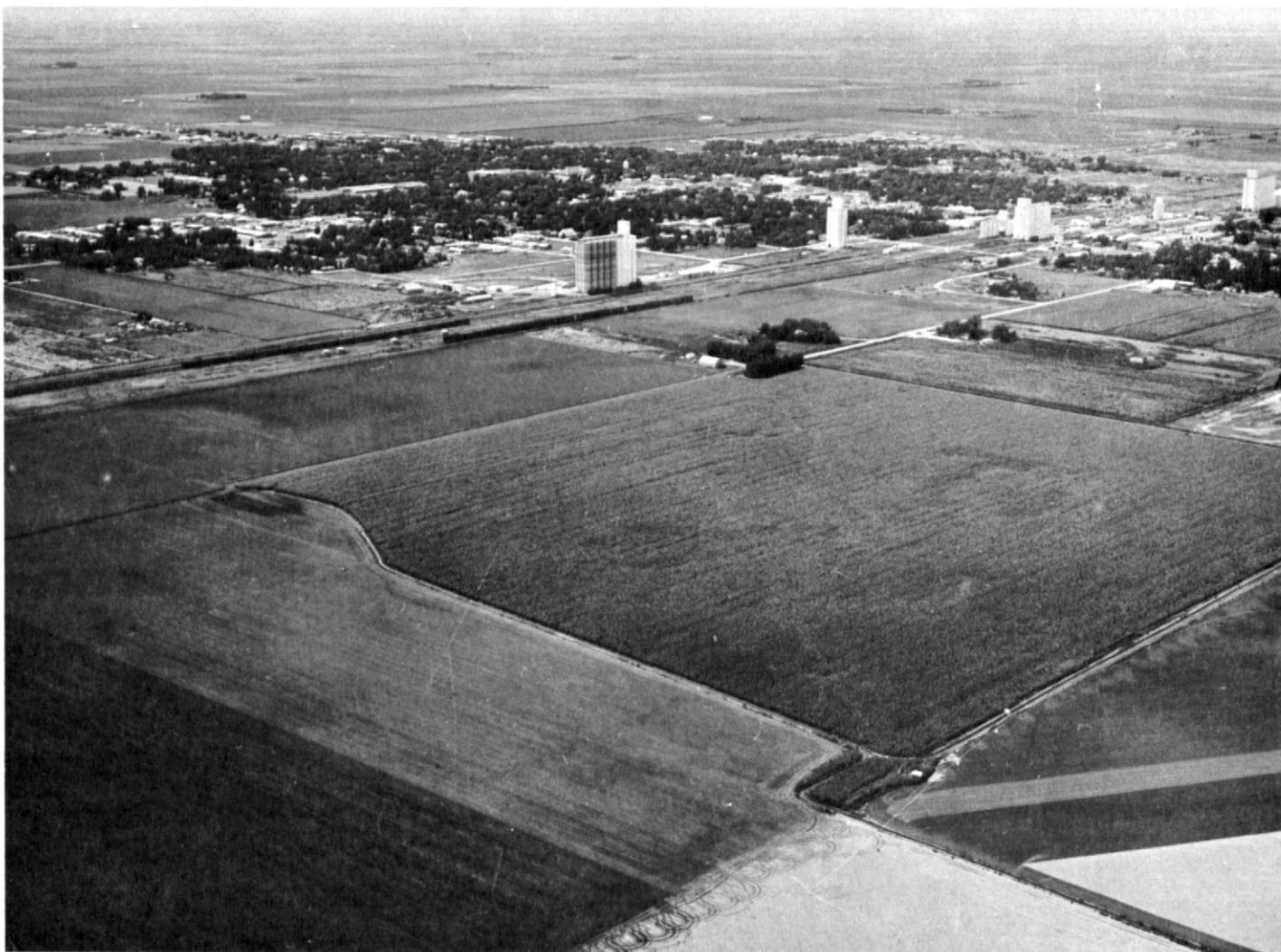


# SOIL SURVEY

## Scott County, Kansas



UNITED STATES DEPARTMENT OF AGRICULTURE  
Soil Conservation Service  
In cooperation with the  
KANSAS AGRICULTURAL EXPERIMENTAL STATION

# HOW TO USE THIS SOIL SURVEY REPORT

**T**HIS SOIL SURVEY of Scott County, Kansas, will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid managers of forest and woodland; add to soil scientists' knowledge of soils; and help prospective buyers and others in appraising a farm or other tract.

## Locating the Soils

At the back of this report is an index map and a soil map consisting of many sheets. On the index map are rectangles numbered to correspond to the sheets of the soil map, so that the sheet showing any area can be located easily. On each map sheet, the soil boundaries are outlined and there is a symbol for each kind of soil. 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 the area and a pointer shows where it belongs. For example, an area on the map has the symbol Rm. The legend for the set of maps shows that this symbol identifies Richfield silt loam, 0 to 1 percent slopes. That soil and all others mapped in the county are described in the section "Descriptions of the Soils."

## Finding Information

In the "Guide to Mapping Units, Capability Units, and Range Sites" at the back of this report the soils are listed in the alphabetic order of their map symbols. This guide shows where to find a description of each soil and a discussion of its capability unit, and range site. It also shows where to find the acreage of each soil, the yields that can be expected, and information about engineering uses of soils.

*Farmers and those who work with farmers* can learn about the soils on a farm by reading the description of each soil and of its capability unit and other groupings. A convenient way of doing this is to turn to the soil map and list the soil symbols of a farm and then to use the "Guide to Map-

ping Units, Capability Units, and Range Sites" in finding the pages where each soil and its groupings are described.

Those interested in protecting their fields and homesites from wind can refer to the section "Windbreak Management." In that section the soils in the county are grouped according to their suitability as sites for windbreaks, and some factors affecting management are explained.

*Game managers, sportsmen, and others concerned with wildlife* can find information about the main kinds of wildlife and their food and cover in the section "Wildlife Management."

*Ranchers and others interested in range* will find the section "Range Management" helpful. In that section the soils of the county are placed in groups according to their suitability as rangeland, and the management of each group is discussed.

*Engineers and builders* will find in the section "Engineering Uses of the Soils" tables that give engineering descriptions of the soils in the county, record soil features that affect engineering practices and structures, and rate the soils according to their suitability for several kinds of engineering work.

*Scientists and others who are interested* 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 other users* will find information about soils and their management in various parts of the report, depending on their particular interest.

*Newcomers in Scott County* will be especially interested in the section "General Soil Map," in which broad patterns of soils are described. They may also be interested in the section "Additional Facts About the County."

\* \* \* \*

Fieldwork for this survey was completed in 1961. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Scott County was made as part of the technical assistance furnished by the Soil Conservation Service to the Scott County Soil Conservation District.

Cover picture: Aerial view of Scott City, Kans.

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# SOIL SURVEY OF SCOTT COUNTY, KANSAS

BY KENNETH H. SALLEE AND VERNON L. HAMILTON,  
SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE  
KANSAS AGRICULTURAL EXPERIMENT STATION

**S**COTT COUNTY is in the west-central part of Kansas (fig. 1). The area of the county is 723 square miles, or 462,720 acres. Scott City is the county seat and the largest city.

The county was organized in 1886 and was named for a war hero, Gen. Winfield Scott. The area was opened to settlement when the Santa Fe Lines were constructed to Garden City (Finney County) in the early 1870's.

Agriculture is the main enterprise in the county. Wheat and sorghum are the principal dryland crops, and corn, wheat, sorghum, and alfalfa are the principal crops grown under irrigation. About one-fourth of the cropland is irrigated. Irrigation water is supplied mainly by deep wells. The raising of livestock is the second largest agricultural enterprise in the county. During fall and spring, the number of cattle and sheep is usually increased by animals brought in from other areas to graze wheat pasture and sorghum stubble.

The production of oil is the most important nonagricultural industry.

## *How the Soil Survey Was Made*

Soil scientists made this survey to learn what kinds of soils are in Scott 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 ob-

served 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 of plants.

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, the reader should 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, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Otero and Ulysses, 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 go with their behavior in the natural, untouched 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 such 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. Otero fine sandy loam is a soil type in the Otero series. The texture of the surface layer is apparent from the soil name.

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 phases. The name of a soil phase indicates a feature that affects management. For example, Ulysses silt loam, 3 to 5 percent slopes, is one of three phases of Ulysses silt loam, a soil type that ranges from nearly level to gently sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These

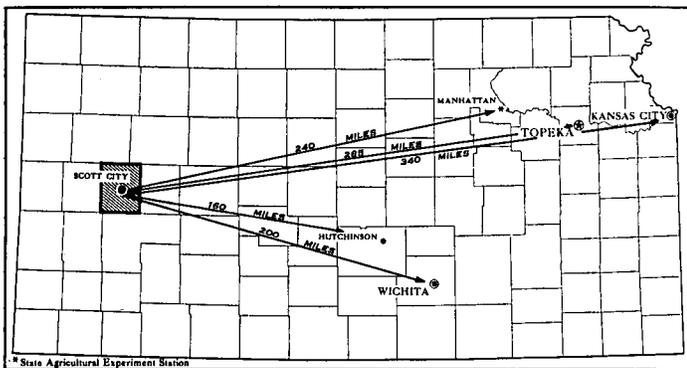


Figure 1.—Location of Scott County in Kansas.

photographs show woodlands, buildings, field borders, trees, and other details that greatly 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, and so small in size, 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 soil in it, for example, Ulysses-Colby silt loams. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Alluvial land or Badland, and are called land types rather than soils.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in 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 the soil survey reports. On basis of the yield and practice tables and other data, the soil scientists set up trial groups, and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists 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

After study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the colored general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic, although not strictly uniform.

The soils within any one association are likely to differ from each other in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general soil map shows, not the kind of soil at any particular place, but patterns of soils, in each of which there are several different kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soils of one soil association may also be present in other associations, but in a different pattern.

The general map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

Six soil associations are shown on the general soil map: (1) Loamy soils on the tablelands make up more than two-thirds of the county. (2) The soils in upland drainageways lie on both sides of White Woman Creek, Ladder (Beaver) Creek, and Rocky Draw. (3) The soils in depressions are prominent in several areas of 2 to about 15 square miles each, in the southern and southeastern parts of the county. (4) Sloping, moderately deep, or shallow soils are in the northern and northeastern parts. (5) Sandy and loamy soils are prominent in the southeastern quarter. (6) Sandhills make up nearly 4 square miles in the southeastern corner.

### **1. Richfield-Ulysses association: Loamy soils on tablelands**

This association occupies the nearly level to gently sloping summits of the High Plains. It is the most extensive association in Scott County and covers 76 percent of the county.

The dominant soils in this association are the Richfield and Ulysses. They developed in loess or similar silty sediment (fig. 2) that covers the area to a depth of a few to many feet.

The Richfield soils make up most of the association. These deep loamy soils have a subangular blocky subsoil. They occupy broad, continuous, nearly level areas and have ill-defined drainageways and many small, enclosed depressions, or potholes. These depressions are occupied by the Randall soils. The Ulysses are deep loamy soils that have a granular subsoil. They occupy the gently sloping and convex topography, mainly along the drainageways in the uplands and in the more undulating and sloping areas of the nearly level tablelands.

Areas of Colby, Goshen, Keith, Lubbock, Manter, and Tivoli soils are also in this association. The Colby are calcareous loamy soils that occupy the side slopes of the narrow, intermittent drainageways that cut through the loess. The Goshen are deep, dark loamy soils and occur throughout the area. They developed in colluvial and alluvial sediments along White Woman Creek and on the nearly level floors of the swales of the uplands. These swales have no channels or have indefinite ones. The Keith soils are deep, dark, friable soils that occur in small, nearly level, concave areas. The Lubbock soils are in the shallow depressions. They receive extra runoff from the adjacent, nearly level to sloping soils. A few small knolls and ridges are occupied by the Manter and Tivoli soils.

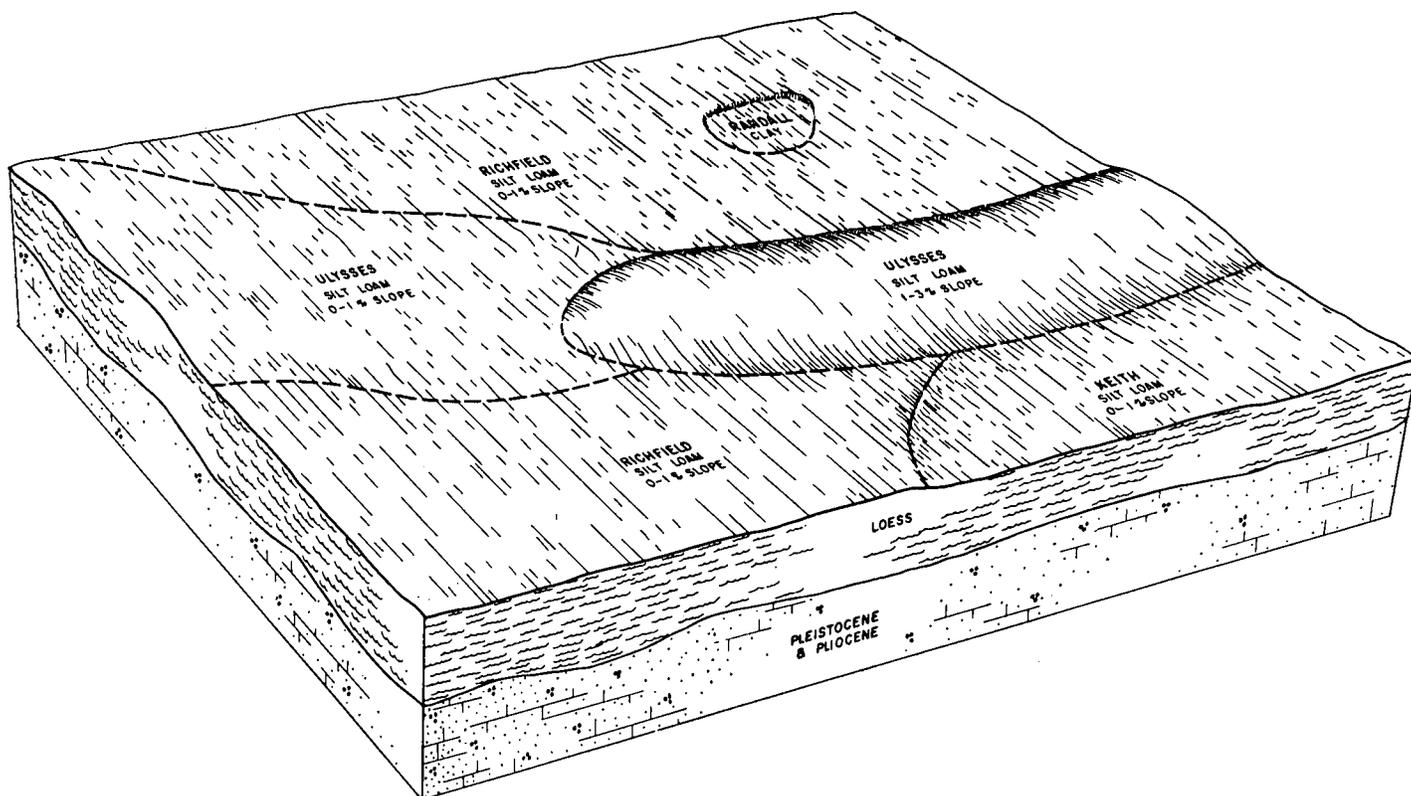


Figure 2.—Typical cross section of the major soils of the Richfield-Ulysses association.

Most of this association is used for wheat and grain sorghum. Wind erosion is a hazard in the nearly level areas. Both wind and water erosion are hazards on the gently sloping soils. Conservation of water is needed for profitable production of crops on all soils in the association.

## 2. *Ulysses-Goshen-Colby association: Soils in drainageways*

This association is made up of steeply sloping to nearly level soils in and along drainageways of the uplands. It occurs along the western 6 to 10 miles of White Woman and Ladder (Beaver) Creeks and of Rocky Draw (fig. 3). It covers about 4 percent of the county.

The association is made up mainly of Ulysses, Goshen, and Colby soils, and it includes other loamy and sandy soils. The Ulysses soils are deep loamy soils that have a granular subsoil. They occupy the convex and gently sloping topography in the association. The Goshen are deep, dark loamy soils on the nearly level floors of the valleys of creeks and swales of the uplands. They receive extra runoff from the adjacent sloping and nearly level uplands. The Colby are thin, calcareous loamy soils that developed in deep loess. Their slopes range from about 5 to 15 percent.

The Bridgeport, Mansker, Potter, Manter, Bayard, and Richfield soils occupy a minor acreage in the association. The Bridgeport are calcareous loamy soils in the alluvial valleys of Ladder (Beaver) Creek. The Mansker and Potter are moderately deep and shallow loamy soils. These soils overlie caliche on the steeper and more broken

slopes. The Manter are deep, noncalcareous sandy loams in undulating areas. The Bayard are calcareous sandy loams that in some places lie along the stream channel. The Richfield soils occupy the nearly level uplands in these areas. Alluvial land, which is composed of loamy alluvium and meandering channels, occupies the narrow valley floors that are cut by channels and are generally bordered by steep slopes.

The soils of this association are used mainly for wheat and grain sorghum. Alfalfa is also grown along the alluvial bottoms of Ladder (Beaver) Creek. The steeper slopes are in native range. Conservation of soil and water is necessary for successful crop production and for erosion control.

## 3. *Colby-Mansker-Potter association: Sloping soils*

This association is made up of deep, moderately deep, and shallow loamy soils of the sloping uplands. These soils are in gently sloping to steep, broken areas along well-entrenched drainageways below the summit of the High Plains, mainly in the northern part of Scott County (fig. 4). The association covers about 9 percent of the county.

The principal soils in the association are Colby silt loam, 5 to 15 percent slopes, the Mansker-Potter complex, and the Potter soils. The Colby are thin, calcareous, loamy soils that developed in deep loess. They are in smoother, less steep areas along the entrenched drainageways. The Mansker soils are moderately shallow over caliche and are mainly on steep slopes. The Potter soils are shallow over

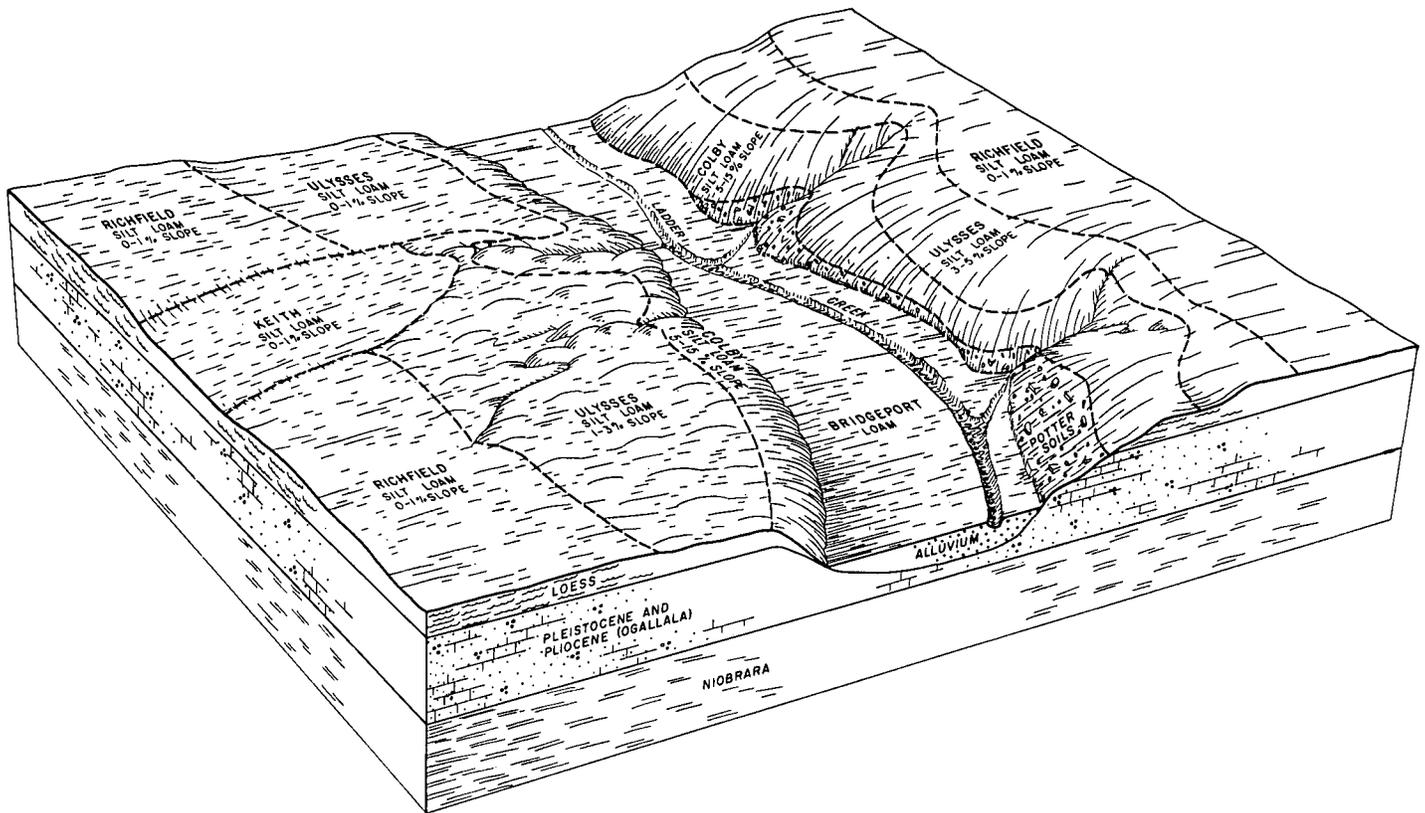


Figure 3.—Typical cross section of part of the valley of Ladder (Beaver) Creek.



Figure 4.—The Colby, Mansker, and Potter soils are in the steep and broken areas, and the Bridgeport soils are in the alluvial valley. The Ulysses soils are in the gently sloping and sloping areas.

caliche or limestone and are mainly on the more broken slopes.

Also in this association are areas of Bridgeport soils and Alluvial land. The Bridgeport are calcareous loamy soils that occupy a minor part of the association. They are in broader areas of the valley of Ladder (Beaver) Creek. Alluvial land is the loamy alluvium along the more nar-

row valleys. Because it is generally interrupted by meandering stream channels and is usually bordered by steep slopes, most areas are not suited to cultivation.

A miscellaneous land type, Badland, makes up a minor part of this association. It occupies the vertical walls of canyons, pinnacles, and barren areas of geological material of the Niobrara formation.

