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; strong, fine, granular structure; friable when moist, hard when dry; calcareous; gradual boundary.

AC—4 to 17 inches, red (2.5YR 4/6) clay, red (2.5YR 4/6) when moist; medium, fine, blocky structure; very firm when moist, extremely hard when dry; calcareous; many small concretions; gradual boundary.

R—17 to 50 inches, red (2.5YR 5/6) clay, red (2.5YR 4/6) when moist; weak, fine, blocky structure to massive; very firm when moist, extremely hard when dry; strongly calcareous; few, very small lime concretions.

The texture of the A horizon ranges from clay to clay loam. The color of this horizon ranges from red to dark reddish brown, and the thickness from 2 to 8 inches. The depth to the R horizon ranges from 5 to 20 inches.

REGOSOLS

Regosols are young, slightly developed soils that lack distinct profile characteristics. They consist of soils that formed in unconsolidated, Permian red-bed clays.

The Regosols in Comanche County are those of the Stamford series.

Stamford Series

The Stamford series consists of deep, weakly developed, reddish-brown, calcareous clayey soils that have a clay subsoil. The parent material is calcareous red clay. These soils occur on low, rolling plains below Permian outcrops. They exhibit a slight degree of gilgai relief.

Profile of Stamford clay in a cultivated field 535 feet west and 27 feet south of the northeast corner of sec. 23, T. 1 N., R. 12 W.

A1—0 to 14 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; strong, medium, granular structure; friable when moist, hard when dry; calcareous; diffuse boundary.

AC—14 to 30 inches, reddish-brown (2.5YR 4/4) silty clay, dark reddish brown (2.5YR 3/4) when moist; weak, medium, angular blocky structure and medium, fine, angular blocky; very firm when moist, extremely hard when dry; calcareous; clear boundary.

C—30 to 50 inches, reddish-brown (2.5YR 4/4) light clay, dark reddish brown (2.5YR 3/4) when moist; massive; firm when moist, hard when dry; calcareous; tongues of AC horizon extend to a depth of 40 inches.

The color of the A horizon ranges from reddish brown to dark reddish brown or brown. These colors typically appear in pockets, bands, or layers to a depth of as much as 3 feet. The thickness of the A horizon ranges from 5 to 15 inches.

General Nature of the County

This section tells something about the agriculture of Comanche County and describes the relief, drainage, geology, and climate.

Relief and Drainage

Comanche County is in the gently rolling part of the southern Great Plains. The northwestern part of the county lies within the Wichita Mountains; the rest is a plain underlain by weakly consolidated, reddish clays and sandstone. There are broad, nearly level areas on the uplands in most parts of the county. The range in elevation is from 2,479 feet at Mt. Pinchot, in the northwestern part of the county, to 1,000 feet in the southeastern part.

The drainage of Comanche County is generally toward the south and southeast. About nine-tenths of the county is drained by tributaries of the Red River. The western part is drained by West Cache Creek, the central part by Cache Creek, and the eastern part by Beaver Creek. A small acreage in the northwestern part of the county is drained by the North Fork of the Red River. The northeast corner is drained by the Little Washita River, and a small area is drained by other tributaries of the Washita River.

Climate [11]

Comanche County has a temperate, continental climate of the dry, subhumid type. The weather patterns that influence this area are sustained by the alternate movement of warm, moist air from the Gulf of Mexico and of either contrasting cooler, modified marine air from the West Coast or colder, dry air from around the Arctic Circle. Rapid changes are common and result in distinct fluctuations of temperature, humidity, cloudiness, wind, and precipitation.

Changes between seasons are usually gradual, and distinct seasonal characteristics vary in severity from year to year. Winters are mild; cold spells normally last only 2 to 5 days before the return of sunny skies and warm, southerly winds. Spring, the most variable season, brings the heaviest rainfall and the greatest number of severe local storms and tornadoes. Summers are long and fairly warm. The discomfort caused by hot spells is often eased by southerly breezes and low humidity. Considerable precipitation occurs, generally as heavy local storms or as light ineffective showers toward the end of summer, and rainfall increases early in fall. Fall is a season of pleasant, sunny days and cool nights.

Table 8 shows, by months, the average daily maximum temperature, the average daily minimum temperature, and the average precipitation. Comanche County has an average annual temperature of 62.7° F. The average monthly temperature ranges from 40.7° in January to 83.7° in August. The average daily variation of 25.9° normally provides welcome relief during periods of extreme temperature. Freezing temperatures occur on an average of 74 days each year, between October and April, and on 5 of these days the highest temperature is below freezing. Minimum readings of 0° or below occur in about 1 year out of 6. Data from the Lawton weather station indicate a normal annual total of 3,118 degree days, ranging from none during the period of June through August to a maximum of 753 during January.