The Richfield and Ulysses soils are in the more gently sloping and nearly level areas and have slopes ranging from about  $\frac{1}{2}$  to 5 percent. Like the soils in the Richfield-Ulysses association, these soils developed in loess.

Some areas of Richfield and Ulysses soils are cultivated; the main crops are wheat and sorghum. Conservation of water is necessary in managing these soils for successful production of crops and control of erosion. Most areas of Bridgeport loam are cultivated; the principal crops are wheat, sorghum, and alfalfa. The Colby, Mansker, and Potter, which are the most extensive soils in this association, are gently sloping to steep and broken. These soils are mostly in native grass and are used for grazing. Alluvial land occupies choice rangeland that regularly produces large amounts of forage. Both wind and water erosion are hazards on unprotected areas of the sloping soils in this association.

#### 4. Lubbock-Church-Randall association: Soils in depressions

This association is made up of deep clayey soils on benches in the broad, slight depressions of the uplands. It is mostly near the central part of the county and in the

Dry Lake area in the southeastern corner. It covers about 4 percent of the county.

The principal soils in this association are the Lubbock, Church, and Randall. The Lubbock soils make up about half of the association. They are deep, dark-colored, well-drained soils that occupy the higher benches and are somewhat more productive than the associated soils. The Church are deep, dark-colored, moderately well drained soils on lower benches around the potholes and the lake area. They are slightly to moderately saline and have a water table that fluctuates between a depth of 3 and 20 feet. Randall clay, occasionally flooded, occupies the broad, nearly level floor of the Scott (White Woman) Basin. It is a gray, very slowly permeable, calcareous soil. Most of this soil is cultivated, and some areas are irrigated. Areas of Randall clay, a gray, noncalcareous soil, occur throughout the association in potholes and old channels. Because of flooding and droughts, these areas are generally nonproductive.

The Lubbock soils are used mainly for irrigated crops. These soils are well suited to cultivation and produce high yields under proper management. Church silty clay loam in the Scott (White Woman) Basin is used mainly for irrigation farming. A small amount of the total acreage in the Dry Lake area is cultivated. The main crops under dryland farming are wheat and sorghum, but some alfalfa has been grown. The soils in this association are subject to occasional flooding.

#### **5. Manter-Ulysses-Keith association: Sandy and loamy soils**

Nearly level and undulating areas make up most of this association, but small ridges and dunes of Tivoli soils also occur. The soils in this association lie east of the Scott-Finney depression and cover about 6 percent of the county.

The principal soils in this association are the Manter, Ulysses, and Keith. The Manter soils are nearly level to undulating sandy mantles. They developed in sandy and loamy, somewhat reworked sediments of outwash material. Like the Ulysses and Keith soils in the Richfield-Ulysses association, these soils developed in loess. Loess mantles part of the soils in the association and in places underlies the sandy mantle. The Ulysses soils are dark-colored, granular silt loams in nearly level to sloping areas. The Keith are dark-colored, friable silty to loamy soils in the nearly level, concave areas.

The Dalhart-Richfield complex, 1 to 3 percent slopes, occupies rather smooth slopes of about 2 percent throughout the association. The Dalhart soil in this complex has a surface soil of brownish-colored sandy loam over a more clayey subsoil. The Richfield soil has a loamy surface soil over a more clayey and silty subsoil. Wind erosion is a serious hazard on both of the soils. Under proper management, however, the soils of this complex are the most productive in the association.

The Otero and Tivoli soils are undulating and hummocky soils in the more erodible areas. The Otero are light-colored, calcareous sandy loams and loamy fine sands. The Tivoli are light-colored, noncalcareous loamy fine sands that developed in deep fine sand.

Much of the acreage of the soils in this association is cultivated without irrigation. Sorghum and wheat are the main crops. Wind erosion, a hazard throughout the association, is particularly serious on the more sandy soils.

In addition, water erosion is a hazard on the gently sloping, more silty and clayey soils. Management practices are needed on all the soils for control of erosion and conservation of water.

#### **6. Otero-Tivoli association: Sandhills**

This association is made up of sandhills—undulating and hummocky dunes that have slopes ranging from about 2 to 20 percent. It is located in the southeastern corner of the county and covers about 1 percent of its total area.

The principal soils in the association are the Otero and the Tivoli. The Otero are the light-colored, calcareous soils that occur in the undulating and hummocky areas around the outer edge of the association. The Tivoli are light-colored, noncalcareous loamy fine sands to fine sands that occupy the dunelike topography. Tivoli soils have weakly defined profiles in deep fine sand. Some blow-outs occur. These actively blowing, nearly barren areas of loose sand are mainly in old cultivated fields. They have been caused by wind erosion of the Tivoli and Otero soils.

Most of the association is not suited to cultivation and should be used for range. Generally, the less sandy areas are considered suitable for cultivation, and they are well suited to range. Wind erosion is a hazard throughout the association and is particularly serious on the more sandy soils. All the soils in this association need practices that control erosion, and a few areas should be reseeded to native grass. Under good management, mixed stands of tall and mid grasses produce enough forage for grazing and for protection of the soil from wind erosion.

### **Descriptions of the Soils**

In this section the soil series in Scott County are described in alphabetic order, and the characteristics of each series are described. A typical profile is then described briefly for each series. The soil profile is a record of what the soil scientist saw and learned when he dug into the ground. Each mapping unit is then discussed, and characteristics it has that are different from those of the typical profile are pointed out. The symbol in parentheses after the name of the soil identifies the soil on the detailed soil map. A more detailed description of a typical profile of the soils of each series is given in the section "Genesis, Classification, and Morphology of the Soils." Some terms used to describe the soils that may not be familiar to the reader are defined in the Glossary at the back of the report.

The approximate acreage and proportionate extent of the soils are shown in table 1. Their location is shown on the detailed soil map at the back of the report.

#### **Alluvial Land (An)**

This land type consists of loamy alluvium and of similar soil material deposited along the channels of meandering, intermittent streams of the uplands. The floors of the valleys in which this land type occurs are at least 200 feet wide and are continuous enough to require separate grazing management.

Alluvial land consists of calcareous, grayish-brown soils that range from sandy loam to clay loam in texture.

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

Soil	Acres	Percent
Alluvial land.....	1,360	0.3
Badland.....	200	( <sup>1</sup> )
Bayard fine sandy loam, loamy substratum.....	1,210	.3
Bridgeport loam.....	3,200	.7
Church silty clay loam.....	5,940	1.3
Colby silt loam, 5 to 15 percent slopes.....	13,230	2.9
Dalhart-Richfield complex, 1 to 3 percent slopes.....	8,270	1.8
Goshen silt loam.....	11,960	2.6
Keith silt loam, 0 to 1 percent slopes.....	32,740	7.1
Lubbock silty clay loam.....	11,720	2.5
Mansker-Potter complex.....	8,490	1.8
Manter fine sandy loam, 0 to 1 percent slopes.....	2,080	.4
Manter fine sandy loam, undulating.....	7,450	1.6
Otero fine sandy loam, undulating.....	1,820	.4
Otero soils, hummocky.....	1,170	.3
Potter soils.....	7,890	1.7
Randall clay.....	7,880	1.7
Randall clay, occasionally flooded.....	3,670	.8
Richfield silt loam, 0 to 1 percent slopes.....	201,030	43.4
Richfield silt loam, 1 to 3 percent slopes.....	2,910	.6
Tivoli loamy fine sand.....	1,940	.4
Ulysses silt loam, 0 to 1 percent slopes.....	62,790	13.6
Ulysses silt loam, 1 to 3 percent slopes.....	38,190	8.3
Ulysses silt loam, 3 to 5 percent slopes.....	7,490	1.6
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.....	12,960	2.8
Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded.....	1,870	.4
Ulysses silt loam, saline, 0 to 1 percent slopes.....	2,490	.5
Marsh.....	160	( <sup>1</sup> )
Lake McBride.....	110	( <sup>1</sup> )
Dry Lake.....	430	.1
Borrow pits.....	20	( <sup>1</sup> )
Gravel pits.....	50	( <sup>1</sup> )
Total.....	462,720	100.0

<sup>1</sup> Less than 0.05 percent.

Layers of weakly stratified, loamy, sandy, and gravelly materials are commonly below a depth of about 2 feet.

Nearly all of this land type is in native grass, for which it is well suited. This land is not cultivated because it is subject to occasional floods. In addition, it is cut by meandering stream channels, and in most areas is bordered by sloping soils not suitable for cultivation. Except for their small size and inaccessibility, many isolated areas formed by the meandering channels would be suitable for cultivation. (Capability unit VIw-1, dryland; Loamy Lowland range site)

### Badland (Bd)

This land type consists of barren areas of geologic material from the Niobrara formation. These areas have little or no soil development and are broken by many drainage channels. Slopes range from 6 percent to the almost vertical walls of canyons and pinnacles.

Most areas of Badland are idle and are almost without vegetation. This land is not well suited to range, but some small areas are included in mapping that have some value for grazing. As much as 20 percent of these areas is vegetated, but most of the areas are not accessible to livestock. (Capability unit VIIIs-1, dryland; not grouped in a range site)

### Bayard Series

The Bayard series consists of deep, well-drained, light-colored soils that are friable and calcareous. These soils are along stream channels.

The surface layer is grayish-brown to dark grayish-brown, very friable sandy loam about 11 inches thick. This layer is easily worked and has weak, granular structure.

The subsoil is about 15 inches thick. The upper part is grayish-brown to pale-brown, very friable fine sandy loam that has weak, granular structure. The lower part is grayish-brown, friable loam that also has weak, granular structure. The upper part is more friable and less clayey than the lower part.

The substratum is alluvial material that consists of grayish-brown to pale-brown loam and clay loam. This layer is friable, contains some lime, and is easily penetrated by plant roots.

The surface layer of the Bayard soils ranges from 6 to 14 inches in thickness. The subsoil ranges from fine sandy loam to loam in texture and from 12 to 24 inches in thickness. The depth of the fine sandy loam over finer textured material ranges from 6 to 30 inches. The deeper areas of fine sandy loam are generally noncalcareous in the uppermost few inches, but cultivated areas are normally calcareous at the surface. The Bayard soils in Scott County have a more loamy substratum than those of the same series mapped in other counties.

Buried soils that are the surface soils of old soil material commonly lie between a depth of 18 and 40 inches. These layers are loam or clay loam in texture.

Bayard soils have good drainage, slow runoff, and moderate permeability. They are moderately fertile. They are susceptible to wind erosion, and soil material may be deposited on them during floods. Their moisture-holding capacity is somewhat limited in the part of their profile that is sandy loam.

The Bayard soils are more sandy throughout their profile than the Bridgeport soils. They are lighter in color than the Manter soils and are also less deeply leached of lime.

**Bayard fine sandy loam, loamy substratum (B1).**—This is the only Bayard soil mapped in the county. The major part is in a narrow band along the channel of White Woman Creek. It has nearly level to gentle slopes that descend from the high channel.

The mapped areas of this soil include small areas of Ulysses and Bridgeport soils. The stream channel and banks are also included and are shown by a symbol.

This Bayard soil is suited to wheat and sorghum. Most areas that are cultivated are irrigated. Excessive tillage should be avoided, as wind erosion is a hazard if the soil is dry and not adequately protected by crop residue. (Capability unit IIIe-2, dryland; capability unit IIs-1, irrigated; Sandy range site)

### Bridgeport Series

The Bridgeport series consists of deep, well-drained, moderately dark colored, calcareous soils. The soils have formed in alluvium that is made up of sediments from the adjacent uplands. The sediments were deposited by local, intermittent streams that empty into the valleys.

Most of the Bridgeport soils occupy the nearly level alluvial fans and terraces along Ladder (Beaver) Creek.

The surface layer is grayish-brown calcareous loam about 8 inches thick. It is slightly hard when dry but is friable when moist. It is easily worked.

The subsoil is grayish-brown, friable loam or light clay loam about 30 inches thick. This layer has weak, granular structure. Moisture and roots can penetrate it with little difficulty.

The substratum is clay loam alluvium. It is friable, contains some lime, and is easily penetrated by plant roots.

The surface layer ranges from grayish brown to dark grayish brown in color, from loam to light clay loam in texture, and from 6 to 12 inches in thickness. The subsoil and substratum range from loam to silty clay loam in texture and from dark grayish brown to pale brown in color. In most areas the soil is calcareous at the surface, but some areas that receive extra runoff from surrounding areas are leached of lime to a depth of 10 inches.

The Bridgeport soils are well drained. Runoff is medium, and permeability is moderately slow. In most areas the depth to sand and gravel is more than 5 feet. The water table is well below the root zone. These soils are porous and permeable and have the capacity to hold a large amount of water available for plant use. There are few hazards and limitations, but infrequent flash floods from the uplands may damage crops.

The Bridgeport soils are more clayey throughout the profile than the Bayard soils. Their profile is similar to that of the Ulysses soils in many ways, but they occupy alluvial fans and terraces and were formed in alluvium instead of loess. The Bridgeport soils are lighter colored than the Goshen and are less deeply leached of lime.

**Bridgeport loam** (0 to 1 percent slopes) (Br).—This is the only Bridgeport soil mapped in Scott County. The largest acreage occurs along the deep, narrow channel of Ladder (Beaver) Creek in nearly level areas that in places have slopes of about 2 percent.

Most areas of Bridgeport loam are cultivated, but the acreage under irrigation is limited. This soil is suited to wheat and sorghum and to native grass. On cultivated areas that are not irrigated, wind erosion is a hazard when the surface is dry and not protected. (Capability unit IIc-1, dryland; capability unit I-1, irrigated; Loamy Upland range site)

## Church Series

The soils of the Church series are nearly level, dark colored, deep, and generally saline. They occupy benches around Dry Lake and intermittent lakes and are also in depressions. These young soils formed under mixed native grasses from clayey sediments laid down by wind and water.

The surface layer is gray silty clay loam about 9 inches thick. It is slightly hard when dry and slightly firm when moist. This layer has granular structure and is somewhat difficult to work. In most areas it is calcareous.

The subsoil is gray silty clay loam about 9 inches thick. It has granular structure, is slightly hard when dry, and is slightly firm when moist.

The substratum consists of calcareous lakebed sediments that contain numerous deposits of crystalline salt (gypsum).

The surface layer ranges from gray to grayish brown in color, from 6 to 15 inches in thickness, and from silt loam to silty clay loam in texture. Most areas are calcareous throughout, but small, local areas are noncalcareous to a depth of 12 inches.

The Church soils are well drained to moderately well drained. They have a fluctuating water table during periods when rainfall is high. The moisture-holding capacity is high, runoff is slow, and permeability is moderately slow. The soils are slightly to moderately saline. Also, they are susceptible to wind erosion in areas not adequately protected by growing vegetation, by enough clods, or by crop residue.

These soils are darker and are more clayey throughout their profile than the Ulysses and Colby soils. They are less clayey throughout the profile than the Randall soils. The Church soils are less deeply leached of lime than the Lubbock and Richfield soils and have less distinct layers.

**Church silty clay loam** (Ch).—This soil has a profile similar to the one described for the series. It occupies areas in depressions on benches around intermittent lakes in the Scott-Finney depression and also around Dry Lake. The soil is generally nearly level, but a small acreage near Dry Lake has slopes that are as much as 3 percent.

The mapped areas of this soil include small areas of Ulysses silt loam, saline, 0 to 1 percent slopes, and areas of Randall and Lubbock soils.

About half of the acreage is used for cultivated crops under dryland or irrigation farming. Wheat and sorghum are the principal crops under dryland farming. In the cropping system, crops are alternated with fallowing. Because of the fluctuating water table in the Dry Lake area, alfalfa is also grown under dryland farming. The principal crops in irrigated areas are the same as those in dry-farmed areas.

The production of this soil is limited by salinity. In irrigated areas satisfactory yields are obtained only if the quality of irrigation water is good, and water and fertilizer are applied carefully. Suitable native grasses produce abundant forage under good management. (Capability unit IVs-1, dryland; capability unit IIIs-1, irrigated; Saline Upland range site)

## Colby Series

The Colby series consists of deep, grayish-brown, calcareous, friable soils of the loess-mantled uplands. These soils are in the steeply sloping areas along intermittent drainageways throughout Scott County. They have a weakly defined profile (fig. 5).

The surface layer is grayish-brown, calcareous silt loam about 5 inches thick. It is friable and has granular structure.

The subsoil is grayish-brown to pale-brown, calcareous silt loam about 6 inches thick. This layer is friable, has granular structure, and is moderately permeable to roots, air, and water.

The underlying material is friable silty loess that contains much lime and is easily penetrated by plant roots.

The darkened surface layer ranges from silt loam to loam in texture and from 2 to 6 inches in thickness. In a few places some rounded gravel is scattered over the surface.



Figure 5.—A profile of Colby silt loam.

The Colby soils are well drained. Internal drainage is medium, and permeability is moderate. They have the capacity to store a large amount of water that is available to plants.

The Colby soils have a lighter colored, more calcareous surface layer than the associated Ulysses soils. Also, they are less deeply leached of lime. Their subsoil contains less clay than that of the Keith and Richfield soils.

In this county some areas of the Colby soils are mapped in a complex with the Ulysses soils.

**Colby silt loam, 5 to 15 percent slopes (Cd).**—This soil has profile characteristics that are similar to those described for the series. As much as 15 percent of the acreage consists of other soils included in mapping.

The mapped areas of this soil include (1) grayish-brown, calcareous loamy alluvium on the floors of narrow valleys in minor drainageways; and (2) the Mansker, Potter, and Ulysses soils in a few small areas that are generally less than 20 acres in size. The included areas are too small to be significant in range planning and management practices.

Most areas of this soil are in native short grass and are used for grazing. A few small areas, however, are parts of large fields of arable soils under cultivation. Most of these areas were abandoned for crops because of severe wind and water erosion. These eroded areas, as well as areas that are still cultivated, should be seeded to suitable

native grass and used for range. (Capability unit VIe-1, dryland; Limy Upland range site)

## Dalhart Series

In the Dalhart series are deep, well-drained, dark grayish-brown to brown sandy loams of the uplands. They developed under mixed native grasses from somewhat reworked, calcareous, sandy and silty outwash sediments of the High Plains. These sediments were reworked by wind and water after they were laid down.

The surface layer is dark grayish brown, free of lime, and about 5 inches thick. This layer has granular structure, is easily worked, and is slightly hard when dry but friable when moist.

The subsoil is about 20 inches thick. The upper part is a brown, noncalcareous light sandy clay loam with moderate, coarse, prismatic structure breaking to weak granular. The lower part is grayish-brown calcareous sandy loam or light sandy clay loam with weak granular structure. The upper part contains more clay than the lower and is more compact.

The underlying material is somewhat reworked, friable, sandy to loamy outwash material that contains much lime and is easily penetrated by plant roots.

The surface layer ranges from light sandy loam to heavy sandy loam in texture and from 3 to 7 inches in thickness. The subsoil ranges from sandy loam to sandy clay loam in texture. The depth to which the soils are free of lime ranges from 12 to 23 inches; the average is about 15 inches.

The Dalhart soils are more sandy throughout the profile than the Richfield soils, which are of loess origin. They are darker than the Otero soils and are more deeply leached of lime. The Dalhart soils have a more distinct and more clayey subsoil than the associated Manter soils.

In this county the Dalhart soils are mapped only in a complex with the Richfield soils.

**Dalhart-Richfield complex, 1 to 3 percent slopes (Dr).**—The soils in this complex occur on gently sloping ridges. The slopes range from 1 to 3 percent and are somewhat smooth. The complex is made up mainly of Dalhart sandy loam and Richfield loam. The soils in this complex are closely associated with the Manter, Otero, Tivoli, Richfield, and Ulysses soils in the southeastern quarter of the county.

On the average, about 50 percent of the acreage of this complex consists of Dalhart sandy loam; 30 percent, Richfield loam; 10 percent, soils with characteristics intermediate between those of the Dalhart and Richfield soils; 5 percent, Manter fine sandy loam; and 5 percent, soils with characteristics intermediate between those of the Dalhart and Colby soils and intermediate between those of the Dalhart and Otero soils.

The soils in this complex are suitable for crops, for which most areas are used. They are easily penetrated by plant roots, air, and water. They are susceptible to wind and water erosion, however, and will blow where the surface soil is not adequately protected. Wind erosion is active on these areas and is also a menace to adjacent soils. (Capability unit IIIe-2, dryland; capability unit IIe-1, irrigated; Dalhart soil, Sandy range site; Richfield soil, Loamy Upland range site)

## Goshen Series

The Goshen series is made up of deep, dark-colored, friable soils that are in swales and along intermittent drainageways of the uplands (fig. 6). These soils developed in silty material that washed from the soils on the higher slopes nearby. The native vegetation was short, mid, and tall grasses.

The surface layer is dark grayish-brown silt loam about 17 inches thick. It has granular structure and is slightly hard when dry but friable when moist. It is free of lime and is easily worked.

The subsoil is dark grayish-brown silty clay loam about 12 inches thick. This layer has granular and subangular blocky structure, is hard when dry but friable when moist, and is free of lime. Moisture, air, and plant roots penetrate this layer with little difficulty.

The underlying material is friable silty alluvium that is easily penetrated by plant roots. It has accumulations of lime in the upper part.

Significant variations in the profile are not common. The texture of the surface layer ranges from loam to silt

loam, but that of the subsoil ranges from heavy silt loam to silty clay loam. The depth to calcareous material ranges from 18 to 36 inches.

The Goshen soils are porous and permeable, absorb water readily, and have good internal drainage. They have a high content of plant nutrients but are susceptible to erosion by both wind and water.

The Goshen soils, compared to the Bridgeport soils, are leached of lime to a greater depth and have a more strongly defined profile. They contain less clay than the Lubbock soils and have a less strongly defined profile. They are darker colored than the Richfield and Keith soils and are more deeply leached of lime.

**Goshen silt loam (Go).**—This soil has profile characteristics similar to those described for the series. It occurs in association with the Richfield, Ulysses, and Keith soils in swales that drain runoff from these soils. The surface layer is darker and thicker than that of typical soils of the uplands. The dominant slope is less than 1 percent, which is enough for good drainage of the surface.

Most areas are cultivated along with areas of other soils used for crops. Because of its high productivity, the soil is important to the agriculture of the county. Crops generally benefit from extra moisture received from accumulations of runoff from adjacent areas, and yields are higher on this soil than on most other cultivated soils. Wind erosion occurs if the soil lacks growing vegetation or its residue, but water erosion is negligible. (Capability unit IIc-2, dryland; capability unit I-1, irrigated; Loamy Lowland range site)

## Keith Series

In the Keith series are deep, friable, dark-colored soils that are in nearly level, slightly lower areas of the loess-mantled uplands.

The surface layer is dark grayish-brown silt loam about 12 inches thick. This layer is free of lime and has granular structure. It is easily worked.

The subsoil is about 20 inches thick. The upper part is dark grayish-brown to brown silty clay loam that has weak, medium, prismatic and moderate, medium, subangular blocky structure. The lower part is brown, calcareous silty clay loam that has moderate, medium, subangular blocky structure.

Beneath the subsoil is loess that is calcareous, friable silt loam. It is penetrated easily by plant roots.

The surface layer ranges from silt loam to loam in texture and from 8 to 14 inches in thickness. The subsoil ranges from 12 to 30 inches in thickness. In places the nearly black layers of a buried soil are evident in the subsoil or substratum. These dark-colored layers are not typical of the Keith soils in this county and are not related to any feature of the landscape.

The Keith soils are well drained and have moderately slow permeability. Runoff is medium, and the moisture-holding capacity is high. These soils are high in content of plant nutrients but are susceptible to erosion by both water and wind.

The Keith soils have a thicker surface layer and a more clayey subsoil than the Ulysses soils. They are also deeper and have been leached of lime to a greater depth. Their subsoil is more friable and less clayey than that of the Richfield soils. They are lighter colored and less deeply



Figure 6.—A profile of Goshen silt loam.

leached of lime than the Goshen soils. Also, they were formed in loess instead of alluvium.

**Keith silt loam, 0 to 1 percent slopes (Kc).**—This nearly level soil is the only Keith soil mapped in Scott County. The profile characteristics are similar to those described in the Keith series.

Most areas of Keith silt loam, 0 to 1 percent slopes, are cultivated. The soil is suited to wheat, other dryland crops, and native grass; however, winter wheat and sorghum are the most common crops. The hazard of water erosion is negligible, but wind erosion occurs where the soil is not covered by vegetation. (Capability unit IIc-1, dryland; capability unit I-1, irrigated; Loamy Upland range site)

## Lubbock Series

In the Lubbock series are deep, very dark colored soils of the broad, slightly concave areas throughout the Scott-Finney depression. The silty material from which the soils developed was blown or washed from soils on nearby, higher slopes.

The surface layer is dark gray, about 12 inches thick, and free of lime. It has granular structure. The upper part is light silty clay loam, but the lower part is silty clay loam.

The subsoil is dark grayish-brown or grayish-brown silty clay loam about 22 inches thick. This layer is free of lime in the upper part, but a small amount has accumulated in the lower part. The structure is moderate, fine, subangular blocky.

The underlying material is limy silty clay loam. The lower part consists of sediments that were deposited in shallow water.

The surface layer ranges from heavy silt loam to silty clay loam in texture, from dark gray to gray in color, and from 8 to 16 inches in thickness. The texture of the subsoil ranges from silty clay loam to light clay. The structure ranges from moderate, medium, granular to strong, subangular blocky to blocky. The depth to calcareous material ranges from 18 to 30 inches.

The Lubbock soils are well drained and have moderately slow permeability. Runoff is slow, and the moisture-holding capacity is high.

The Lubbock soils have developed in more clayey sediment than the Goshen soils. Also, they are more firm and more clayey throughout the profile. They are darker, deeper, and more clayey throughout the profile than the Keith and Richfield soils. They are also leached of lime to a greater depth. The Lubbock soils are more mature than the Church soils. Also, they are leached of lime to a greater depth.

They contain less clay and are less firm than the Randall soils.

**Lubbock silty clay loam (Lu).**—This soil has profile characteristics similar to those described for the series. It occurs in depressions, along with Church and Randall soils, in association with the Ulysses and Richfield soils. It occupies the slightly depressed areas and the higher benches in the larger depressions.

The surface layer is darker and thicker than that of typical soils of the uplands. It is less clayey than that of the soils of the basins or intermittent lakes. The dominant slope, less than 1 percent, is enough for good surface

drainage. Areas of this soil are ponded for short periods during and following intense rains.

Most areas are cultivated and are irrigated. Because of its high productivity, this soil is important to the agriculture of the county.

Crops generally benefit from the water that runs from adjacent areas. The yields on this soil are higher than those on most other cultivated soils. Wind erosion occurs when the soil is barren of vegetation or its residue, but water erosion is negligible. (Capability unit IIc-2, dryland; capability unit I-1, irrigated; Loamy Lowland range site)

## Mansker Series

The Mansker series is made up of moderately deep, strongly calcareous, grayish-brown soils that are underlain by partly weathered caliche (fig. 7). These soils occupy gentle to steep slopes along the drainageways of uplands. The surface layer is grayish-brown, calcareous, granular loam about 7 inches thick. This layer is soft when dry and is friable when moist.

The subsoil is grayish-brown to pale-brown, granular loam or clay loam about 9 inches thick. This layer is slightly hard when dry and is friable when moist. Moisture and roots can penetrate it with little difficulty.

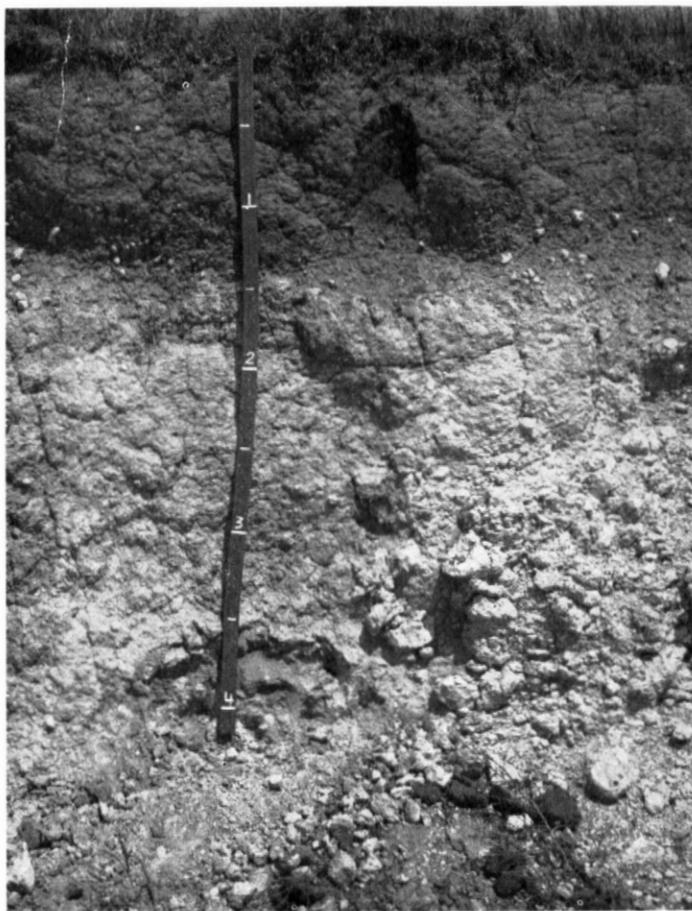


Figure 7.—A profile of a Mansker soil in a road cut.

The substratum is slightly weathered, limy outwash sediment that is friable in the upper part and soft to hard caliche in the lower part.

The surface layer ranges from sandy loam to silt loam in texture and from 4 to 9 inches in thickness. These soils range from 10 to 36 inches in thickness over the layer that is high in lime. The layer of hard caliche is not present in all areas.

The Mansker soils are deeper and have smoother slopes than the associated Potter soils. They are similar to the Colby and Ulysses soils, but they are more shallow and were formed from outwash sediment instead of loess.

The Mansker soils are mapped only in a complex with the Potter soils in this county.

**Mansker-Potter complex (Mm).**—This complex consists mainly of Mansker and Potter soils on gentle to steep slopes in rough, broken areas. Generally, about 60 percent of the acreage of the complex consists of the Mansker soil, 25 percent of the Potter soil, 10 percent of Colby silt loam, and 5 percent of mixed, loamy alluvium in drainage channels. Slopes range from about 5 to 40 percent but are mostly less than 25 percent. The areas are inextensive and occur adjacent to and on the strongly sloping sides of drainage ways in the uplands.

In this complex, variations from typical profiles are common. In many places the profile characteristics are intermediate between those of Potter and Mansker soils or between those of Mansker and Colby soils.

The soils in this complex are not suited to crops, and most areas are in native grass. Erosion occurs in cultivated areas, regardless of the measures used to control it. Areas now in cultivation would be better used if they were reseeded to suitable native grass. (Capability unit VIe-3, dryland; Mansker soil, Limy Upland range site; Potter soil, Breaks range site)

## Manter Series

The Manter series consists of deep, moderately dark, well-drained, friable sandy loams of the uplands. These soils developed in calcareous sediments derived from sandy outwash of the High Plains. After the sediment was laid down, it was reworked by wind and water. These nearly level to undulating soils are mainly along White Woman Creek and in the southeastern quarter of the county.

The surface layer is dark grayish-brown fine sandy loam about 10 inches thick. It is free of lime, very friable, and easily worked. This layer is porous and permeable and has weak, granular structure.

The subsoil is about 20 inches thick. It is dark grayish-brown to brown heavy sandy loam that breaks easily to weak, granular structure. Roots, moisture, and air penetrate it with little difficulty. In most areas lime has not accumulated in this layer.

The substratum consists of reworked outwash sediment that is of loam texture. This material is massive and contains much lime.

The surface layer ranges from heavy loamy fine sand to light loam in texture. The subsoil ranges from sandy loam to light loam. The depth to calcareous material ranges from 12 to 40 inches but is generally 30 inches or more. Because of winnowing, some cultivated areas have as much as 4 inches of loamy fine sand on the surface.

These soils have the capacity to store a moderate amount of moisture, which is easily released for plant use.

The Manter soils are more sandy throughout the profile than the Ulysses, Keith, and Richfield soils. They are darker colored and are leached of lime to a greater depth than the Bayard and Otero soils. They contain less clay and are less mature than the Dalhart soils.

**Manter fine sandy loam, 0 to 1 percent slopes (Mn).**—This nearly level soil has a profile similar to the one described for the series; however, the depth to more loamy material is not quite so great. In places the surface soil is somewhat more loamy near the area of transition between this soil and the Keith, Ulysses, and Richfield soils.

Most of Manter fine sandy loam, 0 to 1 percent slopes, is under cultivation. Sorghum and wheat are the main crops. The hazard of soil blowing is particularly serious where the soil is summer fallowed and not adequately protected. If crop residues are maintained on the surface, soil blowing can be controlled or minimized. (Capability unit IIe-2, dryland; capability unit IIs-1, irrigated; Sandy range site)

**Manter fine sandy loam, undulating (Mr).**—This soil occupies undulating slopes that range from 1 to 5 percent. Some small, insignificant areas of the Otero soils and the Dalhart-Richfield complex that were not practical to map separately have been included with this soil.

Most of Manter fine sandy loam, undulating, is cultivated. The main crop is sorghum, but some wheat is grown. Soil blowing is a serious hazard if the soil is not protected by enough vegetation. Water erosion is another hazard. Maintaining crop residues on the surface conserves moisture and helps to control wind and water erosion. (Capability unit IIIe-2, dryland; capability unit IIe-1, irrigated; Sandy range site)

## Marsh (Mw)

This land type consists of an area of low wetland that is covered by grass, weeds, cattails, rushes, and a few scattered tamarisks. It lies slightly higher than Dry Lake and adjoins the lake. The water table in this land type is at the level of, or slightly higher than, the surface of the lake. Drainage from the uplands empties into the area.

Nearly all of Marsh is in native grass, but part of the acreage was cultivated during the drought. In some periods the surface dries out somewhat, but under average rainfall the soil material becomes saturated and spongy within a depth of a few inches. This land type is well suited to range. (Capability unit Vw-1, dryland; Saline Subirrigated range site)

## Otero Series

The Otero series is made up of undulating to hummocky, light-colored, calcareous soils of the uplands. These young soils formed under mixed native grasses from somewhat reworked, calcareous outwash sediment of the High Plains in the southeastern part of the county.

The surface layer is calcareous, brown fine sandy loam. This layer is about 5 inches thick, has granular structure, and is easily worked.

The subsoil is brown fine sandy loam about 12 inches thick and has granular structure. Moisture, plant roots, and air can penetrate it with little difficulty.

The underlying material consists of sandy to loamy outwash sediment. This layer is friable, contains much lime, and is easily penetrated by plant roots. In places some lime has accumulated in its upper part.

The texture of the different layers varies considerably from place to place. In most places the surface layer is calcareous, but in some places under native grass, it is free of lime to a depth of 10 inches.

The Otero soils are calcareous nearer the surface and are less sandy throughout the profile than the associated Tivoli soils. They are lighter colored and are calcareous nearer the surface than the Manter soils. The Otero soils are more sandy throughout the profile than the Ulysses and Colby soils.

**Otero fine sandy loam, undulating (Of).**—This soil occurs mainly in the southeastern quarter of the county in undulating areas that have slopes ranging from 1 to 5 percent. It occurs in association with the Manter fine sandy loams, the Dalhart-Richfield complex, 1 to 3 percent slopes, and Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.

This soil is more sandy than the Ulysses-Colby soils and is more calcareous than the Dalhart, Richfield, and Manter soils. Small areas of those soils are included in mapped areas of this soil. Small blowouts are also included.

The surface soil and subsoil are calcareous, friable fine sandy loam that has granular structure. A surface layer of loamy fine sand 1 to 3 inches thick occurs in many cultivated areas. Winnowing has left the surface layer more sandy than it was originally, as the finer particles have been sorted out and blown away.

This soil is readily penetrated by air, plant roots, and water but is limited in suitability for crop production. Much of the acreage is cultivated. This soil is susceptible to wind erosion if the surface is not adequately protected. The hazard of wind erosion is high. Wind erosion on this soil may cause damage to adjacent soils. (Capability unit IVe-2, dryland; Sandy range site)

**Otero soils, hummocky (Oh).**—This mapping unit consists mainly of Otero loamy fine sand and Otero fine sandy loam. It occurs mostly on hummocky topography on which small, low flats and undulating areas are intermingled. The slopes are generally more than 5 percent but range from about 3 to 20 percent. Otero soils, hummocky, are closely associated with Tivoli loamy fine sand and Otero fine sandy loam, undulating, in the southeastern corner of the county.

On the average, about 50 percent of the mapping unit consists of Otero loamy fine sand; 40 percent, Otero sandy loam; and 10 percent, Tivoli loamy fine sand and soils having profile characteristics intermediate between those of the Otero and Colby soils. Otero loamy fine sand has a surface layer and subsoil of loose, slightly coherent, calcareous loamy fine sand.

These soils are highly erodible and have low fertility. Erosion occurs in cultivated areas, regardless of the measures taken to control it. The hazard of wind erosion is high. Soil blowing also menaces adjacent soils.

These soils are unsuitable for crops, and only small areas remain in crops. Areas now used for crops would be better used if reseeded to suitable native grass. (Capability unit VIe-2, dryland; Otero loamy fine sand and Tivoli loamy fine sand in Sands range site; Otero fine sandy loam in Sandy range site)

## Potter Series

The Potter series is made up of grayish-brown, very shallow, strongly calcareous soils. These soils are underlain at a depth of 12 inches or less by partly indurated caliche. They occupy steeply sloping and more broken areas that are below the tablelands of the High Plains. The mantle of loamy sediment has been stripped away by geologic erosion, and the basal material of caliche and limestone is exposed.

The surface layer is strongly calcareous, grayish-brown loam and sandy loam about 5 inches thick. This layer is granular in structure and contains fragments of hard caliche.

Below the surface layer is a mixture of white to grayish-brown soil material and hard fragments of caliche about 5 inches thick. This material is underlain by nearly white, hard caliche.

These soils are as much as 12 inches thick over caliche but average about 6 or 7 inches. They range from loam to sandy loam and in places grade from one texture to the other within a short distance. The amount of gravel in the soils varies greatly and depends on the composition of the underlying caliche. In some places this rock almost resembles limestone, and in others it is moderately indurated, calcareous conglomerate.

The Potter soils are shallower than the associated Mansker and Colby soils. Furthermore, they are more strongly sloping and are somewhat less dark.

Some areas of the Potter soils have been mapped in a complex with the Mansker soils.

**Potter soils (Po).**—These steep, broken soils are inextensive and occur mainly in the northern part of the county. Slopes range from 5 to 40 percent.

The mapped areas of this soil include small areas of Mansker and Colby soils and small, barren areas that consist of outcrops of caliche and of underlying limestone and shale that are associated with the caliche.

The Potter soils are not suitable for cultivation; they are suitable only for wildlife, grazing, and recreation. They support sparse stands of native grass, mainly side-oats grama, blue grama, and little bluestem. Grazing management is necessary to keep these soils productive. (Capability unit VIIs-1, dryland; Breaks range site)

## Randall Series

The Randall series consists of deep, dark-colored, clayey soils in enclosed depressions on the uplands. These depressions are locally called potholes or lagoons. Water may be ponded in them for several days to a month or more before it drains into the soils or evaporates.

The surface layer consists of dark-gray to gray clay about 6 to 20 inches thick. It has irregular and blocky structure and is extremely hard when dry.

The subsoil is gray, blocky clay about 20 inches thick. It is extremely hard when dry but very firm and sticky when wet. Generally, there is no accumulation of lime in this layer.

The underlying material is grayish-brown to light-gray silty clay loam that is friable and contains some lime concentration.

The characteristics of the profile vary somewhat from one depression to another according to the size of the de-

pression and the extent of its drainage area. Variations are mainly in the texture of the surface layer and in the depth to calcareous material. In places the surface layer is clay loam.

The Randall soils occupy lower, more poorly drained areas than the Church soils. Also, they are more clayey.

**Randall clay** (0 to 1 percent slopes) (Rc).—This soil has a profile similar to the one described for the series. The surface soil is a few inches of clay loam or clay. The depth to calcareous material is generally more than 3 feet. Brown mottling occurs in places in the profile.

Many areas of Randall clay are cultivated along with areas of the associated surrounding soil. At times water is ponded long enough to delay planting or harvesting. Crops are frequently drowned out and are either replanted or lost. Wind erosion is a hazard when not enough crop residues are kept on the surface to protect the soil. For these reasons this soil is generally considered nonarable. (Capability unit VIw-2, dryland; not grouped in a range site)

**Randall clay, occasionally flooded** (Rb).—This nearly level soil occupies the floor of the Scott (White Woman) Basin and is calcareous throughout the profile (fig. 8). This Randall soil developed in saline, lacustrine deposits, whereas Randall clay developed in nonsaline deposits.

The surface layer ranges from light gray to dark gray in color and from 3 to 15 inches in thickness. This layer is generally calcareous to the surface. In some areas surface accumulations of silt loam and silty clay loam material 1 to 6 inches thick are evident. Various amounts of white crystalline salts (gypsum) occur in the gray sub-



Figure 8.—A profile of Randall clay, occasionally flooded, showing concentrated, white crystalline salts.

stratum. They range from a few scattered crystals to large nests and pockets of crystals generally below a depth of 30 inches. Thin sandy strata occur in places at a depth below 4 feet.

The darker color that occurs in places in the substratum is the result of the churning of the soil during shrinking and swelling. Gilgai microrelief is evident only in fields that have not been cultivated recently.

Most of this Randall soil is cultivated, and part of it is irrigated. This soil has limited suitability for cultivated crops because it ponds for periods that last a few days to more than a year. An adequate seedbed is difficult to prepare because of the clay texture of the surface soil. Slow surface drainage, slow permeability, and slight to moderate salinity limit crop production. Yields are satisfactory only when water, fertilizer, and tillage are carefully managed. Capability unit VIw-2, dryland; capability unit IVw-1, irrigated; not grouped in a range site)

### Richfield Series

The Richfield series consists of deep, well-drained, dark-colored, nearly level to gently sloping soils. These soils are in the deep, loess-mantled tablelands (fig. 9) and are the most extensive in the county.



Figure 9.—A profile of Richfield silt loam.

The surface layer is dark grayish-brown silt loam about 8 inches thick. It is free of lime, is easily worked, and has granular structure. The lower part is more clayey than the upper part.

The subsoil is dark grayish-brown silty clay loam about 20 inches thick. The upper part is free of lime and has moderate, medium, granular and fine, subangular blocky structure. It is moderately firm when moist. The middle part is brown silty clay loam that has moderate, medium, subangular blocky structure and is firm when moist. The lower part of the subsoil is pale-brown silty clay loam that contains much lime.

The substratum is silty loess that is friable and porous. It contains much lime and is easily penetrated by plant roots.

The surface layer ranges from 4 to 10 inches in thickness. The depth at which light-colored, calcareous material occurs ranges from about 12 to 25 inches. In some places darkened layers (fig. 10) that are remains of buried soils occur at a depth of 24 to 48 inches or more from the surface. Layers of buried soil are not unusual but are not typical of the Richfield soils. The buried soils are not related to any feature of the landscape.

The Richfield soils are well drained and are high in natural fertility. Runoff is slow to medium, and permeability is moderately slow. The capacity to hold water is high, but the soils are susceptible to both wind and water erosion.

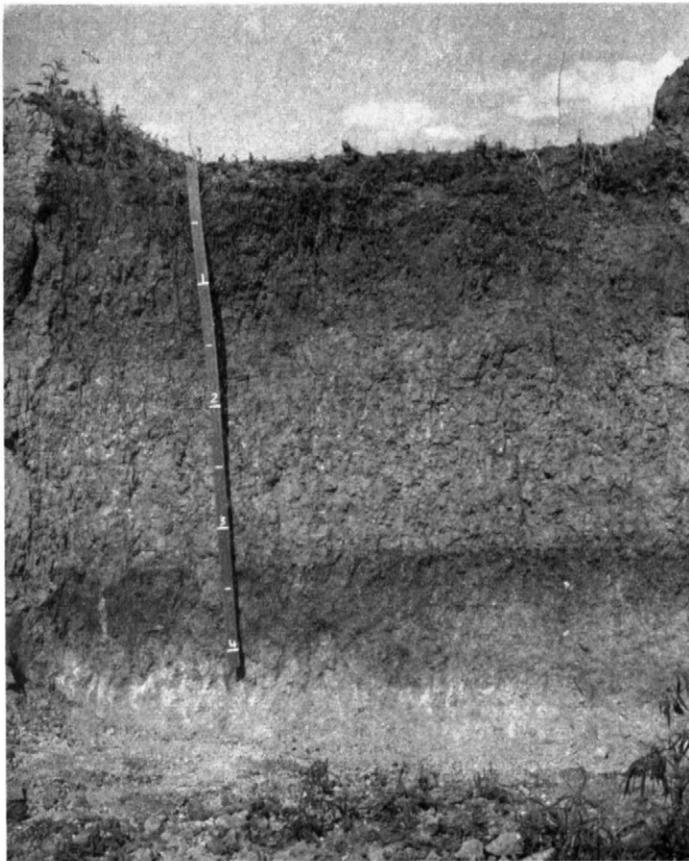


Figure 10.—A profile of Richfield silt loam that is underlain by a buried soil.