The average annual precipitation ranges from about 27 inches along the western border of the county to 32.5 inches in the northeast corner. Records for the period 1931 to 1960 indicate a normal of 29.19 inches at the Wichita Mountains Wildlife Refuge and of 30.18 inches at Lawton. About 34 percent of the total precipitation falls in spring, 27 percent in summer, 24 percent in fall, and 15 percent in winter.

May, which is the wettest month, normally receives about 20 percent of the annual precipitation. January, the driest month, normally receives only 5 percent of the annual precipitation. The longest period during which no measurable precipitation was recorded at Lawton lasted

[11] By STANLEY G. HOLBROOK, State climatologist, U.S. Dept. of Commerce, Weather Bureau.

TABLE 8.—*Temperature and precipitation data*

[Based on records kept at Lawton, Comanche County, Okla., 1931–60]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	2 years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average total	1 year in 10 will have— Less than—	1 year in 10 will have— More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
	°F	°F.	°F.	°F.	In.	In.	In.		In.
January	52.8	28.5	73	11	1.39	0.2	3.0	2	3
February	57.8	32.4	75	18	1.58	.1	2.9	1	2
March	66.1	38.5	83	24	1.78	.1	3.5	(1)	3
April	75.6	49.2	89	35	2.37	.2	5.4	(1)	2
May	82.7	58.1	94	46	5.95	1.1	12.4	0	0
June	91.8	67.2	101	57	3.67	1.4	8.1	0	0
July	96.6	70.5	105	64	2.61	.4	6.6	0	0
August	97.3	70.0	108	62	1.96	.5	4.0	0	0
September	89.8	62.4	102	50	2.71	(2) T	5.9	0	0
October	78.2	51.3	93	36	3.01	.1	9.9	0	0
November	64.1	37.6	80	23	1.62	(2) T	3.8	(1)	1
December	54.9	31.2	72	19	1.53	.1	3.4	1	3
Year	75.6	49.7	(3) 107	(4) 7	30.18	20.9	40.3	4	2

[1] Less than 0.5 day.
[2] Trace (less than 0.05 inches).
[3] Average annual highest maximum.
[4] Average annual lowest minimum.

TABLE 9.—*Probabilities of freezing temperatures in spring and fall at Lawton, Comanche County, Okla.*
[Based on records for the period 1921–50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	March 7	March 18	April 1	April 9	April 17
2 years in 10 later than	February 27	March 11	March 26	April 3	April 12
5 years in 10 later than	February 13	February 26	March 14	March 23	April 2
Fall:					
1 year in 10 earlier than	November 29	November 21	November 9	October 27	October 18
2 years in 10 earlier than	December 6	November 29	November 15	November 2	October 24
5 years in 10 earlier than	December 19	December 12	November 28	November 13	November 3

from September 21, 1950, to January 1, 1951. Heavy 24-hour rains of at least 2 inches have occurred in all months, but 24-hour rains of 3 to 4 inches have occurred only in April, May, and June and in September and October.

The average annual snowfall ranges from 5 inches in the southwestern part of the county to 7.5 inches in the north-central part. The snowfall season usually begins in November and continues through April. Heavy snow normally melts within 4 days.

The prevailing wind direction is northerly in January and February and southerly to southeasterly the rest of the year. The average wind speed is a little more than 12 miles per hour, but winds of 30 to 50 miles an hour are common. Gusts of up to 85 miles per hour occur occasionally in the vicinity of severe thunderstorms, which are most common from April through June. Tornadoes have struck in most parts of the county. During the past 89 years, a total of 26 damaging tornadoes have occurred; 14 of these have occurred in May. During the past 40 years, there have been 35 severe hailstorms, and more than half of these have occurred in May. Hailstones 3½ inches in diameter, some weighing 2 pounds, fell in the south-central part of the county in May 1957.

The evaporation rate is high and is highest between May and October. The average annual lake evaporation is about 63.5 inches.

The dates of freezing temperatures shown in table 9 are representative of the southeastern third of the county. At the higher elevations in the northeastern quarter, freezing temperatures occur 10 to 12 days later in spring and 5 to 9 days earlier in fall. The average freeze-free season is 216 days at Lawton and 200 days at the Wichita Mountains Wildlife Refuge.