The Richfield soils are not so dark and deeply leached of lime as the Goshen and Lubbock soils. They are deeper and have a more strongly defined profile than the Ulysses soils. They are also less friable. The Richfield soils have a more clayey subsoil than the Keith soils but are not so deeply leached of lime.

**Richfield silt loam, 0 to 1 percent slopes (Rm).**—The profile of this soil is similar to the one described for the series. This is the most extensive soil in the county, and it is also the most important to agriculture.

The mapped areas of this soil include small areas of Ulysses and Keith soils. It was not practical to map these soils separately. In most places the included areas do not exceed 10 acres in size and make up less than 5 percent of the acreage. Also included are many small, shallow depressions less than 5 acres in size.

This soil is well suited to crop production, and most of it is cultivated under dryland or irrigation farming. Under dryland farming wheat and sorghum make satisfactory yields when grown on land that was summer fallowed. Conservation of moisture and its storage in the soil are essential for profitable crop yields. Wind erosion is a hazard on this soil when the soil is dry and not adequately protected by growing vegetation, crop residue, or enough clods. (Capability unit IIc-1, dryland; capability unit I-1, irrigated; Loamy Upland range site)

**Richfield silt loam, 1 to 3 percent slopes (Rn).**—This soil occurs on gently sloping ridges in the tablelands. Most areas have slopes between 1 and 2 percent. In most characteristics this soil is similar to Richfield silt loam, 0 to 1 percent slopes, but is much less extensive. The surface layer is somewhat less deep and dark, and the content of clay in the subsoil is slightly lower. The depth to calcareous material is somewhat less than in Richfield silt loam, 0 to 1 percent slopes; it averages about 12 inches.

The mapped areas of this soil include a few areas of Ulysses silt loam, 1 to 3 percent slopes, and minor areas of Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.

This soil is well suited to crop production, and most areas are cultivated. Controlling wind erosion and conserving moisture are important problems in management. Controlling water erosion is an additional problem. (Capability unit IIe-1, dryland; capability unit IIe-2, irrigated; Loamy Upland range site)

## Tivoli Series

The Tivoli series is made up of deep, light-colored, non-calcareous soils in the sandhills of the uplands. These soils have weakly defined profiles that formed in deep, eolian (wind-deposited) sands. They are in the eastern part of the county and along White Woman Creek. They occur on hummocky sand dunes that have slopes ranging from 5 to 20 percent. The sands have been stabilized by the growth of perennial vegetation.

The surface layer is brown loamy fine sand that is free of lime and about 4 inches thick. This layer is very friable when moist and is nearly structureless.

The subsoil ranges from brown to pale brown in color and from loamy fine sand to fine sand in texture. It is about 9 inches thick. This layer is free of lime, very friable when moist, and single grained to massive.

The underlying material consists of loose, single-grained fine sand. Ordinarily, this material is leached free of lime.

Significant variations in the profile are not common. The thickness of the darkened surface layer ranges from about 2 to 7 inches.

The Tivoli soils absorb water rapidly and have little or no runoff. Because they have a low moisture-holding capacity and are excessively permeable, some water is lost through internal drainage.

Compared with the Otero soils, the Tivoli soils are more sandy and more deeply leached of lime. They are more sandy, lighter colored, and less fertile than the Manter soils.

**Tivoli loamy fine sand (5 to 20 percent slopes) (T<sub>s</sub>).**—This soil has a profile similar to the one described for the Tivoli series. It has a thin, brown surface layer that is only slightly darker than the subsoil and underlying material.

The mapped areas of this soil include areas of Otero soils. Isolated blowouts are included and are generally shown by symbol.

Tivoli loamy fine sand is not suitable for crops. Most areas are in native range, but a few areas are cultivated. Since soil blowing cannot be controlled in cultivated areas, the areas in cropland should be reseeded to suitable native grasses. In addition, the soil in a few isolated blowouts should be stabilized by fencing out livestock and reseeding to native grasses. Range management practices, such as proper grazing, stabilizing blowouts, and in some places, reseeding of native grasses, help to protect and improve the grass cover. Moderate to large amounts of forage are produced under good grazing management. (Capability unit VIe-2, dryland; Sands range site)

## Ulysses Series

Nearly level to sloping, well-drained, dark-colored soils make up the Ulysses series. These friable soils are in the loess-mantled uplands (fig. 11). They are calcareous nearer the surface than most other soils of the uplands.

The surface layer consists of dark grayish-brown, massive silt loam about 4 inches thick. This layer is free of lime and is friable, but if excessively tilled, it pulverizes and then crusts over after rains. A plowpan may form when tillage is always at the same depth.

The subsoil consists of dark grayish-brown to grayish-brown light silty clay loam about 12 inches thick. It breaks easily to fine, moderate, granular structure and is easily penetrated by moisture, plant roots, and air. Ordinarily, the upper part is noncalcareous.

The substratum is deep, friable, porous silty loess that contains much lime. It is easily penetrated by plant roots. In most places some lime has accumulated in the upper part.

The darkened surface layer ranges from silt loam to loam in texture. It ranges from 3 to 7 inches in thickness over a lighter colored or slightly more clayey material. In places the subsoil is heavy silt loam or light silty clay loam and is as dark as the surface layer. The depth to calcareous material is variable; it averages about 8 inches. In cultivated areas the soils are calcareous to the surface, but in areas under virgin native grass, the depth to calcareous material is as much as 15 inches. In places remnants of dark-colored buried soils are below a depth of about 20 inches.



Figure 11.—A profile of Ulysses silt loam.

The Ulysses soils are well drained. Runoff is medium, permeability is moderately slow, and the moisture-holding capacity is high. The soils are moderately fertile but are susceptible to both wind and water erosion.

**Ulysses silt loam, 0 to 1 percent slopes (U<sub>a</sub>).**—This soil is scattered over the county on nearly level uplands. The thickness of the surface layer averages about 5 inches. Lime occurs at a depth of about 9 to 11 inches.

The mapped areas of this soil include small areas of the closely associated Richfield silt loam, 0 to 1 percent slopes.

Nearly all areas of this soil are cultivated. If seeded on summer-fallowed land, wheat and sorghum yield satisfactorily in most years. Moisture conservation and control of wind erosion are problems. Most cultivated areas have had some wind erosion. (Capability unit IIc-1, dryland; capability unit I-1, irrigated; Loamy Upland range site)

**Ulysses silt loam, 1 to 3 percent slopes (U<sub>b</sub>).**—This soil occurs on convex slopes associated with the Richfield soils. The thickness of the surface layer averages about 4 inches. Lime occurs at a depth of about 7 to 9 inches, or slightly nearer the surface than in Ulysses silt loam, 0 to 1 percent slopes.

The mapped areas of this soil include small areas of the closely associated Richfield silt loam, 1 to 3 percent slopes, and Colby silt loam.

Most cultivated areas have had some erosion. Control of wind and water erosion and conservation of moisture are problems when this soil is cultivated. Unless proper

conservation practices are used, the losses from runoff and soil removal are excessive. Much of this soil is now used for production of wheat and sorghum. Profitable yields are obtained during most years when crops are seeded in fields left in summer fallow. (Capability unit IIIe-1, dryland; capability unit IIe-2, irrigated; Loamy Upland range site)

**Ulysses silt loam, 3 to 5 percent slopes (Uc).**—This soil occurs mainly in the northern part of the county along with the more steeply sloping and more dissected areas of the uplands. In most areas the slopes are from 3 to 5 percent, but in some they are as much as 7 percent.

The thickness of the surface layer averages about 4 inches. The subsoil is silt loam and is slightly less clayey than that of the Ulysses soils on less steep slopes. Lime occurs at a depth of about 7 to 9 inches; most areas under cultivation are limy at the surface.

The mapped areas of this soil include small areas of the associated Colby silt loam and Mansker soils. These inclusions make up about 5 percent of the total acreage.

Ulysses silt loam, 3 to 5 percent slopes, is not well suited to crops, but some areas are cultivated. Water erosion is a serious hazard. The hazard of wind erosion is the same as on the other Ulysses soils. Unless proper conservation practices are used, excessive losses of soil and water will result from runoff. Most cultivated areas have had some erosion. Damage from erosion has been slight on this soil. (Capability unit IVe-1, dryland; Loamy Upland range site)

**Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded (Ue).**—This mapping unit consists primarily of gently sloping areas of Ulysses silt loam and Colby silt loam. The small, scattered areas are associated with soils in the Ulysses and Richfield series.

On the average, about 60 percent of this mapping unit is Ulysses silt loam, and 35 percent, Colby silt loam. Richfield silt loam, Dalhart fine sandy loam, and Manter fine sandy loam make up the remaining 5 percent.

Most of the soils in this complex are cultivated or at one time were cultivated and are now eroded. Areas under native vegetation that adjoin this complex are Ulysses soils. Therefore, most areas in this mapping unit were Ulysses silt loam before most of the darkened surface layer was removed by erosion.

Much of the acreage of this mapping unit is cultivated to wheat and sorghum. Because the soils have a tendency to seal over during rainstorms, runoff and soil removal by water erosion are excessive. Wind erosion is also a serious hazard where the soil is not adequately protected by growing vegetation or its residue. (Capability unit IIIe-1, dryland; capability unit IIe-2, irrigated; Limy Upland range site)

**Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded (Um).**—This mapping unit consists primarily of Ulysses silt loam and Colby silt loam. It occurs mainly in the northern part of the county in association with the more steeply sloping and more dissected areas of the uplands.

On the average, about 50 percent of this mapping unit is Ulysses silt loam, and 50 percent, Colby silt loam. Most of the areas now classified as Colby silt loam were Ulysses silt loam before most of the darkened surface layer was removed by erosion. Much of the remaining Ulysses soil has been somewhat eroded, but it still has enough of the

surface layer left to be within the range of characteristics for Ulysses soils.

All of these soils are cultivated or have been cultivated, except for small areas near the channels of drainageways. These areas were too small to be mapped separately.

The soils in this mapping unit are not well suited to crops. Runoff is excessive because of steep slopes and the sealing of the surface during rainstorms. Excessive runoff results in large losses of soil and damage to crops that do not have a well-established root system. Wind erosion is also a serious hazard. (Capability unit IVe-1, dryland; Limy Upland range site)

**Ulysses silt loam, saline, 0 to 1 percent slopes (Us).**—This nearly level soil has a profile similar to the one described for Ulysses silt loam, 0 to 1 percent slopes. In most areas, however, the substratum contains nests of white crystalline salts (gypsum). This soil occurs mainly in the Scott-Finney depression and in the Dry Lake area.

The mapped areas of this soil have inclusions of the Richfield, Colby, Dalhart, and Manter soils. Also included are areas of Church soils and small, irregular-shaped slick spots. The inclusions make up about 20 percent of the total acreage of this soil. All of the included areas generally contain some salts.

The surface layer of Ulysses silt loam, saline, 0 to 1 percent slopes, is grayish-brown to dark grayish-brown, massive silt loam about 5 inches thick. Under native vegetation it is free of lime, but under cultivation it is generally limy at the surface.

The subsoil is grayish-brown, light silty clay loam about 9 inches thick; it breaks easily to fine, moderate, granular structure. Moisture, plant roots, and air penetrate it with little difficulty.

The upper part of the substratum is light silty clay loam, is about 12 inches thick, and contains much lime. The lower part is porous, massive silt loam that contains concentrations of white crystalline salts ranging from a few scattered threads and nests to many nests and clusters.

The surface layer ranges from loam to light silty clay loam in texture and from 4 to 8 inches in thickness. Under cultivation this soil is generally calcareous within 10 inches of the surface, but in places it is noncalcareous to a depth of 15 inches. The depth to the horizon of salt accumulation ranges from near the surface to 50 inches; it averages between 26 and 32 inches.

Nearly all of this soil is cultivated. Wheat and sorghum seeded on summer-fallowed land produce satisfactory yields in most years. In irrigated areas alfalfa and vegetable crops are also grown. The salinity reduces yields under both dryland and irrigation farming. Moisture conservation and control of wind erosion are also problems. Most cultivated areas have had some wind erosion. (Capability unit IIIs-1, dryland; capability unit IIs-2, irrigated; Saline Upland range site)

## Erosion

Erosion is the wearing away of the land surface by geological agents, mainly wind, running water, and gravity. This discussion deals with accelerated soil erosion in Scott County. Accelerated erosion should not be confused with geologic erosion. Geologic erosion is the gradual process of soil removal that takes place under natural



**Figure 12.**—Water erosion after the snow has melted on a field of winter wheat. The field was not protected by mechanical structures and was planted up and down the slope.

conditions in an undisturbed environment. Accelerated erosion is brought about by the changes in the natural cover or condition of the soil that were caused by the activities of man. The amount of erosion is determined by the following factors: Slope, soil, vegetation, climate, and land used.

Wind and water are the main active forces of soil erosion in this county. Wind erosion is always a hazard and is related to the physical characteristics and the condition of the soil. It may be serious during recurring droughts when the soil lacks vegetation or surface roughness. High wind velocities and limited vegetation are characteristic of periods of drought on the High Plains, and soil blowing results.

Water erosion is a hazard on all sloping soils, especially the silty soils under cultivation. It is affected by slope, soil type, land use, and intensity of rainfall. Runoff occurs during thunderstorms, when the hard, dashing rains fall more rapidly than water can enter the soil and during the melting of snow in spring (fig. 12). Runoff is greater on unprotected, sloping silty soils and causes sheet erosion, which removes thin layers of the soil from the entire surface, or rill erosion, which cuts small channels. Evidence of erosion may be removed by cultivation, and there may be little evidence of it until the subsoil or other underlying material is exposed. In most nearly level fields, water erosion does little permanent damage but is a nuisance to the farmers. Management practices that slow down or decrease runoff help to conserve moisture and to control water erosion.

Erosion may cause permanent damage to the soil, and changes in use and management may be necessary. On the other hand, it may impair the soil temporarily until conservation practices are used. During the fieldwork on the soil survey, some observations on erosion in the county were made, and the results are summarized as follows:

1. Slight erosion has occurred in most nearly level to gently sloping areas of cultivated soils. Wind erosion is a hazard on these soils if the surface is dry and not protected by growing plants, their residue,

or enough clods. The observed effects of erosion on these areas were the thinner surface soil in cultivated fields and the deposits of silt in other places, especially on grassland and in fence rows. These accumulations smother out the grasses and let the weeds take over.

2. In the more undulating and sloping areas, the tops of ridges and knolls are more susceptible to blowing than the adjacent, nearly level areas. Therefore, in the higher areas, the soil blows more often, and much of it is deposited in the smoother areas nearby. Some of the finer soil particles are transported long distances and are lost. The silt and sand that are deposited on the adjacent areas are often calcareous. Since calcareous silty and sandy soils blow readily, these deposits may start wind erosion in fields that would otherwise be stable.

Undulating soils are susceptible to water erosion during spring and summer in areas where the soil is not protected by plant growth or its residue. The sloping, calcareous silty soils are more erodible because they tend to seal over during rainstorms. Bare, overgrazed, or clean-cultivated surface soils are easily eroded. Unless the soil is protected by vegetation and mechanical structures, runoff and soil removal are a serious hazard. In sloping areas, the type or amount of vegetation is important in erosion control. In many places erosion has removed the surface soil and subsoil and has exposed the underlying calcareous material (fig. 13). It has removed much of the more permeable and fertile surface layer. Many of these eroded areas were mapped as eroded phases of soil types.

3. During droughts and years of average rainfall, some areas of the very sandy, nonarable rangeland, as well as some very sandy areas of cultivated land, have been so overused that the protective vegetation has been lost, and severe wind erosion has resulted. These soils are permanently damaged, and their value for grazing is greatly reduced. Erosion in



**Figure 13.**—Permanent soil damage on a gently sloping field. Water erosion has removed the surface soil and subsoil and has exposed the underlying limy outwash. Soil blowing is also a serious problem in these areas.

many of these areas is difficult to control once the soils start blowing. Cultivated crops and grass in adjacent areas are damaged by the drifting sand. Also, these sandy sediments increase the hazard on the soils on which they are deposited.

Eroded soils in Scott County were placed in separate mapping units only if erosion has modified some important characteristic that was significant to their use and management. Eroded soils were mapped as eroded phases of a soil type if they retained enough identifying characteristics; for example, Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded. As much as 30 to 70 percent of the acreage of this complex was eroded, and the plow layer in eroded places of each soil consists of a mixture of the original surface layer and the underlying layer. The hazard of erosion on soils that are less eroded but that are subject to further erosion is discussed in the section "Use and Management of the Soils."

The coarse-textured loamy fine sands and fine sands show the most drastic effects of wind erosion. In cultivated areas low dunes and deep blowouts are common. County roads may be closed after the blowing of drifting sand. Because of shifting sand, farmers may often have to plant a crop two to four times. In such areas the identity of the soil is lost through severe damage by erosion.

Erosion is a serious problem not only because of the damage done to the soils but also because of the immediate cost of repairing the damage. Replanting crops, reseeding rangeland, and using emergency tillage and smoothing may remove most of the temporary effects of erosion and restore the full use of the soil, but the operations are time consuming and costly. The soils in a clean-tilled field tend to start blowing soon after a rain, and the field will need to be tilled to control soil blowing (fig. 14).

Management practices needed to control erosion on a given site are discussed under the capability units in the sections "Management of Dryland Soils by Capability Units" and "Management of Irrigated Soils by Capability Units." A representative of the Soil Conservation Service should be consulted for more specific and detailed information about the control of erosion.

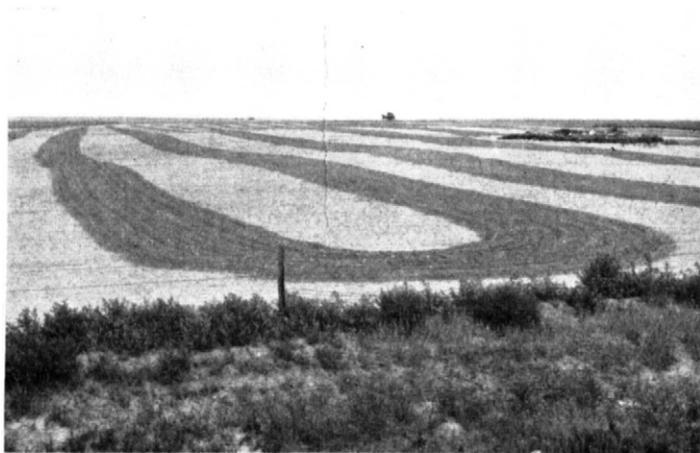


Figure 14.—Surface roughening on a clean-tilled field to control soil blowing the day after a good rain.

## Use and Management of the Soils

In this section the system of capability classification used by the Soil Conservation Service is explained. The general management and management by capability units for both dryland and irrigated soils are discussed. Yields per acre for the principal dryland crops are given. Also discussed in this section are the management of soils for range, for windbreaks, and for wildlife and the engineering uses of the soils.

### Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be up to four subclasses. The subclass is indicated 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* means that water in or on the soil will interfere 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 country, indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are subject to little or no erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils 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 the management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

## Management of Dryland Soils

The first part of this section describes general practices needed for dryland soils. In the second the dryland capability classes, subclasses, and capability units are listed, and management by dryland capability units is discussed. In the third part, the estimated yields of principal dryland crops are given.

### General management of dryland soils<sup>1</sup>

The soils in this county were covered with grass before cultivation. Roots permeated the soil, and living and dead vegetation covered the surface. The action of rain and wind on these protected soils caused little damage. Rains were absorbed rapidly by the soils, and there was little flash runoff. Winds had little chance to move protected soils. Erosion was limited to a slow, harmless rate, known as geologic erosion. In most areas erosion and soil formation were in balance.

Cultivation, especially in areas that were not irrigated, has reduced the organic-matter content of the soils. In many areas the soil structure and general physical condition have deteriorated. This poorer physical condition, combined with management that left the soil bare and unprotected, has resulted in erosion by both wind and water.

The conservation of cropland in this county should be based on the practice of keeping a cover on the surface of the soil at all times. It is not necessary to restore the native grass vegetation. The practices used, however, must be based on nature's own method of protecting the soil; that is, providing vegetative cover.

Conservation practices, such as flexible cropping systems, stubble-mulch farming, and minimum tillage, are needed on all cropland in the county. Terracing, contour farming, and stripcropping are additional practices that may be used to control erosion by wind and water. Erosion control and water conservation are most successful if a proper combination of these practices is used. A single practice may reduce erosion or conserve some moisture, or it may do both, but it is seldom enough for full conservation.

When cultivating the soils in this county, it is necessary to conserve moisture, control erosion, and maintain fertility and tilth. Most good management practices accomplish more than one purpose. A discussion of some management practices that are beneficial to the soils of the county follows.

*Stubble-mulch farming.*—This is a system of residue management in which harvesting, seedbed preparation, planting, and any subsequent cultivation are done in such a manner that enough residue is kept on the surface soil until the next growing crop can provide protection.

Crop production in this county is sometimes uncertain, even when summer fallowing is used. For this reason a practice such as stubble-mulch farming is necessary to help control wind and water erosion (fig. 15). The moisture intake of the soil is increased by reducing the tendency of the soil to form a crust that seals the surface.

Stubble-mulch farming is a practice that should be



Figure 15.—Wheat stubble that is undercut by wide sweeps will provide protection until the next crop is planted.

used on all cropland. The methods used depend on the soil type, the cropping system, the amount of residue, the season of the year, and the kind of equipment available.

The amount of residue required to protect the soil varies according to the kind of residue, the height of the stubble, surface roughness, soil texture, and other factors.

*Flexible cropping system.*—A flexible cropping system consists of a sequence of crops grown on a given area of soil over a period of time. It may be a regular rotation of different crops, in which the crops follow a definite order in the field; or it may consist of only one crop grown year after year in the same area. Some cropping systems may include different crops, but the crops do not follow one another in planned order. The management applicable to dryland farming in Scott County may include such practices as summer fallowing, contour farming, stubble-mulch farming, and minimum tillage.

The cropping system should be combined with management practices that keep damage by wind and water to a minimum. Also, the productivity of the soil must be maintained or increased.

Winter wheat and grain sorghum are the two principal dryland crops in the county. The most common cropping system, or sequence, is summer fallow, winter wheat, and grain sorghum. Most farmers, however, prefer a flexible cropping system. Such a system permits them to take advantage of moisture in the subsoil to produce enough protective cover, and to meet the economic needs of the particular farm.

*Summer fallowing.*—When summer fallowed, soils are kept free of growing vegetation during one crop season, so

<sup>1</sup> By EARL J. BONDY, agronomist, Soil Conservation Service, Garden City, Kans.

that moisture will be stored for crops produced the following season.

Generally, there is not enough available moisture under continuous cropping for economical crop production. The practice of summer fallowing is therefore considered a necessary part of most cropping systems used in the county. This practice is not an efficient way to increase the total amount of moisture stored. However, each additional inch of water stored in the soil produces about 2 bushels of wheat.

*Tillage.*—The purposes of tillage are the management of crop residue, the control of weeds, and the preparation of a suitable seedbed for the next crop.

Crop residue will do the most good when it is left on the surface to protect the soil from erosion. It also protects soil structure from the deteriorating effect of splashing raindrops. The equipment that undercuts the vegetation kills the weeds but also leaves the residue on the surface (see fig. 15).

The surface must be roughened by emergency tillage when the soil has little protective cover and is left susceptible to wind erosion. Surface roughening minimizes the damage from blowing as long as the clods and ridges are large enough to resist blowing.

A desirable soil structure is one in which the aggregates are stable. Excessive tillage breaks down soil aggregates and leaves the soil susceptible to crusting and blowing. If the aggregates are stable, tillage is needed only for killing weeds and management of residue. The minimum amount of tillage used should be the amount necessary to do these two things.

Tillage at the proper time is important in maintaining good structure. Tilling the soils when too wet causes a compact layer, or tillage pan, to form, particularly in the loams or silt loams.

*Contour farming.*—In this practice tillage and planting are done parallel to terraces or contour guidelines. As a result, furrows, ridges, and wheel tracks are nearly level across the slope. The furrows and ridges hold much of the rain where it falls and thus decrease runoff and erosion. Yields of crops increase because more water is absorbed by the soil and made available to crops. Somewhat less power is required than in farming up-and-down-hill.

Contour farming is most effective when used with other conservation practices, such as stubble-mulch farming, terracing, and contour stripcropping.

*Terracing.*—Terracing consists of constructing an earth embankment or a series of ridges and channels across the slope at suitable intervals. In this county terraces are built with or without grade.

Graded terraces are constructed to reduce erosion by intercepting runoff and conducting it to a stable outlet or waterway at a nonerodible velocity. Level terraces are constructed to conserve moisture and help control erosion. Most terraces in Scott County should be of the level type, since moisture conservation is of primary importance.

Contour farming and other conservation practices should be used along with terraces. Each row planted on the contour between terraces acts as a miniature terrace, by holding back some water and letting it soak into the soil. If both terracing and contour farming are used, yields are increased and soil losses are decreased.

The horizontal distance needed between terraces depends on the slope of the soil and the kind of soil. Since much of the precipitation falls in storms of high intensity, terracing acts as a safety valve for other conservation practices, such as contour farming, stubble-mulch farming, and contour stripcropping.

*Stripcropping.*—This is a system of growing suitable crops in narrow strips on the same field. Strips of erosion-resistant crops or of their residue are alternated with strips of other crops or with fallowed strips. Good stands of wheat and sorghum and their thick, heavy stubble are considered erosion resistant. Stripcropping helps to control wind erosion by shortening the distance that loose soil can move. It also provides a barrier of growing crops to reduce water erosion.

Two types of stripcropping are (1) contour stripcropping and (2) wind stripcropping. Contour stripcropping is used on sloping fields to help control erosion by wind and water. The strips are arranged on the contour; terraces or contour guidelines are used to establish the pattern.

Wind stripcropping is used (a) on nearly level coarse-textured soils where water erosion is not a problem; and (b) on some sloping areas where slopes are so complex that contour farming is not practical. The strips are of uniform width, are usually straight, and are arranged across the direction of prevailing winds.

The width of strips necessary to control soil blowing varies according to the kind of soil. On silt loams and clay loams, the strips may be wider than on the sandy soils.

Though stripcropping will reduce soil blowing, it does not completely control it if used alone. It is much more effective when used with residue management, minimum tillage, and other needed conservation practices.

#### **Management of dryland soils by capability units**

In this section the capability classes, subclasses, and units for dryland farming are listed. Following the list, the soils of this county are grouped in capability units, and the use and management of the soils of each unit are discussed.

The capability classes, subclasses, and capability units for dryland farming in Scott County are as follows:

Class I.—Soils that have few limitations that restrict their use. (None in this county.)

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

Subclass IIe.—Soils subject to moderate erosion if they are not protected.

Unit IIe-1.—Gently sloping silty soils.

Unit IIe-2.—Nearly level, moderately sandy soils.

Subclass IIc.—Soils that have climatic limitations of low rainfall, high evaporation, low humidity, high winds, and abrupt changes in temperature.

Unit IIc-1.—Nearly level loamy soils.

Unit IIc-2.—Nearly level, dark, fertile soils of upland swales.

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

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe-1.—Gently sloping, silty, limy soils.

Unit IIIe-2.—Nearly level to undulating, moderately sandy soils.

Subclass IIIs.—Soils limited mainly by moderate salinity or alkalinity.

Unit IIIs-1.—Nearly level, silty saline soils.

**Class IV.**—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe-1.—Sloping, limy, silty soils.

Unit IVe-2.—Moderately sandy, limy soils in undulating areas.

Subclass IVs.—Soils that have very severe limitations due to salinity, alkalinity, or other soil features.

Unit IVs-1.—Nearly level, clayey, saline soils.

**Class V.**—Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass Vw.—Soils too wet for cultivation; drainage or protection not feasible.

Unit Vw-1.—Low, wet, marshy, saline soils.

**Class VI.**—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIe-1.—Steep, limy, silty soils of the uplands.

Unit VIe-2.—Sandy soils in hummocky to undulating areas of the uplands.

Unit VIe-3.—Moderately shallow and shallow, steep and broken loamy soils.

Subclass VIw.—Soils severely limited by excess water and generally unsuitable for cultivation.

Unit VIw-1.—Narrow loamy soils of the bottom lands.

Unit VIw-2.—Clayey soils in depressions on the uplands.

**Class VII.**—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIs.—Soils very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs-1.—Very shallow, steep and broken loamy soils.

**Class VIII.**—Soils and landforms that have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply or esthetic purposes.

Subclass VIIIs.—Rock or soil materials that have little potential for production or vegetation.

Unit VIIIs-1.—Barren areas of geologic material.

#### DRYLAND CAPABILITY UNIT IIe-1

Richfield silt loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, dark, fertile, silty soil on the gently sloping uplands.

The texture of the surface soil is silt loam, and that of the subsoil is silty clay loam. This soil has a high moisture-holding capacity and is easily penetrated by plant roots, air, and water. Conservation of moisture and control of erosion by wind and water are problems.

Wheat and sorghum are suitable crops. Management should provide for conservation of moisture and control of wind erosion by using suitable crops in a cropping system, as well as practices such as stubble-mulch farming, a minimum of tillage, and contour stripcropping. Grazing of crop residues should be limited, so that enough stubble is left to protect the soil.

#### DRYLAND CAPABILITY UNIT IIe-2

Manter fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, moderately dark, fertile soil that is in nearly level, moderately sandy areas of the uplands.

The surface soil is fine sandy loam, but the subsoil ranges from sandy loam to loam. The soil is easily penetrated by plant roots, air, and water. The moisture-holding capacity is moderate. Because of the semiarid climate, control of wind erosion and conservation of moisture are problems.

Sorghum is well suited to this soil, but wheat may also be grown if crop residues are used to protect the soil from blowing. Crops should be planted during extended droughts to protect the soil from blowing, but a harvest should not be expected from these. Good management includes the use of a suitable cropping system and necessary practices for conserving soil and water, such as stubble-mulch farming, minimum tillage, and wind stripcropping. The losses from water erosion are not so severe on this soil as on the soils of capability units IIe-1 and IIIe-2. Nevertheless, contour farming, terracing, and application of fertilizer are effective practices for controlling water erosion. Grazing of crop residues should be limited, so that enough stubble is left to protect the soil.

#### DRYLAND CAPABILITY UNIT IIc-1

This unit consists of deep, dark, fertile loamy soils that are in smooth, nearly level areas.

The texture of the surface soil and subsoil is loam, silt loam, or clay loam. These soils have a high moisture-holding capacity and are easily penetrated by plant roots, air, and water. Low precipitation and recurrent droughts limit crop production. The conservation of moisture and control of wind erosion are problems on these soils. The soils in this unit are—

Bridgeport loam.

Keith silt loam, 0 to 1 percent slopes.

Richfield silt loam, 0 to 1 percent slopes.

Ulysses silt loam, 0 to 1 percent slopes.

Wheat and sorghum are suited to these soils. Good management includes use of a suitable cropping system and necessary practices for conserving soil and water, such as stubble-mulch farming and a minimum of tillage. Contour farming, terracing, and stripcropping are also effective practices on these soils, though losses from runoff and

water erosion are not so severe as on the soils in capability units IIe-1 and IIIe-1. Grazing of crop residues should be limited, so that enough stubble remains to protect the soils.

#### DRYLAND CAPABILITY UNIT IIc-2

This unit is made up of deep, dark, fertile soils. The soils are in nearly level swales and on benches around depressions in the uplands.

The texture of the surface soil and subsoil is silt loam or silty clay loam. The soils have a high moisture-holding capacity and are easily penetrated by roots, air, and water.

Low precipitation and recurrent drought are limiting factors in crop production. Some extra moisture, however, is received as runoff from adjacent areas. Consequently, higher yields are produced by these soils than by those in capability unit IIc-1, but conservation of moisture and control of wind erosion are management problems. The soils in this unit are—

Goshen silt loam.  
Lubbock silty clay loam.

Wheat and sorghum are well suited to the soils in this unit. Management should include a cropping system designed to help conserve soil and moisture, as well as such practices as stubble-mulch farming and minimum tillage. Stripcropping may also be used. Management practices such as terracing and contour farming help to conserve water and may be used on sites that are suitable by engineering standards.

#### DRYLAND CAPABILITY UNIT IIIe-1

In this unit are deep, moderately dark, limy, silty soils that occupy gently sloping uplands.

The surface soil is calcareous silt loam, and the subsoil is silt loam to silty clay loam. The surface soil tends to seal over during rainstorms. The subsoil is easily penetrated by plant roots, air, and water and has a high moisture-holding capacity. The conservation of moisture and control of wind and water erosion are problems on these soils. The soils in this unit are—

Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.  
Ulysses silt loam, 1 to 3 percent slopes.

Wheat and sorghum are suited to these soils. Good management consists of using suitable crops in a cropping system, as well as the necessary practices for conserving soil and water, such as stubble-mulch farming, minimum tillage, terracing, and contour farming. Contour stripcropping is also needed in some cropping systems to help control erosion. Grazing of crop residues should be limited, so that enough stubble is left to protect the soils.

#### DRYLAND CAPABILITY UNIT IIIe-2

Deep, moderately dark and dark, moderately sandy soils make up this unit. These fertile soils occupy nearly level to undulating areas in the uplands.

The surface soil is loam and fine sandy loam, and the subsoil is sandy loam to clay loam. The soils have a moderate to high moisture-holding capacity and are easily penetrated by roots, air, and water. The conservation of moisture and control of erosion by wind and water are problems. The soils in this unit are—

Bayard fine sandy loam, loamy substratum.  
Dalhart-Richfield complex, 1 to 3 percent slopes.  
Manter fine sandy loam, undulating.

Sorghum is well suited to these soils, but wheat may also be grown if crop residues are used to protect the soils from blowing. Crops should be planted during extended droughts to protect the soils, but a harvest should not be expected. Good management includes the use of a suitable cropping system and necessary practices for conserving soil and water, such as stubble-mulch farming and minimum tillage. In some cropping systems, such practices as field stripcropping, contour stripcropping, and contour farming are needed, along with stubble-mulch farming and a minimum of tillage. Losses from runoff and water erosion are not severe on these soils. Nevertheless, terracing may be used as a supplementary practice. Grazing crop residues should be limited, so that enough stubble is left to protect the soils.

#### DRYLAND CAPABILITY UNIT IIIs-1

Ulysses silt loam, saline, 0 to 1 percent slopes, is the only soil in this capability unit. It is a deep, moderately dark, silty, saline soil that occupies nearly level areas in the Scott-Finney depression.

The texture of the surface soil is silt loam; that of the subsoil ranges from silt loam to silty clay loam. The soil has a high moisture-holding capacity and is easily penetrated by air, roots, and water. The productivity of the soil is slightly to moderately affected by the slight to moderate salinity. Moisture conservation and control of wind erosion are also problems.

Wheat is well suited to the soil in this unit. The growth of sorghum, however, is somewhat impaired by the salts in the soil, as is evident from chlorosis, or yellowing, of the plant leaves. Management should provide for conservation of moisture and control of wind erosion by the use of stubble-mulch farming and a minimum of tillage. Contour farming, terracing, and stripcropping are effective on this soil, even though losses from runoff and water erosion are not so severe as on the soils in capability units IIe-1 and IIIe-1. Grazing of crop residues should be limited, so that enough stubble remains to protect the soils.

#### DRYLAND CAPABILITY UNIT IVe-1

This unit consists of deep, limy, silty soils. These soils are light colored and moderately dark colored and occupy sloping uplands.

The surface soil is calcareous silt loam. The subsoil ranges from silt loam to silty clay loam. It has a high moisture-holding capacity and is easily penetrated by roots, air, and water. The surface tends to seal over during rainstorms. This results in excessive runoff and serious erosion. Where the soils lack enough protective cover, wind erosion is also a serious hazard. The soils in this unit are—

Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded.  
Ulysses silt loam, 3 to 5 percent slopes.

The soils in this unit may be used for crops but are not well suited. In most years yields of wheat and sorghum are low; however, good yields are obtained in years when precipitation is higher than normal. These soils are best kept in suitable native grass and used for range. Since the hazard of wind and water erosion is serious, the soils need to be protected by cover at all times. During droughts, crops must be planted to protect the soils, but a harvest should not be expected.

In areas used for crops, management requires the use of a suitable cropping system and practices for conserving soil and water, such as stubble-mulch farming, a minimum of tillage, contour farming, contour stripcropping, and terracing. Stripcropping should be used where the slope is so complex that a system of terraces or contour lines cannot be laid. All crop residues must be used to protect the soils and should not be grazed.

#### DRYLAND CAPABILITY UNIT IVe-2

Otero fine sandy loam, undulating, is the only soil in this unit. This deep, calcareous, light-colored, well-drained, limy soil is moderately sandy. It is in gently undulating areas on the outer edge of the sandhills.

The surface soil is fine sandy loam, but the subsoil ranges from sandy loam to sandy clay loam. The soil is easily penetrated by air, roots, and water. It has a moderate to high moisture-holding capacity. Control of wind erosion is the main problem. Runoff is slow, and water erosion is not significant.

Because of the hazard of wind erosion, this soil is not well suited to crops. It may be used for crops, but it is better kept in suitable native grass and used for range.

When this soil is used for crops, management should provide for control of wind erosion by the use of stubble-mulch farming, a minimum of tillage, and a cropping system in which sorghum or wheat are grown continuously. Because of the severe hazard of wind erosion, summer fallowing should not be used. Applications of fertilizer may be needed to produce enough vegetation for control of wind erosion. As all residues are needed to protect the soil, crop residues should not be grazed.

#### DRYLAND CAPABILITY UNIT IVs-1

The only soil in this unit is Church silty clay loam. This deep, dark, droughty, saline soil is somewhat poorly drained and is slowly permeable. It occurs on nearly level benches and in broad basins in the uplands.

The surface soil and subsoil are calcareous silty clay loam underlain by lacustrine deposits. The productivity is affected by slight to moderate salinity. The moisture-holding capacity is restricted because of the clayey subsoil. The control of wind erosion and conservation of moisture are problems.

This soil is not well suited to crops, though it may be used for them. Yields of sorghum and wheat are generally low. Nevertheless, good yields may be obtained in years when moisture is favorable. Alfalfa can be grown in some areas because of the high water table that furnishes necessary moisture during the drier seasons.

When this soil is used for crops, good management requires the use of a suitable cropping system and necessary practices for conserving soil and water, such as stubble-mulch farming and a minimum of tillage. When rainfall is high, crops are sometimes drowned out by runoff from adjacent areas. Management in adjacent areas that conserves soil and water, for example, terracing, contour farming, and stubble-mulch farming, keeps some of the runoff out of these depressional areas. The grazing of crop residues should be limited, so that enough stubble is left to protect the soil.

#### DRYLAND CAPABILITY UNIT Vw-1

This capability unit includes only Marsh—a miscellaneous land type made up of saline, low, wet, marshy areas.

These areas receive extra moisture from the high water table and as runoff from adjacent areas.

This land type is generally not suited to cultivation, because it is wet and marshy. It is best kept in suitable native grass, which produces abundant forage if not overgrazed. More information on management of this land type for range is given in the section "Range Management."

#### DRYLAND CAPABILITY UNIT VIe-1

Colby silt loam, 5 to 15 percent slopes, is the only soil in this unit. This deep, well-drained, limy and silty soil occurs along steep drainageways of the uplands. The surface soil consists of light-colored, calcareous silt loam, but the subsoil is friable, calcareous silt loam and silty clay loam. This soil has a high moisture-holding capacity and is easily penetrated by roots, air, and water. Erosion by wind and water is a serious hazard.

This soil is suitable only for grass. If the soil is cultivated, runoff and erosion are excessive. Suitable native grass should be planted in any areas that are still cultivated. Management practices that produce adequate forage for livestock and cover for the soils are proper intensity of grazing, deferred grazing, and rotation grazing. More information on management of this soil for range is given in the section "Range Management."

#### DRYLAND CAPABILITY UNIT VIe-2

This unit is made up of deep, well-drained sandy soils that are in hummocky to undulating areas in the sandhills. The surface soil ranges from light-colored, calcareous and noncalcareous sandy loam to loamy fine sand; the subsoil ranges from sandy loam to fine sand. Most areas are loamy fine sand, but 40 percent of Otero soils, hummocky, consists of fine sandy loam.

The soils in this unit have a high to low moisture-holding capacity and are easily penetrated by roots, air, and water. Rainfall is rapidly absorbed in most areas, but the more sandy soils will not hold large amounts of water. Water erosion is a hazard on the sandy loams. Wind erosion is a severe hazard when the soils of this unit are not adequately protected. The soils in this unit are—

Otero soils, hummocky.  
Tivoli loamy fine sand.

Because of their low moisture-holding capacity and susceptibility to drifting, these soils are suitable only for grass. Blowouts form quickly in places where grass is destroyed by overgrazing, trampling, and cultivation. Management practices for range that help prevent overgrazing are proper range use and deferred grazing. Blowouts and bare spots should not be grazed, and cultivated areas should be seeded to suitable native grasses. Under good management, these soils produce high forage yields. More information on management of these soils for range is given in the section "Range Management."

#### DRYLAND CAPABILITY UNIT VIe-3

Only the Mansker-Potter complex is in this unit. This complex is made up of moderately shallow and shallow loamy soils on steep and broken slopes along drainageways of the uplands.

The surface soil ranges from sandy loam to silt loam, but the subsoil ranges from sandy loam to clay loam. This complex of soils overlies caliche at a depth ranging from near the surface to 30 inches. Rock outcrops are not so

common on these soils as on soils in capability unit VII<sub>s</sub>-1. The soils of this complex have a low to high moisture-holding capacity and a restricted root zone in the more shallow areas.

The soils of the Mansker-Potter complex are suitable only for grass. Runoff is excessive on the steep, shallow areas. If the grass is overgrazed, and good cover is not maintained, both wind and water erosion will occur. Suitable native grasses should be seeded on areas now cultivated. If the proper intensity of grazing is used or if grazing is deferred, erosion resulting from overgrazing can be prevented. More information on the management of these soils for range is given in the section "Range Management."

#### DRYLAND CAPABILITY UNIT VI<sub>w</sub>-1

Only Alluvial land is in this unit. This land type consists of narrow areas of loamy, bottom-land soils. The soils occur adjacent to meandering channels of narrow drainageways in the uplands. On the valley floors, the soils are nearly level, but in some places along stream-banks they are steep, cut up, and broken.

The mixed, calcareous soils of this mapping unit range from sandy loam to silty clay loam in texture. They are friable and have a good moisture-holding capacity. They receive extra moisture from occasional floods and from side drainage.

Alluvial land is not generally cultivated, as areas suitable for cultivation are subject to flooding. In addition, these areas are small and irregular and are generally isolated by adjacent steep, nonarable slopes. Alluvial land is best kept in suitable native grass. If management practices are used to prevent overgrazing, forage yields are abundant. More information on management of this land type for range is in the section "Range Management."

#### DRYLAND CAPABILITY UNIT VI<sub>w</sub>-2

This unit consists of deep, dark, somewhat poorly drained, very slowly permeable, clayey soils. These soils are in small to large depressions in the uplands and on broad basins. Water is ponded on the surface for several months after rainstorms, and crops and grasses may be drowned. The soils in the basins have slight to moderate salinity. Wind erosion is a hazard, particularly when there is no vegetation on the soils. The soils in this unit are—

Randall clay.

Randall clay, occasionally flooded.

When used for crops, these soils are usually managed like the surrounding soils in the same field. If needed practices for conserving soil and water, such as terracing, contour farming, and stubble-mulch farming, are used on the adjacent soils, some runoff can be kept off these soils. In most places artificial drainage is not feasible, but in some places surface drainage can be used. For further information on managing the soils in depressions, a local representative of the Soil Conservation Service should be consulted.

#### DRYLAND CAPABILITY UNIT VII<sub>s</sub>-1

This unit includes only Potter soils. These very shallow loamy soils occupy steep and broken slopes along deeply entrenched drainageways.

The surface soil ranges from strongly calcareous sandy loam to silt loam. Caliche may occur at the surface or at a depth of 12 inches. Rock outcrops are common. The Potter soils have a low moisture-holding capacity and a restricted root zone.

These soils are suited only to range. Runoff is excessive in steep, shallow areas. If the grass is overgrazed and cover is not maintained, both wind and water erosion will occur. Except for maintaining a good cover of grass through control of grazing, little can be done to protect the soils from erosion. The section on "Range Management" gives more information on management of the soils for range.

#### DRYLAND CAPABILITY UNIT VIII<sub>s</sub>-1

This capability unit includes only Badland. This miscellaneous land type consists of barren, eroded areas and outcrops of chalk rock and shale. There is little or no soil development. Fertility is low, and the root zone is restricted. This land type has excessive runoff, and little moisture can penetrate it.

Badland is suitable for a limited amount of grazing in areas by streams where silting has taken place. In these minor included areas, a limited amount of vegetation is produced. Little can be done to protect the soil.

#### Yield predictions (dryland)

The average yields per acre that can be expected from seeded wheat and grain sorghum grown on the soils of Scott County are shown in table 2. Information is limited on which to base yield predictions because the records of longtime yields needed to make fairly accurate estimates are not available for Scott County. Yields fluctuate greatly during the recurring, alternating periods of drought and high precipitation.