Geology [12]

Most of the soils of Comanche County are underlain by clastic sedimentary rocks. The more common of these are the sandstones and shales of the Permian system. Figure 20 shows the distribution of the geologic formations in the county.

Meers quartzite (1 on figure 20), a metamorphic rock of the Precambrian system, is probably the oldest sedimentary rock in Oklahoma. It was derived from an ancient sedimentary rock that was engulfed in younger igneous rocks before the molten mass cooled and crystalized. Only one exposure, directly south of Meers, is indicated on figure 20. Other exposures have been reported in sec. 34, T. 4 N., R. 14 W., and in secs. 2 and 3, T. 3 N., R. 14 W.

Gabbro (2), anorthosite (3), granite (4), and rhyolite (5) are all igneous rocks, late Precambrian in age. These are not the oldest igneous rocks in Oklahoma, but a study of radioactive minerals indicated that one sample was almost 600 million years old.

The Timbered Hills group and the lower part of the Arbuckle group (6) are Cambrian in age. The oldest, the Reagan sandstone, rests on igneous rocks and contains weathered debris from them. Above the Reagan sandstone, from oldest to youngest, are the Honey Creek formation, which is largely sandstone and limestone; Fort Sill limestone; Royer dolomite; and Signal Mountain limestone.

The upper part of the Arbuckle group (7) belongs to the Ordovician system. It is essentially limestone and contains, from oldest to youngest, the McKenzie Hill, Cool Creek, and Kindblade formations.

The Wichita formation (8, 8_p, and t), Hennessey shale (9), the El Reno group (10), the Marlow formation (11), Rush Springs sandstone (12), and the Cloud Chief formation (13) are all Permian in age. The Wichita formation (8) is the oldest of the Permian rocks in Comanche County. It is essentially shale but contains a considerable amount of sandstone and some conglomerate. The base bituminous gray sandstone (t) is probably equivalent to the Garber sandstone north of the Arbuckle Mountains. The conglomerate, the Post Oak conglomerate member (8_p), is in the lower part of the Wichita formation. It rests on older sedimentary rocks and on igneous rocks near the Wichita Mountains and contains weathered debris from all of them. Near igneous exposures it contains igneous boulders and pebbles; near limestone exposures it contains limestone boulders and pebbles; in some areas it contains both types of debris. The debris is coarse near the mountains, becomes increasingly finer with distance, and finally grades into the shales and sandstones typical of the Wichita formation. Hennessey shale (9) is mostly red shale but contains some reddish-brown to red sandstone. The El Reno group (10) consists of Duncan sandstone in the lower part and the Chickasha