The predicted average yields per acre are based on data obtained from farmers, from workers at Kansas State Agricultural Experiment Station, and from members of the survey party. Predicted yields may not apply directly to any specific tract of soil in any particular year, because management practices vary slightly from farm to farm, and climate fluctuates from year to year.

Yields of wheat and grain sorghum that may be expected over a long period under prevailing, or most common, system of management in the county are shown in columns A of table 2. Yields that may be expected under an improved system of management are shown in columns B. Wheat yields reflect the general use of summer fallow. The yields are not given for Bayard fine sandy loam, loamy substratum, as most of this soil is irrigated.

The practices used under the prevailing, or most common, system of management in the production of wheat are as follows:

1. Tillage is performed in straight lines and is generally parallel to field boundaries and not on the contour.
2. The equipment used and the manner and frequency of tillage soon destroy the protective crop residues.
3. The cropping system consists of wheat and fallow. Winter wheat is seeded early in autumn on soil left idle and kept free of weeds during the growing season. If a satisfactory stand of wheat is not obtained, or if the wheat blows out during winter or spring, the soil is planted to sorghum.

- Crop residues are grazed, where available. Both seeded and volunteer types of wheat are usually grazed during fall and winter.

The practices for production of grain sorghum under the prevailing, or most common, system of management are as follows:

- Sorghum is seeded on land that was planted in wheat the previous season. Following the wheat harvest, the soil is plowed to obtain a stand of volunteer wheat that will be used for fall pasture.
- The soil generally is clean tilled at least twice in spring before sorghum is planted about June 1. The first tillage is done to kill the volunteer wheat. Subsequent tillage is shallow and is done for weed control.
- Sorghum is planted in rows spaced about 30 inches apart. After it emerges, the sorghum is cultivated once with a rotary-hoe type implement, and later it is sprayed with a chemical weedkiller.
- In many fields sorghum is not harvested for grain. The plants in these fields and the residues remaining on harvested fields are grazed off by cattle and sheep.

Under improved management for wheat and grain sorghum, practices necessary to control soil and water losses are used, in addition to the cropping sequences given under the prevailing, or most common, system of management. The practices necessary to conserve soil and water are mentioned for each dryland capability unit in the section

TABLE 2.—*Expected longtime average yields per acre of seeded wheat and sorghum grown on the soils suited to cultivation, under two levels of management*

Soil	Wheat <sup>1</sup>		Sorghum	
	A	B	A	B
Bridgeport loam.....	Bu. 15.0	Bu. 18.5	Bu. 14.5	Bu. 18.0
Church silty clay loam.....	13.0	15.0	14.0	16.0
Dalhart-Richfield complex, 1 to 3 percent slopes.....	12.0	17.5	17.0	22.0
Goshen silt loam.....	18.0	22.0	24.0	28.0
Keith silt loam, 0 to 1 percent slopes.....	17.0	21.0	17.5	21.0
Lubbock silty clay loam.....	18.5	22.5	25.0	28.5
Manter fine sandy loam, 0 to 1 percent slopes.....	13.0	17.0	17.0	21.0
Manter fine sandy loam, undulating.....	11.0	15.0	16.0	20.0
Otero fine sandy loam, undulating.....	7.5	10.5	13.0	16.0
Richfield silt loam, 0 to 1 percent slopes.....	16.5	20.0	17.0	20.0
Richfield silt loam, 1 to 3 percent slopes.....	13.5	17.0	14.0	18.0
Ulysses silt loam, 0 to 1 percent slopes.....	15.0	19.0	16.0	19.0
Ulysses silt loam, 1 to 3 percent slopes.....	12.5	16.5	14.0	17.0
Ulysses silt loam, 3 to 5 percent slopes.....	11.0	15.5	11.5	14.0
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.....	11.5	15.5	12.0	14.5
Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded.....	10.0	13.5	10.0	12.5
Ulysses silt loam, saline, 0 to 1 percent slopes.....	12.0	15.0	10.0	13.0

<sup>1</sup> The wheat yields given reflect the general use of summer fallow.

"Management of Dryland Soils by Capability Units." Different cropping systems may be more flexible and may require different conservation practices. For example, on the soils in unit IIe-1 that have a cropping sequence in which wheat and fallow are alternated, the needed practices are stubble-mulch farming, a minimum of tillage, and contour stripcropping. If the cropping system consists of fallow, wheat, or wheat followed by forage sorghum, the needed practices are stubble-mulch farming, minimum of tillage, terracing, contour farming, and contour stripcropping. A local representative of the Soil Conservation Service should be consulted for further information on cropping sequences and management practices needed on a specific tract of land.

## Management of Irrigated Soils

In this section the general practices for irrigation farming are discussed. Also, the capability classes, subclasses, and units for irrigated farming are listed, and management by irrigated capability units is discussed.

### General management of irrigated soils <sup>2</sup>

Approximately 44 percent of all the farms in Scott County had irrigated acreage in 1959. The principal source of irrigation water is deep wells drilled into the Ogallala formation (fig. 16). The depth to water ranges from 25 to nearly 250 feet.

According to the 1959 Census of Agriculture, 52,746 acres were irrigated in the county. Of these, 52,103 acres were irrigated from wells on 178 farms, and 643 acres on 2 farms were irrigated from streams. When available, water is diverted from White Woman Creek to flood fields.

Of the 180 farms irrigated in 1959, 25 had from 50 to 99 acres under irrigation; 50, from 100 to 199 acres; 65, from 200 to 499 acres; 25, from 500 to 999 acres; and 5, over 1,000 acres.

In 1961 approximately 365 wells on 210 farms in Scott County were irrigating about 77,500 acres. Each year about 5 new wells are brought into production.

<sup>2</sup> EARL J. BONDY, agronomist, Soil Conservation Service, Garden City, Kans., assisted in preparing this section.



Figure 16.—Water for irrigation is pumped from deep wells into open ditches or pipelines.

Much of the irrigation farming is done along with dry-land farming. Because the farming units are large, only part of the farm may be irrigated. Irrigation is used as a supplement to rainfall in many areas when rainfall is below average. Nearly all irrigated soil is watered by flooding or furrow methods. In 1959 water was applied by sprinkler to only 450 acres on 4 farms.

The characteristics of the soils most suitable for irrigation are given in table 6 under the column headed "Irrigation" in the section "Engineering Uses of the Soils." Management of the soils suited to irrigation is discussed under "Management of Irrigated Soils by Capability Units" in this section.

#### PLANNING AN IRRIGATION SYSTEM

The following factors should be considered in planning an irrigation system: (1) the kind of soil; (2) the quality and amount of water; (3) the control and conveyance of water; (4) the type of irrigation system; (5) the method of applying water; (6) preparation of the soil; and (7) adequate drainage.

If the quality of the soil and water and the management practices used are all suitable, irrigation is not harmful to the soil. A local representative of the Soil Conservation Service should be consulted for further information about conservation irrigation.

*Kind of soil.*—The kind of soil influences to varying degree all other factors in the development of an irrigation system and in planning the kinds of crops to be grown. The suitability of a soil for irrigation depends on the permeability of the subsoil and substratum, the texture of the surface soil and subsoil, the available moisture-holding capacity of the root zone, the amount of soluble salts in the soil, the erodibility of the soil, its wetness and workability, and the depth of the soil over coarse sand and gravel. The influence of many of these factors is inter-related.

The available moisture-holding capacity influences the frequency of applying water and the amount applied at one time. A shallow soil has limited moisture-holding capacity and requires lighter and more frequent irrigations. If soils are leveled, care should be taken to leave enough soil to hold water and to allow adequate growth of roots.

The amount of soluble salts in the soil is greatly influenced by the soil texture and the fluctuating water table. When the water table rises, it carries soluble salts upward into the soil. When it recedes, some of the salts are deposited in the soil. When the soil dries out through transpiration, evaporation, or both, the soluble salts tend to move upward. These salts adversely affect crops.

*Quality and amount of water.*—The quality of the water is also important. A heavy concentration of dissolved salts is harmful. The soil, climate, cropping system, and irrigation practices must all be considered in appraising the quality of the water.

*Structures.*—Various physical structures are needed for controlling and conveying the water after a suitable supply has been located. The irrigation system may include storage dams, canals, and laterals to convey the water to the farm; the farm distribution system; and other structures, such as pipelines, pumping plants, and drop structures for controlling erosion. The supply of water should

be delivered economically from the source to the point of use.

*Land leveling.*—Before the land is irrigated, leveling is usually necessary to obtain efficient, uniform application of water, regardless of the type of irrigation system used. Land leveling saves soil and water and helps to insure more efficient application and more uniform distribution of water (fig. 17). Valuable surface soil and subsoil may be removed by this practice, however. For this reason, applications of fertilizer and manure are needed to make the exposed soil productive. Deep-rooted legumes may also be grown.

*Drainage.*—The plans for an irrigation system should include drainage facilities that control water and salinity efficiently.

After an irrigation system has been established, the success of the system depends on the following factors:

*Cropping system.*—Growing crops affect both the chemical and physical condition of the soil. If top yields are to be obtained year after year on irrigated soil, a farmer must maintain and improve the soils by applying organic material annually. He should rotate crops in such a way as to have a sod crop growing once every few years. This crop helps to rebuild and stabilize soil aggregates and also adds organic matter to the soils.

*Use of commercial fertilizers.*—The use of commercial fertilizers, especially nitrogen, has become increasingly important in irrigation management. Other plant nutrients, particularly phosphate, may be needed on some soils to produce high crop yields. The Kansas Agricultural Experiment Station at Garden City maintains a laboratory for soil testing to determine the amount of fertilizers needed.

*Management of irrigation water.*—The efficiency of the irrigation system is affected by the kind of soil, the topography, and the condition of the crop. The total amount of water required depends mainly on the design of the system, the amount of land preparation, and the skill and care of the irrigator. From 50 to 80 percent of the irrigation water can be applied efficiently by use of current irrigation facilities and practices.



Figure 17.—Leveling a field of Richfield silt loam for more efficient use of irrigation water. About 1½ feet of soil will be moved from this area into lower areas and lagoons in the field.

*General irrigation management.*—The productivity of irrigated soil may be short lived. On the other hand, many irrigated areas are farmed successfully. If the irrigation system is carefully planned and proper management is used, continuous irrigation farming can be practiced for a long time.

### **Management of irrigated soils by capability units**

In this section the capability classes, subclasses, and units for irrigated soils are listed. Following the list, the soils of this county are grouped in capability units, and the use and management of the soils in each unit are given.

The capability classes, subclasses, and units for irrigation farming are listed as follows:

**Class I.**—Soils that have few limitations that restrict their use.

**Unit I-1.**—Nearly level loamy soils.

**Class II.**—Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices.

**Subclass IIe.**—Soils subject to moderate risk of erosion when used as cropland.

**Unit IIe-1.**—Gently sloping fine sandy loams.

**Unit IIe-2.**—Gently sloping loamy soils.

**Subclass IIs.**—Soils that have moderate limitations of moisture capacity or salinity.

**Unit IIs-1.**—Nearly level, well-drained fine sandy loams.

**Unit IIs-2.**—Nearly level, loamy, saline soils.

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

**Subclass IIIs.**—Soils that have severe limitations of moisture capacity or salinity.

**Unit IIIs-1.**—Nearly level, saline, silty clay loams.

**Class IV.**—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

**Subclass IVw.**—Soils that have very severe limitations for cultivation because of excess water.

**Unit IVw-1.**—Nearly level, very slowly permeable, clayey soils.

#### **IRRIGATED CAPABILITY UNIT I-1**

In this unit are deep, dark, nearly level loamy soils. The texture of the surface soil and subsoil of the soils in this unit is loam to clay loam. These are fertile and well-drained soils. They are moderately permeable and have a good moisture-holding capacity. The soils in this unit are—

Bridgeport loam.  
Goshen silt loam.  
Keith silt loam, 0 to 1 percent slopes.  
Lubbock silty clay loam.  
Richfield silt loam, 0 to 1 percent slopes.  
Ulysses silt loam, 0 to 1 percent slopes.

Management should include the following practices that maintain or improve fertility and tilth: (1) Use of a cropping system that includes a deep-rooted legume; (2) use of crop residues to maintain the content of organic matter; (3) the application of commercial fertilizer if needed; and (4) proper use of irrigation water. Suitable

crops on these soils include wheat, sorghum, alfalfa, sugar beets, tame grasses, and vegetables.

Engineering or other mechanical practices should be those that conserve and use irrigation water most efficiently. Land leveling is commonly needed. Drainage of the surface and control of runoff from adjacent areas are problems in some areas.

#### **IRRIGATED CAPABILITY UNIT IIe-1**

The soils of this unit are gently sloping, deep, fertile, and well drained. They have a surface soil of fine sandy loam to loam and a subsoil of fine sandy loam to clay loam.

These soils are moderately permeable and have a moderate to high moisture-holding capacity. The hazard of erosion and difficulty in making the best use of irrigation water are management problems. The soils in this unit are—

Dalhart-Richfield complex, 1 to 3 percent slopes.  
Manter fine sandy loam, undulating.

Not much of the acreage of these soils is irrigated. The irrigation water that is available in the uplands is generally used on soils with a slope of less than 1 percent.

Management of these soils must provide for control of erosion, efficient use of irrigation water, and maintenance of fertility and tilth. Fertility and tilth can be improved or maintained by using a cropping system that includes close-growing crops and deep-rooted legumes, as well as crop residues and commercial fertilizer or manure. Alfalfa, sweetclover, tame grass, wheat, sorghum, and sugar beets are suitable crops.

Practices that help to control erosion and make the best use of water are land leveling, irrigation on the contour, and sprinkler irrigation of close-growing crops. Distribution of irrigation water through pipes prevents the loss that occurs in open irrigation ditches. Other problems in erosion control and in engineering uses of the soils may occur in a particular area.

#### **IRRIGATED CAPABILITY UNIT IIe-2**

In this unit are deep, gently sloping loamy soils of the uplands. These soils have a silt loam surface soil over a silt loam and clay loam subsoil. They are fertile, well drained, and moderately permeable and have a high moisture-holding capacity. Controlling water erosion and obtaining efficient use of irrigation water are management problems. The soils in this unit are—

Richfield silt loam, 1 to 3 percent slopes.  
Ulysses silt loam, 1 to 3 percent slopes.  
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.

Management must provide for control of erosion, efficient use of irrigation water, and maintenance of fertility and tilth. Fertility and tilth can be improved or maintained by use of (1) a cropping system that includes close-growing crops and deep-rooted legumes, (2) crop residues, and (3) commercial fertilizer or manure. In areas cut by leveling, the soils especially need organic matter. This can be obtained by plowing under crop residues and barnyard manure. Alfalfa, sweetclover, tame grasses, wheat, sorghum, and sugar beets are suitable crops.

Land leveling, contour-furrow irrigation, and other practices are necessary for decreasing the hazard of erosion and making the best use of water. In most areas

drop structures are necessary for controlling erosion in the irrigation ditches. Distributing water through pipes helps to control erosion and prevents the loss that occurs in open irrigation ditches. A system is needed for removing excess irrigation water and runoff from rainstorms. Some sites may have other engineering and erosion control problems.

#### IRRIGATED CAPABILITY UNIT II<sub>s</sub>-1

This unit consists of deep, nearly level, well-drained soils. The surface soil is fine sandy loam. In most areas the subsoil is sandy loam, but in some it is loam. These soils are fertile, are moderately to rapidly permeable, and have a moderate to high moisture-holding capacity. The somewhat restricted moisture-holding capacity and susceptibility to erosion are management problems. Wind erosion is a hazard when the surface soil is not protected. The soils in this unit are—

Bayard fine sandy loam, loamy substratum.  
Manter fine sandy loam, 0 to 1 percent slopes.

Management of the soils in this unit should include practices that maintain or improve fertility and tilth and that provide the most efficient use of water. Fertility and tilth can be maintained by the following practices: (1) Use of a cropping system that includes a deep-rooted legume; (2) proper use of crop residues; and (3) application of commercial fertilizer when needed. These soils respond well to applications of manure that are plowed under. Care must be taken to avoid overirrigation and leaching of plant nutrients. Suitable crops are wheat, sorghum, alfalfa, sweetclover, sugar beets, tame grasses, and vegetables.

A properly designed irrigation system is necessary for the most efficient use of water. Land leveling is needed in many places for uniform distribution of water, but the soil should not be removed from areas where sand pockets occur. Losses of water may be excessive in irrigation ditches through these sandy soils, unless underground pipelines are used, or the ditches are lined with impervious material.

#### IRRIGATED CAPABILITY UNIT II<sub>s</sub>-2

The only soil in this unit is Ulysses silt loam, saline, 0 to 1 percent slopes. It is a moderately dark, nearly level, loamy soil that occurs in the Scott-Finney depression. The surface soil is silt loam; the subsoil ranges from silt loam to clay loam. The substratum is slightly to moderately saline silt loam.

The soil in this unit is moderately fertile, is moderately permeable, and has a high moisture-holding capacity; however, it is slightly to moderately saline. In some areas affected by a fluctuating water table, slight to moderate accumulation of toxic salts may occur when the water table is high. Artificial drainage to lower the water table is not feasible. Slick spots occur throughout the area.

Management must provide for maintaining and improving fertility and tilth, controlling salinity, and making the best use of water. Fertility and content of organic matter can be improved by use of a cropping system that includes legumes, and by proper use of crop residues and commercial fertilizer. Before the soil is seeded, a heavy irrigation may be necessary to reduce the salt content of the root zone. Chlorosis is generally a problem, particu-

larly with sorghum. Suitable crops on this soil are wheat, alfalfa, sugar beets, sweetclover, tame grass, and sorghum.

A properly designed irrigation system and use of land leveling, where needed, help provide efficient use of water. Adequate drainage of the surface is feasible in some areas.

#### IRRIGATED CAPABILITY UNIT III<sub>s</sub>-1

The only soil in this unit is Church silty clay loam—a deep, dark, nearly level, saline silty clay loam that is in depressional areas in the Scott-Finney depression and on a broad bench around Dry Lake. In some areas with a fluctuating water table, slight to severe accumulation of toxic salts may occur when the water table is high. Artificial drainage of this Church soil is not feasible.

This soil is fertile, moderately well drained, and moderately permeable. It has a high moisture-holding capacity but tends to seal over and become hard and cloddy as it dries.

Management must provide for maintaining and improving fertility and tilth and controlling salinity. Plant residues and barnyard manure should be plowed under to maintain productivity and to improve tilth. Fertility can be maintained and improved by use of a cropping system that includes legumes, and by proper use of crop residues and commercial fertilizer. Care should be taken to leach the excess salts from the root zone. Heavy irrigation of the soil in winter and early in spring reduces accumulations of salt and fills the root zone with water. The soil is well suited to irrigated pasture but can also produce profitable yields of wheat, sorghum, and sugar beets.

A properly designed irrigation system, and use of land leveling where needed, will provide for efficient use of water. Adequate drainage of the surface is a problem in some areas.

#### IRRIGATED CAPABILITY UNIT IV<sub>w</sub>-1

This unit consists of only one soil—Randall clay, occasionally flooded. It is a deep, dark, calcareous clayey soil. It is very slowly permeable and is somewhat poorly drained. This nearly level soil occurs in the Scott (White Woman) Basin.

During some periods, this soil is covered by runoff water from other areas. Some areas of this soil are affected by a fluctuating water table, and accumulation of toxic salts may occur when the water table is high. Artificial drainage to lower the water table is not feasible.

The soil is susceptible to accumulations of salt, so that irrigation water must be carefully applied. It soaks up water slowly and stays wet for a long period after irrigation. Also, it crusts and seals over the surface, and many areas become compacted. Drainage of the surface is necessary to remove excess water and prevent ponding. Timely tillage is needed to prepare a seedbed; otherwise, the soil becomes cloddy and difficult to work.

In areas used for cultivated crops, management must provide for maintaining and improving fertility and tilth, controlling salinity, and making the best use of water. Crop residues and barnyard manure should be plowed under to increase the content of organic matter and to improve tilth. The productivity can be maintained by using a cropping system that includes a deep-rooted legume and commercial fertilizer, if needed. Such practices as plowing and cultivating at different depths help to avoid the formation of tillage pans. Heavy application of irrigation water

in winter and spring removes excess salts and stores some water for the next crop.

Much of this soil is cultivated, and a large amount is irrigated. Sorghum is the main crop because of the possibility of floods in winter and spring. Wheat and legumes can be grown during most years, however.

The layout needed for irrigation and surface drainage systems varies according to the particular site. Practices necessary for efficient use of water and for salinity control also vary from place to place. Because this soil shrinks when dry and swells when wet, maintenance of irrigation ditches and structures and of the proper grade is a problem.

### Range Management<sup>3</sup>

Rangeland makes up about 24 percent of the total acreage of this county. Generally, the rangeland is not suitable for cultivation. It is scattered throughout the county, but some areas are concentrated in the north along Ladder Creek and in the broken land along tributaries to the Smoky Hill River.

The raising of livestock is the second largest agricultural industry in Scott County. The success of the industry depends on the way ranchers and farmers manage their range and other sources of feed. Feeder-stocker cattle are the main livestock, but a few breeding herds are in the county.

#### Range sites and condition classes

Different kinds of range produce different kinds and amounts of grasses and other forage. To manage rangeland properly, an operator should know the different kinds of land (range sites) in his holdings and the plants each site can grow. He will then be able to use the management that produces the best forage plants on each site.

*Range sites* are areas of rangeland that produce a significantly different kind or amount of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing use, or to require other management that maintains or improves the present vegetation. *Climax vegetation* is the combination of plants that originally grew on a given site. The most productive combination of forage plants on a range site is generally the climax vegetation.

*Range condition* is classified according to the percentage of vegetation now on the range site that is original, or climax, vegetation. This classification is used to compare the kinds and amounts of vegetation on the site at present with the kinds and amounts the site can produce. Changes in range condition are caused primarily by intensity of grazing and by periods of drought. Four range condition classes are defined as follows:

Condition class:	Percentage of climax vegetation on the site
Excellent -----	76-100
Good -----	51-75
Fair -----	26-50
Poor -----	0-25

In the descriptions of range sites, native vegetation is referred to in terms of *decreasers*, *increasers*, and *invaders*. Decreasers and increasers are climax plants. Decreasers

are the most heavily grazed and, consequently, are the first to be injured by overgrazing. Increasers withstand grazing better, or are less palatable to the livestock. They increase under grazing and replace the decreasers. Invaders are plants that become established after grazing has reduced the climax vegetation.

The amount of forage produced on each site is mainly influenced by differences in individual soils, management practices, and relief.

#### Descriptions of range sites

The range sites in this county are Loamy Lowland, Loamy Upland, Limy Upland, Saline Upland, Saline Subirrigated, Sandy, Sands, and Breaks. Randall clay and Randall clay, occasionally flooded, are not classified as true range sites because of the instability of the soils and the vegetation.

The Randall soils are very slowly permeable clays in undrained depressions. Runoff from surrounding soils stands in ponds on the surface of these soils. The plant cover is unstable and its composition fluctuates between wet and dry periods. It is mostly Pennsylvania smartweed, bur ragweed, cocklebur, sedges, and rushes.

The description of each range site that follows includes (1) the names of the soils in each site, and (2) the dominant vegetation on the site when it is in excellent condition.

##### LOAMY LOWLAND SITE

This range site consists of deep, nearly level, permeable loamy soils. The soils have a high moisture-holding capacity. All of them receive extra moisture from occasional flooding or from run-in. The soils in this site are:

Alluvial land.  
Goshen silt loam.  
Lubbock silty clay loam.

The climax vegetation on the soils of this site consists of a mixture of switchgrass, big bluestem, Indiangrass, Canada wildrye, little bluestem, and other decreasers. These grasses make up at least 55 percent of the total cover; perennial grasses and forbs make up the rest. Increasers may make up as much as 45 percent of the climax vegetation. The dominant increasers are western wheatgrass, blue grama, and buffalograss. The common invaders are ironweed, verbenas, and annual sunflower.

##### LOAMY UPLAND SITE

This range site is made up of nearly level to steeply sloping soils of the uplands. The soils have a surface soil of loam and silt loam and subsoil of loam, silt loam, and silty clay loam. They are moderately permeable, are well drained, and have a high moisture-holding capacity. The soils in this site are:

Bridgeport loam.  
Keith silt loam, 0 to 1 percent slopes.  
Richfield loam in Dalhart-Richfield complex.  
Richfield silt loam, 0 to 1 percent slopes.  
Richfield silt loam, 1 to 3 percent slopes.  
Ulysses silt loam, 0 to 1 percent slopes.  
Ulysses silt loam, 1 to 3 percent slopes.  
Ulysses silt loam, 3 to 5 percent slopes.

The climax vegetation on the soils of this site consists of a mixture of blue grama, buffalograss, western wheatgrass, side-oats grama, little bluestem, and other grasses. Buffalograss is the main increaser under heavy grazing. Blue grama and buffalograss are the dominant grasses

<sup>3</sup> By PETER N. JENSEN, range conservationist, Soil Conservation Service, Dodge City, Kans.

under present grazing. The principal invaders are little barley and annual brome. In droughty years pricklypear is the common invader.

#### LIMY UPLAND SITE

In this range site are gently sloping and sloping soils of the uplands. These soils have a surface soil and subsoil of calcareous loam, silt loam, or clay loam. They are permeable, are well drained, and have a high moisture-holding capacity. The soils in this site are:

- Colby silt loam, 5 to 15 percent slopes.
- Colby soil in Mansker-Potter complex.
- Mansker soil in Mansker-Potter complex.
- Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.
- Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded.

The climax vegetation on the soils of this site consists of a mixture of little bluestem, side-oats grama, blue grama, hairy grama, buffalograss, and other grasses. The dominant decreaseers are little bluestem and side-oats grama. The dominant increaseers are buffalograss, broom snake-weed, and grasses that form mats. Little barley and three-awn are the common invaders.

#### SALINE UPLAND SITE

This range site is made up of deep, nearly level and gently sloping, saline and saline-alkali soils in the Scott-Finney depression. The texture of these soils ranges from loam to silty clay loam. The soils have moderate to slow permeability and a high moisture-holding capacity. The soils in this site are:

- Church silty clay loam.
- Ulysses silt loam, saline, 0 to 1 percent slopes.

The climax vegetation on the soils of this site consists of a mixture of such decreaseers as alkali sacaton and western wheatgrass. These grasses make up at least 70 percent of the total cover; other perennial grasses and forbs make up the rest. Increaseers may make up 30 percent of the climax vegetation, which consists mainly of saltgrass. The common invaders on this site are tumblegrass and annuals.

#### SALINE SUBIRRIGATED SITE

This range site includes only Marsh. It is located next to Dry Lake and consists of nearly level, somewhat poorly drained saline soils. The soils have a surface soil and subsoil of loam and clay loam. They receive additional moisture from floods and from a high water table.

The climax vegetation is a mixture of switchgrass, alkali sacaton, Indiangrass, western wheatgrass, and other decreaseers. These grasses make up at least 80 percent of the total cover; other perennial grasses and forbs make up the rest. Switchgrass and alkali sacaton are the dominant decreaseers. Increaseers, consisting of saltgrass, sedges, and rushes, may make up 20 percent of the climax vegetation. Common invaders are alkali muhly, western ragweed, foxtail barley, and tamarisk.

#### SANDY SITE

This range site is made up of deep, nearly level to steeply rolling soils of the uplands. These soils have a surface soil of sandy loam and subsoil of sandy loam or sandy clay loam. The permeability is moderately rapid, and the moisture-holding capacity is moderate. The soils in this site are:

- Bayard fine sandy loam, loamy substratum.
- Dalhart sandy loam and Manter fine sandy loam in Dalhart-Richfield complex.
- Manter fine sandy loam, 0 to 1 percent slopes.
- Manter fine sandy loam, undulating.
- Otero fine sandy loam in Otero soils, hummocky.
- Otero fine sandy loam, undulating.

The climax vegetation on the soils of this site consists of a mixture of sand bluestem, little bluestem, switchgrass, side-oats grama, and other decreaseers. These climax grasses may make up 55 percent of the composition, and perennial forbs and grasses may make up the rest. The dominant increaseers are blue grama, buffalograss, sand dropseed, and sand paspalum. The principal woody increaseers are sand sagebrush and small soapweed. Common invaders are perennial three-awn and windmillgrass.

#### SANDS SITE

This range site is made up of deep, rapidly permeable soils. The surface soil is loamy fine sand, and the subsoil is fine sandy loam, loamy fine sand, or fine sand. These soils are on hummocky and low-dune topography. The moisture-holding capacity is moderate to low. The soils in this site are:

- Otero loamy fine sand and Tivoli loamy fine sand in Otero soils, hummocky.
- Tivoli loamy fine sand.

The climax vegetation on the soils of this site consists of a mixture of sand bluestem, little bluestem, switchgrass, side-oats grama, big sandreed, and other decreaseers. These climax grasses may make up 65 percent of the composition, and perennial grasses and forbs may make up the rest. Dominant increaseers include blue grama, sand dropseed, and sand paspalum. Sand sagebrush is the principal woody increaseer. False buffalograss, purple sandgrass, and red lovegrass are common invaders.

#### BREAKS SITE

In this range site are loamy soils on steep and somewhat broken slopes. They are shallow over caliche and limestone. The soils are well drained but have shallow root zones and a low moisture-holding capacity. The soils in this site are:

- Potter soils.
- Potter soil in Mansker-Potter complex.

The climax vegetation on the soils of this site consists of a mixture of such decreaseers as little bluestem and side-oats grama. These climax grasses may make up 60 percent of the composition, and other perennial grasses and forbs may make up the rest. The dominant increaseers are blue grama, hairy grama, and sand dropseed. The common invader is broom snakeweed.

#### *Management principles and practices*

High production of forage and the conservation of soil, water, and plants on rangeland are obtained through maintenance of range that is in good and excellent condition, and through improvement of range that is depleted. The vegetation is improved by managing the grazing so as to encourage the growth of the best native forage plants.

Leaf development, root growth, flower-stalk formation, seed production, forage regrowth, and food storage in roots are processes in the development and growth of grass. Ranchers must allow these processes to take place if maxi-

imum yields of forage and peak production of livestock are to be maintained.

Livestock are selective in grazing and constantly seek the more palatable plants. If grazing is not carefully controlled, the better plants are eventually eliminated. If heavy grazing is continued, even the second-choice plants will be thinned out, or eliminated, and undesirable weeds or invaders will take their place.

Research by agricultural workers and the experience of ranchers have shown that when only about half the yearly volume of grass is grazed, damage to the desirable plants is minimized, and the range is improved. The grass that is left to grow has the following effects on the range:

1. It allows the better range plants to maintain or improve their vigor and thus crowd out or prevent weeds.
2. It enables plants to store food for quick and vigorous growth after droughts and in spring.
3. It causes the roots to increase in number and length so that they can reach additional moisture and plant nutrients. Roots of overgrazed grass cannot reach deep moisture, because not enough green shoots are left to provide food needed for good root growth.
4. It protects the soil from erosion by wind and water. Grass is the best kind of cover to control erosion.
5. It serves as a mulch that allows rapid intake of water. The more moisture that is stored in the ground, the better the growth of grass for grazing.
6. It stops snow where it falls, so that it may melt and soak into the soil for later use.
7. It provides a greater reserve of feed for the dry years that might otherwise force the rancher to sell his livestock.

Range management requires adjustment in stocking rates from season to season according to the amount of forage produced. It should provide for reserve pastures or other feed during droughts or other periods of low forage production. Thus, the range forage can be moderately grazed at all times. In addition, it is often desirable to keep part of the livestock, such as stocker steers, readily salable. If this is done, the rancher can adjust the number of livestock to the amount of forage produced without the sale of breeding animals.

The following are management practices that are applicable to all rangeland, regardless of other practices used. They cost little and improve the range.

*Proper range use.*—This is the practice of grazing rangeland at a rate that will maintain plant vigor, forage reserves, and enough residues to conserve soil and water. In addition, this practice helps to improve the quality of the vegetation that has deteriorated.

*Deferred grazing.*—This is the practice of resting a pasture for a definite period during the growing season. This practice allows the forage plants to increase in vigor and number and permits the desirable plants to reproduce naturally by seed. In addition to improving the range, it helps to build up a reserve of forage for later use.

*Rotation-deferred grazing.*—This is a practice by which one or more pastures are rested at planned intervals throughout the growing season. Each pasture is rested at a different period each successive year, so that the desirable forage plants can develop and produce seed.

Following is a list of practices that improve the range and help to control the movement of livestock:

1. *Range seeding.*—This is the establishment, by seeding or reseeding, of native or improved dominant grasses on land suitable for range. The area to be seeded should have a climate and soil that naturally support range plants, so that only grazing management is needed to maintain forage. A mixture of native grasses that are locally suitable and dominant in the climax vegetation should be seeded. When species of native grass are used, only seed produced within 250 to 400 miles south or 100 to 150 miles north of the county should be planted. Grass should be seeded in forage or grain stubble. This type of cover protects the soil from erosion, provides a firm seedbed, and helps to control weeds. Also, the mulch helps to retain moisture in the upper layer of soil. The newly seeded areas should not be grazed for at least 2 years, so that plants have enough time to become firmly established.
2. *Use of water developments.*—If possible, watering places should be distributed over the entire range, so that livestock do not have to go too far for water. Good distribution of watering places helps to achieve uniform use of the range. Generally, wells, ponds, and dugouts furnish water for livestock, but water must be hauled in some places. The makeup of each range will determine which type of water development is the most practical.
3. *Fencing.*—Fences should be constructed to separate ranges that are used during different seasons. In some places different range sites are separated if they are large enough, and there is enough difference in the way they are used.
4. *Salting.*—This practice is needed to supplement native range forage. Periodic changing of salting grounds will improve grazing distribution and provide more uniform use of the range.
5. *Weed and brush control.*—Chemical or mechanical means may be needed to control undesirable plants on some sites. This will improve range forage and also make easier the handling of livestock.

The management that will obtain high production of livestock and conserve the range resources includes:

1. A feed and forage program that provides enough range forage, concentrates, hay or tame pastures, and harvested roughages to keep livestock in good condition throughout the year. During emergencies, deferred grazing of native pastures and use of roughages reserved for feed will indirectly conserve plant cover, soil, and water. The feed reserves are in addition to normal winter requirements. Feed shortages can be avoided by reserving the surplus produced in years of high yields. This surplus can be stored in stacks, pits, or silos.
2. A breeding program that provides (a) the kind of livestock most suitable for the range, (b) a supply of calves in seasons when forage is most nutritious, and (c) a continued improvement of the animals that is consistent with the type of range and climate.
3. Culling of nonproductive animals from the herds.

ESTIMATED FORAGE YIELDS BY RANGE SITES

Yields of forage for range sites in excellent condition may be expected to vary with the amounts of rainfall received each year. In addition, yields will be influenced by the amount of grazing in past years. Disappearance of forage, other than by grazing, is brought about by rodents, insects, trampling, and other factors. These factors vary from year to year, and the annual yield of forage is greatly affected.

Following is an estimate of the total forage for range sites in excellent condition under average rainfall—

Range site:	Air-dry weight (lb. per acre)
Loamy Lowland.....	2,000-3,000
Loamy Upland.....	1,250-2,000
Limy Upland.....	1,500-2,250
Saline Upland.....	1,500-2,250
Saline Subirrigated.....	4,000-6,000
Sandy.....	1,500-2,000
Sands.....	2,000-2,500
Breaks.....	1,250-1,750

Windbreak Management

There are no native forests or woodlands in Scott County. A sparse, mixed stand of cottonwood, elm, and other trees and shrubs grows on the flood plains along Ladder Creek. Trees and shrubs survive only if grown in places that receive extra moisture. Farmstead windbreaks and trees for shade or ornament are the only plantings grown in the county.

Windbreak plantings help protect farmsteads and feeding areas for livestock. If they are well planned and cared for, they can be established successfully. Competition for survival among plants in windbreaks is severe. Trees should be properly spaced, so that there is adequate space for root growth and as little competition as possible for moisture. Tillage is needed to control weeds. If plantings are made in an area of sod, the area should be summer-fallowed for a year before planting. This practice helps to conserve moisture and kill growing plants.

Most windbreaks in the county have received extra moisture the first 2 to 4 years by being watered from hauled water, irrigation wells, or diversion terraces. The diversion of runoff from surrounding areas to the windbreak site provides additional moisture for the trees. Windbreaks in irrigated areas provide protection sooner than those not irrigated.

There are three windbreak suitability groups in Scott County: (1) Silty Upland, (2) Sandy Upland, and (3) Lowland. Each group consists of soils that are similar in potential for tree growth and in requirements for conservation and other management practices. The soils of the Silty Upland group are loam to silty clay loam in texture and have moderate to moderately slow permeability. The soils of the Sandy Upland group are loamy fine sand to sandy clay loam in texture and have moderate to moderately rapid permeability. They have a more rapid moisture-intake rate than the soils of the Silty Upland group, and therefore have more moisture for trees. Soil blowing is a problem on some of the sandy soils until the trees are large enough to give adequate protection. The soils of the Lowland group are loamy to silty clay loam in texture and receive extra moisture as runoff from other areas. These soils are also more fertile than soils in the other two groups.

Badland, the Mansker-Potter complex, and the Potter soils are in barren areas or are shallow and steep. These soils are not considered suitable for windbreak plantings. Randall clay, and Randall clay, occasionally flooded, are deep clayey soils that are droughty and are covered with water during seasons of high rainfall. Species of trees suited to saline soils should be considered for plantings on Church silty clay loam and on Ulysses silt loam, saline, 0 to 1 percent slopes.

In table 3 are shown trees and shrubs suitable for each windbreak suitability group and the approximate average height that they attain during 10 years on dryland and irrigated soils.

The most drought-resistant species of trees adapted to the county are eastern redcedar, Siberian elm (Chinese elm), Osage-orange, Rocky Mountain juniper, and ponderosa pine. Hardwoods in dryland windbreaks should remain effective between 25 and 35 years on upland sites and between 40 and 60 years on lowland sites. Conifers should be effective windbreaks for up to 50 years on upland sites and 80 years on lowland sites. Coniferous species should make up at least 50 percent of a windbreak.

TABLE 3.—Suitable trees and shrubs for windbreak suitability groups and estimated height in 10 years on dryland and irrigated soils

Windbreak suitability groups and soil types	Suitable trees and shrubs	Estimated height in 10 years	
		Dry-land	Irrigated
<i>Silty Upland:</i>		<i>Feet</i>	<i>Feet</i>
Bridgeport loam; Colby silt loam; Keith silt loam; Richfield silt loam; Ulysses silt loam, and Ulysses-Colby silt loams.	Tamarisk.....	11	20
	Russian-olive.....	13	22
	Osage-orange.....	13	22
	Mulberry.....	15	20
	Siberian elm.....	24	32
	Honeylocust.....	20	27
	Eastern redcedar.....	9	11
	Rocky Mountain juniper.....	9	11
	Ponderosa pine.....	9	11
	Skunkbush sumac.....	8	11
<i>Sandy Upland:</i>			
Bayard fine sandy loam, loamy substratum; Dalhart-Richfield complex; Manter fine sandy loam; Otero fine sandy loam; Otero soils; and Tivoli loamy fine sand.	Tamarisk.....	11	15
	Russian-olive.....	14	22
	Osage-orange.....	14	22
	Mulberry.....	18	24
	Siberian elm.....	26	35
	Honeylocust.....	21	28
	Eastern redcedar.....	10	12
	Rocky Mountain juniper.....	10	12
	Ponderosa pine.....	10	12
	Skunkbush sumac.....	8	11
<i>Lowland:</i>			
Alluvial land; Goshen silt loam; Lubbock silty clay loam.	Tamarisk.....	13	20
	Russian-olive.....	16	22
	Osage-orange.....	16	22
	Mulberry.....	19	24
	Siberian elm.....	26	32
	Honeylocust.....	21	28
	Eastern redcedar.....	11	12
	Rocky Mountain juniper.....	11	12
	Ponderosa pine.....	11	12
	Skunkbush sumac.....	10	11

Planting stock, especially conifers, should be properly handled to prevent the trees from drying out from exposure to air and heat, and also from heating while in storage. Tree plantings need protection from fire, livestock, insects, and rabbits. They should also be kept free of weeds and grass. Since rabbits are especially fond of young trees and shrubs, plantings may need protection the year round until they are 5 years old, or older.

Additional information on planting trees and developing farmstead windbreaks can be obtained from a local representative of the Soil Conservation Service or the county extension agent.

## Wildlife Management<sup>4</sup>

The kinds and amounts of wildlife that can be produced and maintained in the county are largely determined by the kinds and amounts of vegetation the soils can produce and by the way in which the vegetation is distributed.

Wildlife is influenced by topography and by such soil characteristics as fertility. Fertile soils are capable of more wildlife production than less fertile ones, and waters that drain from fertile soils generally will produce more fish than waters that drain from infertile soils. Wildlife is affected by the influence of topography on land use.

Wetness and moisture-holding capacity of the soils are important in selecting sites for constructing ponds for fish and in developing and maintaining habitats for waterfowl. Many areas in depressions subject to inundation during some periods are suitable for developing aquatic

and semiaquatic habitats for waterfowl and some species of fur bearers.

Factors of the kind mentioned in the foregoing paragraphs were considered in preparing table 4, which shows the potential of the soil associations in the county for producing habitats for the more important species of game in Scott County. The last column in the table, titled "Food," shows, by means of ratings, the capacity of the soil association to provide the kinds of food plants needed by the kind of wildlife specified. The ratings in this table of *excellent*, *good*, and *fair* take into account the soils and the characteristics of the soils that affect their potential for producing the kinds of vegetation needed for wildlife habitats.

The soils used for agriculture in the county provide suitable habitats for a number of kinds of wildlife. Ring-necked pheasants are probably the most important resident game bird, and mourning doves are an important migrant. Many kinds of waterfowl make seasonal use of inundated depressions in the Lubbock-Church-Randall association. The habitats for fish are mainly ponds and lakes that are suitable for stocking largemouthed black bass, bluegill, and channel catfish.

Land-use practices that conserve soil and water resources are important in the conservation of wildlife. Stripcropping and similar practices intersperse the different crops that provide a habitat for wildlife. Stubble-mulch farming and maintenance of crop residues provide waste grain for wildlife.

Areas where trees and shrubs can be planted for field and farmstead windbreaks meet the needs for habitats of some species of wildlife. Also important to many birds nesting on the ground is proper use of native grass.

<sup>4</sup>By C. V. BOHART, conservation biologist, Soil Conservation Service.

TABLE 4.—Potential of soil associations for producing habitats for some species of wildlife

Soil association	Wildlife	Potential for producing, for species of wildlife named—			
		Woody cover	Herbaceous cover	Aquatic environment	Food
Richfield-Ulysses.	Pheasant.....	-----	Good.....	-----	Excellent.
	Dove.....	-----	Good.....	-----	Good.
Ulysses-Goshen-Colby.	Dove.....	Fair.....	Good.....	-----	Good.
	Deer.....	Fair.....	Good.....	-----	Fair.
	Pheasant.....	Fair.....	Good.....	-----	Excellent.
	Cottontail rabbit.....	Fair.....	Good.....	-----	Good.
	Fish.....	-----	-----	Fair.....	Fair.
Colby-Mansker-Potter.	Dove.....	Fair.....	Good.....	-----	Good.
	Deer.....	Fair.....	Good.....	-----	Fair.
	Pheasant.....	Fair.....	Good.....	-----	Fair.
	Cottontail rabbit.....	Fair.....	Good.....	-----	Fair.
	Fish.....	-----	-----	Fair.....	Fair.
Lubbock-Church-Randall.	Pheasant.....	-----	Good.....	-----	Excellent.
	Waterfowl.....	-----	-----	Good.....	Good.
	Fish.....	-----	-----	Fair.....	-----
	Fur bearers.....	-----	Fair.....	Fair.....	Fair.
Manter-Ulysses-Keith.	Pheasant.....	Fair.....	Good.....	-----	Good.
	Dove.....	Fair.....	Good.....	-----	Good.
Otero-Tivoli.	Prairie chicken.....	-----	Good.....	-----	Fair.
	Dove.....	-----	Good.....	-----	Fair.

Some areas of land are more suitable for wildlife production than for the production of agricultural crops. These areas can be improved for wildlife by protecting natural vegetation, or by establishing needed cover.

The wildlife resources of Scott County are important primarily because of the recreational opportunities provided by hunting and fishing. Many species of wildlife also help control rodents and undesirable insects. Many of the hawks residing in or migrating through the county are especially helpful in controlling rodents.

Development of specific habitats needed by wildlife requires proper location and distribution of the kind of vegetation that soils can produce. Technical assistance in planning wildlife developments and determining which species of vegetation to use can be obtained from the local representative of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Forestry, Fish, and Game Commission, Bureau of Sports, Fisheries, and Wildlife, and from the Extension Service.