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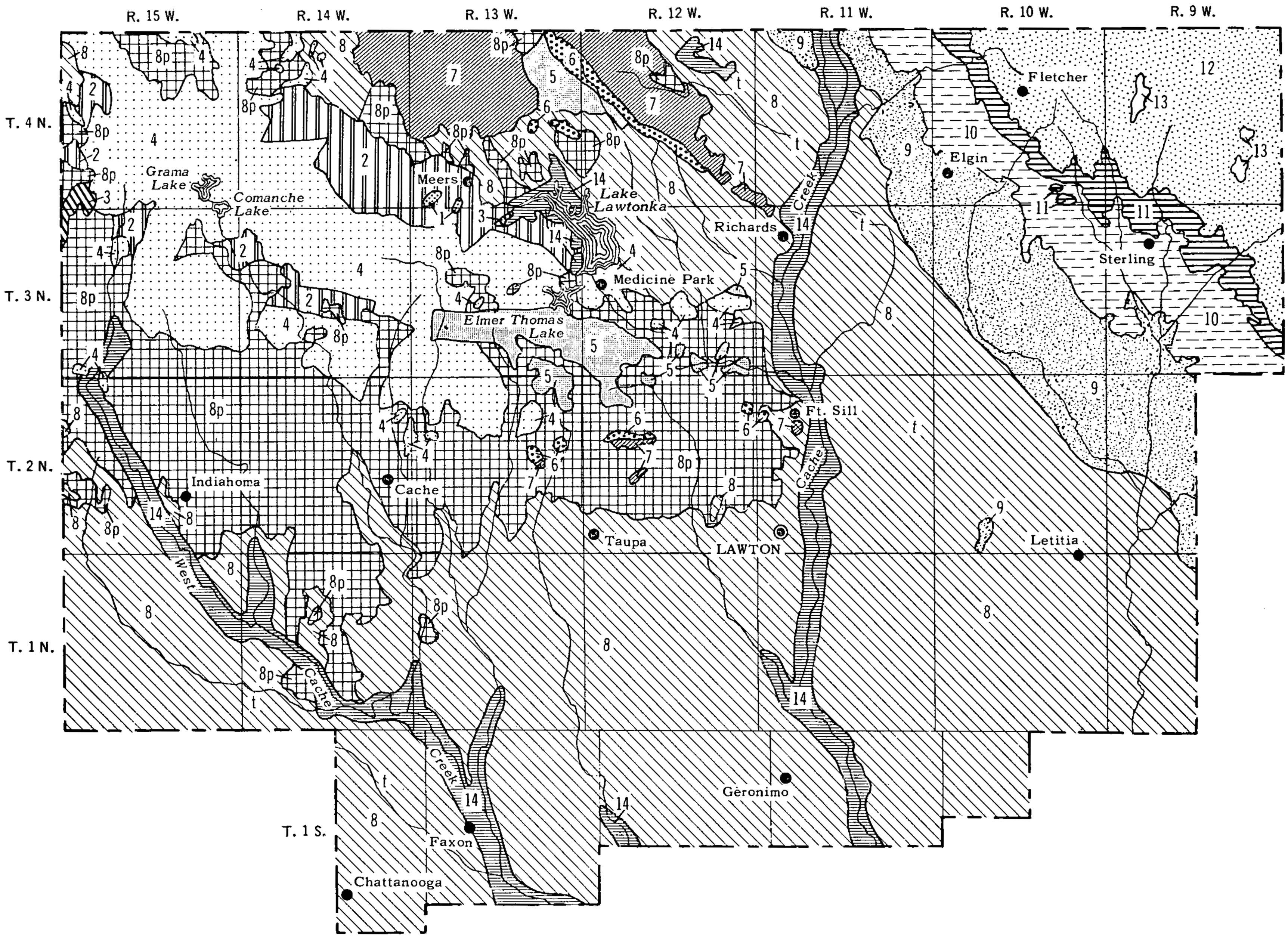

Figure 20.—(1) Meers quartzite, (2) gabbro, (3) anorthosite, (4) granite, (5) rhyolite, (6) lower part of Arbuckle group and the Timbered Hills group, (7) upper part of Arbuckle group, (8) Wichita formation, (8_p) Post Oak conglomerate, (t) base of bituminous gray sandstone, (9) Hennessey shale, (10) El Reno group, (11) Marlow formation, (12) Rush Springs sandstone, (13) Cloud Chief formation, and (14) recent alluvium.

formation in the upper part. Duncan sandstone is largely soft, fine-grained, reddish-brown to red sandstone but also contains much sandy, silty, red shale. The Chickasha formation is predominantly shale. The Marlow formation (11) contains soft, fine-grained, reddish-brown to red sandstone and red shale and a few thin dolomite beds. Rush Springs sandstone (12) is mostly soft, fine-grained, silty to shaly sandstone but contains a small amount of silty, sandy shale. The Cloud Chief formation (13) crops out only on the tops of a few hills in the northeastern part of the county. It contains much gypsum.

The recent alluvium (14) and terrace deposits along the larger streams belong to the Quaternary system. These deposits consist of unconsolidated sand, silt, and clay derived from the consolidated rocks that crop out in the areas drained by the streams along which the deposits occur.

Agriculture

Agriculture in Comanche County is currently less diversified than it has been in past years. Much of the farm income is derived from the sale of livestock. In 1959, approximately 60 percent of the 481,195 acres of farmland in the county was in permanent pasture, and an additional 28,620 acres of cropland was used only for pasture. Crops, mainly wheat and cotton, were harvested from only 20 percent of the acreage in farms.

The number of farms in the county decreased from 1,696 in 1950 to 1,224 in 1959. The acreage in farms decreased from 527,663 acres in 1950 to 481,195 acres in 1959. The average size of farms, however, increased from 311 acres in 1950 to 393 acres in 1959.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Clay. As a soil separate, the mineral soil particles that are 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. (See also Texture, soil.)

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above or below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by soil creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules that consist of concentrations of compounds or of soil grains cemented together. They are of various sizes, shapes, and colors. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Gilgai. Microrelief of clays that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls in nearly level areas, or of microvalleys and microridges that run with the slope.

Permeability. The ability of the soil to transmit air or water. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values or words as follows:

	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	6.6 to 7.3		

Sand. As a soil separate, individual rock or mineral fragments 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

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).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions 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."

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