### Engineering Uses of the Soils<sup>5</sup>

This section of the soil survey report contains information about the soils of Scott County that is useful to engineers, particularly for highway construction and agricultural engineering. Additional information about the soils can be obtained from the detailed soil map at the back of the report and the sections "Descriptions of the Soils" and "Genesis, Classification, and Morphology of the Soils." 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.
2. Make preliminary estimates of the engineering properties of soils that help in the planning of agricultural drainage systems, farm ponds, terraces, waterways, dikes, diversion terraces, irrigation canals, and irrigation systems.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway and airport locations and in planning detailed investigations of selected locations.
4. Locate probable sources of gravel, sand, and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in maintaining the structures. The information may also prove useful as a guide in future planning.
6. Determine the suitability of soils for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that will be more useful to engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here can be useful for many purposes. It should be emphasized, however, that they may not eliminate the need for sampling

<sup>5</sup> By CARL L. ANDERSON, civil engineer, and KENNETH H. SALLEE, soil scientist, Soil Conservation Service.

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. Nevertheless, 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.

Some of the terms used in soil science may have different meanings than those used in engineering. Many of these terms are defined in the Glossary. Some of the terms used in engineering are defined in this section.

### Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture classify soils according to texture, color, and structure. This system is useful only as the initial step in making engineering classifications of soils. The engineering properties of a soil must be determined or estimated after the initial classification has been made. Two systems are used by engineers for classifying soils. These are the systems used by the American Association of State Highway Officials (AASHO) and the Unified system. These systems are explained briefly in the following paragraphs (1, 8, 12).<sup>6</sup>

The AASHO (1) system is based on actual performance of material used as a base for roads and highways. In this system all the soils are classified in seven groups. The soils most suitable for road subgrade are classed as A-1, and the soils least suitable are classed as A-7. Within rather broad limits, soils are classified numerically between these two extremes, according to their load-carrying ability. Three of the seven basic groups may also be divided into subgroups to designate within-group variations. Within each group, the relative engineering value of the soil material is indicated by a group index number, which is shown in parentheses following the group classification. Group indexes range from 0 for the best material to 20 for the poorest. Increasing values of group indexes denote decreasing load-carrying capacity.

In the AASHO system the soil materials may be further divided into the following two major groups: (1) Granular materials in which 35 percent or less of the material passes a 200-mesh sieve, and (2) silt-clay materials in which more than 35 percent of the material passes a 200-mesh sieve. The silty part of the silt-clay materials has a plasticity index of 10 or less, and the clayey material has a plasticity index greater than 10. The plasticity index refers to the numerical difference between the liquid limit and the plastic limit. The liquid limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil material passes from a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percent of the oven-dry weight of the soil, at which the soil material passes from a semisolid to a plastic state.

In the Unified system (12), the soils are grouped on the basis of their texture and plasticity, as well as on their performance when used as material for engineering structures. The soil materials are identified as coarse grained, which are gravels (G) and sands (S); fine grained, which are silts (M) and clays (C); and highly organic (Pt). There are no highly organic soils in Scott County.

<sup>6</sup> Italic numbers in parentheses refer to Literature Cited, p. 64.

In the Unified system, clean sands are identified by the symbols SW or SP; sands with fines of silt and clay are identified by the symbols SM and SC; silts and clays that have a low liquid limit are identified by the symbols ML and CL; and silts and clays that have a high liquid limit are identified by the symbols MH and CH. The soils in this county have been classified only in the SM, SP, SC, ML, CL, and CH classes of material.

After training and experience, an engineer can make approximate classification of soils, based on visual field inspection and observation. Exact classification, however, must be based on review and application of complete data from laboratory analyses. Field classifications are useful in determining when, and on which soils, laboratory analyses should be made.

### **Soil properties significant to engineering**

The engineer should know the physical properties of the soil materials and their in-place conditions to enable him to make the best use of the soil maps and the soil survey report.

Two tables are given in this section. In the first (table 5) the soils are briefly described, and their physical properties significant to engineering are estimated. In the second (table 6) some engineering interpretations are given. No test data were available for the soils of Scott County.

The estimated properties in table 5 are given for a typical profile, generally of each soil series. They are based on laboratory tests on soils from Ford, Logan, and Morton Counties, on tests by the State Highway Commission of Kansas at construction sites, on experience with the same kinds of soils in other counties, and on the information in other sections of this report.

In table 5 the soil profile is divided into significant layers (horizons), and the depth from the surface is given in inches. More complete profile descriptions are given in the section "Genesis, Classification, and Morphology of the Soils." Also given in table 5 are the textural classes of the U.S. Department of Agriculture and estimates of AASHO and Unified classifications.

In table 5 the columns under the heading "Percentage passing sieve" show the percentage of soil material that is smaller in diameter than the openings of the given screen. The grain-size analysis in this table is based on the tests made by a combination of the sieve and hydrometer methods.

Soil permeability is the ability of the soil to transmit water or air. It is measured in terms of the rate of flow of water through the soil. The estimated rate, in inches per hour, that water moves through a soil that is not compacted is shown in the column headed "Permeability" in table 5.

The column headed "Available water capacity" gives the amount of water, in inches per inch of soil depth, that is held at field capacity over that held at a tension of 15 atmospheres.

In the column headed "Shrink-swell potential," a rating is given of the volume change of a soil when the content of water changes. This is an estimate of how much a soil shrinks and swells under extremes of dryness and wetness. Examples of soils that have high shrink-swell potential are the Church and Randall soils. These soils shrink greatly when they are dry and swell when they are wet. The Tivoli soils are examples of soils that have a low shrink-

swell potential. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures.

The shrink-swell potential of the soils of this county is indicated by the relative terms of "low," "moderate," "high," and "very high." The soils that have a liquid limit of 25 or less are rated "low;" 25 to 40, "moderate;" 40 to 60, "high;" and more than 60, "very high."

The depth to bedrock and to consolidated, calcareous (caliche) deposits varies according to differences in topography and position of the soils. The approximate depth is given in the column headed "Description" if the deposits are less than 10 feet below the surface. Layers of caliche and of generally mixed materials, consisting of gravel, sand, silt, and clay, occur in many areas in deposits of Pliocene and Pleistocene time. These materials have been used in some areas for road surfacing. The Mansker-Potter complex and the Potter soils are good sources of such sediments.

Outcrops of chalk and shale of the Niobrara formation are in small areas along the northern edge of the county. As shown in the column headed "Description," chalk and shale outcrops comprise most of the area of Badland but occur in only a few areas of the Potter soils.

The reaction of the soils in the county ranges from neutral to moderately alkaline. The pH of the surface layer and subsoil ranges from 7.0 to 8.5. Most of the soils have a moderately alkaline substratum with a pH of 7.9 to 8.5.

The type of geologic material determines the depth to the water table and the amount of water available for use. The depth to the water table ranges from about 160 feet in the northern and southwestern corners of the county to less than 25 feet in the Scott (White Woman) Basin and Dry Lake area.

In Scott County only three soils are affected by salinity—Church silty clay loam, Randall clay, occasionally flooded, and Ulysses silt loam, saline, 0 to 1 percent slopes. These soils have slight to moderate salinity. Salinity is more of a problem in the Church and Randall soils than in the Ulysses soil. The more clayey, slowly permeable Church and Randall soils restrict the movement of water throughout the profile and allow salts to concentrate.

Dispersion may be a problem in small areas of slick spots on Church silty clay loam and Ulysses silt loam, saline. Dispersion refers to the degree that particles smaller than 0.005 millimeter are separated, or dispersed. It is to be distinguished from the single grain, or unaggregated condition, common to clean sands. Dispersed soils commonly slick over when wet and form a crust when dry. Soils that have a high content of sodium, especially those that contain more than 15 percent of exchangeable sodium, are likely to be dispersed. Acid silty soils developed under poor surface and internal drainage may also be dispersed.

Table 6 indicates the suitability of the soils in Scott County for various engineering uses. Also given in this table are the soil features that affect use of the soils for highway construction and for agricultural engineering.

The suitability of the soils for topsoil is given in table 6, as this information is needed in growing vegetation for erosion control on embankments, road shoulders, ditches, and cut slopes. Each layer of the soil profile was considered as a possible source of topsoil. As shown in the

table, the subsoil of some soils has a different rating than the surface layer because of its different characteristics. For example, it may be more sandy or clayey or contain caliche material. In many areas, as on embankments and cut slopes, part of the soil material can be used as topsoil, whether it is still in place or has been moved. Usually, the loamy soils on cut slopes can be seeded without an added layer of topsoil. The more sandy Tivoli and Otero soils need a layer of suitable topsoil on cut slopes that are to be vegetated. These sandy soils are subject to severe wind erosion when the plant cover is removed. Wind erosion is a hazard on the road shoulders, ditches, and cut slopes where roads are constructed through these soils.

Sand and gravel in quantities of commercial value are limited to small, local pockets in the Potter soils and beneath some soils in the eastern part of the Scott-Finney depression. The sand and gravel in many of the areas have been used, and there is little left. The Tivoli soil is a dependable source of a large quantity of fine quartz sand.

Suitability of the soils for road fill depends largely on the texture of the soils and on their natural water content.

Soils that are highly plastic and that have a high natural water content are rated "poor." Soils that are highly erodible (silts and fine sands) are difficult to compact and need moderately gentle slopes and fast-growing vegetation; therefore, these soils are rated "poor to fair."

The Church, Lubbock, and Randall soils occur in depressions and are ponded during wet seasons. Roads across these soils must be constructed on embankment sections, or a good system of underdrains and surface drains must be provided. Also, these soils have moderately slow to very slow permeability and poor surface drainage. They are occasionally flooded by accumulations of water from runoff. The clayey layers of the Church and Randall soils shrink greatly when dry and swell when wet. If the subgrade of these soils is too wet when the pavement is constructed, the soil will shrink as it dries out under the edges, and the pavement may crack. If the subgrade is too dry, the pavement will warp as the soils absorb moisture and swell. A granular base course should be used beneath pavements laid over plastic soils. This reduces the risk of cracking and warping.

TABLE 5.—*Brief descriptions and the*

Map symbol	Soil	Description	Depth from surface
An	Alluvial land.	Stratified loamy and sandy soils on valley floors of streams in the uplands; subject to occasional flooding and deposition.	Inches ( <sup>1</sup> )
Bd	Badland.	Barren chalk and shale of the Niobrara formation with little or no soil development; occupies broken slopes, vertical canyon walls, and pinnacles.	0
Bl	Bayard fine sandy loam, loamy substratum.	Well-drained soil; consists of 20 inches of fine sandy loam underlain by loam and clay loam; occupies alluvial fans along channel of White Woman Creek; water table is below a depth of 10 feet.	0-20 20-51
Br	Bridgeport loam.	About 3 feet of calcareous loam underlain by clay loam; on nearly level alluvial fans and terraces; water table is below a depth of 10 feet.	0-37 37-54
Ch	Church silty clay loam.	About 6 to 10 feet of calcareous saline silty clay loam; occupies nearly level benches in depressed areas around intermittent lakes; water table fluctuates from 3 to 25 feet below surface.	0-64
Cd	Colby silt loam, 5 to 15 percent slopes.	Well-drained, calcareous silt loam (loess) 3 to 12 feet thick over mixed outwash (Pleistocene) deposits; sloping soils of the uplands.	0-56
Dr	Dalhart-Richfield complex, 1 to 3 percent slopes.	This complex occupies gently sloping, partly reworked sandy and loamy (Pleistocene) deposits. The following profile is for the Dalhart soil: Deep, well-drained sandy loam 3 to 7 inches thick; overlies 20 to 36 inches of light sandy clay loam underlain by loam. For the Richfield soil of this complex, see Richfield silt loam, 0 to 1 percent slopes.	0-5 5-35 35-64
Go	Goshen silt loam.	Deep, well-drained soil in swales of the uplands; consists of 8 to 20 inches of silt loam over 10 to 20 inches of silty clay loam; underlain by calcareous silt loam; occupies nearly level, colluvial-alluvial sediment washed from surrounding soils of the uplands; subject to occasional flooding and deposition.	0-17 17-35 35-64
Ka	Keith silt loam, 0 to 1 percent slopes.	Deep, well-drained soil of the uplands; has nearly level, concave slopes; consists of 8 to 14 inches of silt loam over 20 to 40 inches of light silty clay loam; underlain by 5 to 12 feet of silt loam (loess).	0-7 7-52 52-64
Lu	Lubbock silty clay loam.	Deep, well-drained soil in depressions in the uplands; nearly level; consists of 5 to 10 feet of silty clay loam; subject to ponding.	0-65

See footnote at end of table.

Adequate drainage can be provided by extending this granular base course through the road shoulder.

In table 6 reservoir areas and pond embankments are listed as not applicable to the Church, Lubbock, and Randall soils. These soils occur in upland depressions where natural drainage has not developed and there are generally no suitable sites for ponds. Dugouts, however, could be constructed. In some sites the Bayard, Colby, Potter, and Ulysses soils and the Mansker-Potter complex may contain layers of stratified sand and gravel that have rapid permeability. In fact, sand pockets may occur in the bottoms of drainage channels at any pond site in this county. The Dalhart, Otero, and Tivoli soils are not suitable for pond sites. The outcrops of chalk and shale characteristic of areas of Badland are subject to piping.

Also given in table 6 are soil features affecting the suitability of soils for agricultural drainage. Randall clay occurs in upland depressions where natural drainage has not developed. The Church and Lubbock soils and Randall clay, occasionally flooded, occupy the Scott (White Woman) Basin. The construction of drains in these soils is difficult because the possible outlets are remote.

Soil features that affect the suitability of a soil for irrigation are shown in table 6. Soil problems and limitations that are related to irrigation are also discussed in the section "General Management of Irrigated Soils."

The Bayard soil occurs along the channel of White Woman Creek, and the Lubbock and Randall soils occur in depressions and basins. Construction of field and diversion terraces is not feasible on soils in such positions. Terraces are not feasible on Otero loamy fine sand or Tivoli loamy fine sand because of undulating, hummocky, and dune topography and the hazard of wind erosion.

Waterways are not feasible on Church, Randall, and Lubbock soils. These soils occur in upland depressions in areas where natural drainage has not developed. Occasional floods occur, and outlets are remote. Waterways are also not feasible on the Tivoli soil because of undulating, hummocky, and dune topography and the hazard of wind erosion. Wind erosion is a hazard to all waterways constructed in the county, because windblown materials accumulate in the waterways, smother the vegetation, and hinder the flow of water.

*estimated physical properties of the soils*

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200			
Chalk and shale.						<i>Inches per hour</i>	<i>Inches per inch of soil</i>	
Fine sandy loam	SM	A-2	95-100	95-100	20-30	0.5-1.0	0.13	Low.
Loam	CL	A-6	90-100	85-95	50-70	0.2-0.5	.17	Moderate.
Loam	CL	A-6	90-100	85-95	50-70	0.2-0.5	.17	Moderate.
Clay loam	CL	A-6	95-100	95-100	70-80	0.2-0.5	.18	Moderate.
Silty clay loam	CL	A-7		100	90-100	0.2-0.5	.18	Moderate to high.
Silt loam	ML-CL	A-6		100	85-95	0.2-0.5	.19	Moderate.
Sandy loam	SM	A-2-4 or A-1-b.		100	20-30	1.0-2.0	.10	Low.
Sandy clay loam	SC	A-2-6 or A-6		100	30-40	0.5-1.0	.17	Low.
Loam	CL	A-6		100	50-70	0.2-0.5	.17	Moderate.
Silt loam	ML-CL	A-4		100	85-95	0.2-0.5	.19	Moderate.
Silty clay loam	CL	A-6		100	85-95	0.2-0.5	.20	Moderate.
Silt loam	ML-CL	A-4 or A-6		100	85-100	0.2-0.5	.19	Moderate.
Silt loam	CL	A-4 or A-6		100	85-95	0.2-0.5	.19	Moderate.
Silty clay loam	CL	A-6		100	90-100	0.2-0.5	.20	Moderate to high.
Silt loam	ML-CL	A-4		100	90-100	0.2-0.5	.19	Moderate.
Silty clay loam	CL	A-7		100	90-100	0.2-0.5	.20	Moderate to high.

TABLE 5.—*Brief descriptions and the estimated*

Map symbol	Soil	Description	Depth from surface
Mm	Mansker-Potter complex.	This complex occupies steep and broken slopes ranging from 5 to 25 percent. The following profile is for the Mansker soil: 3 to 9 inches of loam over 10 to 30 inches of clay loam; moderately deep over slightly weathered, white, soft and hard caliche. For the Potter soil of this complex, see Potter soils.	<i>Inches</i> 0-7 7-16 16-28
Mn	Manter fine sandy loam, 0 to 1 percent slopes.	Fine sandy loam 25 to 40 inches thick over loam to sandy clay loam; occupies nearly level to undulating slopes; derived from reworked sandy (Pleistocene) outwash.	0-31
Mr	Manter fine sandy loam, undulating.		31-64
Mw	Marsh.	Low, wet land adjacent to Dry Lake; properties of the soil when dry are similar to those of Church silty clay loam.	-----
Of	Otero fine sandy loam, undulating.	Calcareous fine sandy loam about 5 feet thick; stratified with loamy fine sand and clay loam; developed from reworked calcareous (Pleistocene) outwash.	0-64
Oh	Otero soils, hummocky.	Calcareous fine sandy loam and loamy fine sand on hummocky and undulating topography. The following profile is for Otero loamy fine sand: loamy fine sand 6 to 36 inches thick over sandy loam; stratified with layers of fine sand to clay loam. For the Otero fine sandy loam component of this mapping unit, see Otero fine sandy loam, undulating.	0-28 28-48
Po	Potter soils.	Shallow soils consisting of 2 to 12 inches of loam and sandy loam over hard caliche; raw outcrops of caliche, limestone, and shale; on rough and broken uplands; slopes range from 5 percent to nearly vertical walls of canyons.	0-5 5-10
			10
Ra	Randall clay.	Deep, very slowly permeable clay 2 to 4 feet thick over silty clay loam; occupies enclosed depressions of the uplands; ponds after rainstorms.	0-41 41-64
Rb	Randall clay, occasionally flooded.	Deep, calcareous, very slowly permeable clay 5 to 15 feet thick; slight to moderate salinity below 20 inches; occupies lower part of Scott (White Woman) Basin.	0-64
Rm	Richfield silt loam, 0 to 1 percent slopes.	Deep, well-drained soils of the uplands on long, smooth slopes; consists of 4 to 10 inches of silt loam over 8 to 30 inches of silty clay loam; underlain by 5 to 12 feet of silt loam or loam (loess).	0-4
Rn	Richfield silt loam, 1 to 3 percent slopes.		4-28 28-65
Ts	Tivoli loamy fine sand.	Deep, loose, noncalcareous loamy fine sand 5 to 20 feet thick; in hummocky sandhills.	0-13 13-48
Ua	Ulysses silt loam, 0 to 1 percent slopes.	Deep, well-drained soils of the uplands; nearly level to sloping areas; consists of 3 to 8 inches of silt loam over 10 to 30 inches of light silty clay loam; underlain by silt loam or loam (loess).	0-4
Ub	Ulysses silt loam, 1 to 3 percent slopes.		4-37
Uc	Ulysses silt loam, 3 to 5 percent slopes.		37-56
Ue	Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded.	For properties of the Ulysses soils, see the Ulysses silt loams. For those of the Colby soil, see Colby silt loam, 5 to 15 percent slopes.	-----
Um	Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded.		
Us	Ulysses silt loam, saline, 0 to 1 percent slopes.	The properties are the same as those of Ulysses silt loam, 0 to 1 percent slopes, except for slight to moderate salinity below a depth of 20 to 50 inches.	-----

<sup>1</sup> Variable.



TABLE 6.—*Interpretation of engineering*

Soil series and map symbol	Suitability as source of—			Suitability for—		Soil features affecting—	
	Topsoil	Sand	Gravel	Fill <sup>1</sup>	Subgrade <sup>1</sup>	Highway location	Dikes and canals
Bayard (Bl)-----	Fair-----	Poor-----	Unsuitable; (localized pockets).	Good-----	Fair-----	Medium erodibility.	Well graded; moderate stability and permeability.
Bridgeport (Br)---	Good-----	Unsuitable---	Unsuitable---	Good-----	Fair-----	( <sup>3</sup> )-----	Deep; moderate stability and permeability.
Church (Ch)-----	Poor-----	Unsuitable---	Unsuitable---	Fair-----	Poor-----	High plasticity; moderately slow permeability.	High plasticity and shrink-swell potential; poor stability and compaction.
Colby (Cd)-----	Good-----	Unsuitable---	Unsuitable---	Good-----	Good-----	Erodible-----	Moderate erodibility; low to moderate shear strength and plasticity.
Dalhart (Dr)-----	Surface layer is fair; subsoil is good.	Fair-----	Unsuitable---	Good-----	Good-----	Moderate erodibility.	Moderate stability and erodibility.
Goshen (Go)-----	Good-----	Unsuitable---	Unsuitable---	Good-----	Fair-----	Occasional floods that leave deposits.	Moderate permeability; fair compaction; moderate erodibility.
Keith (Ka)-----	Good-----	Unsuitable---	Unsuitable---	Good-----	Fair-----	( <sup>3</sup> )-----	Deep; moderately slow permeability; moderate shear strength and stability.
Lubbock (Lu)-----	Good-----	Unsuitable---	Unsuitable---	Good-----	Fair-----	Infrequent ponding.	Deep; moderate shear strength and stability; moderately slow permeability.

See footnotes at end of table.

*properties of the soils*

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Field terraces and diversion terraces	Waterways
Reservoir area	Embankment				
In places sand strata occur; moderate to rapid permeability.	Well graded; moderate shear strength and stability; medium erodibility.	Well drained; moderate permeability; low plasticity.	Limited water-holding capacity; sand pockets; well drained; moderate permeability.	(?)-----	Moderate stability and erodibility; friable.
Moderately slow permeability.	Moderate shear strength and stability; fair to good compaction; high compressibility.	Well drained; moderately slow permeability; moderate plasticity.	Deep; well drained; moderately slow permeability; high water-holding capacity.	Deep; friable; moderate stability and plasticity; moderately slow permeability.	Deep; friable; fertile; moderate stability; low erodibility.
(?)-----	(?)-----	Deep; moderately slow permeability; high plasticity; outlets, remote.	Deep; high water-holding capacity; moderately slow permeability; high shrink-swell potential; occasional floods; slight to moderate salinity.	(?)-----	(?).
Deep; moderate permeability; in places stream channels contain rapidly permeable sand.	Moderate to low stability, shear strength, and plasticity; moderate to high compaction and compressibility.	Deep, well-drained, sloping soils over permeable deposits of outwash.	Deep; friable; sloping; high water-holding capacity; moderate permeability.	Deep; friable; sloping; moderate to high erodibility.	Deep; friable; sloping; moderate to high erodibility; moderate to low stability.
(?)-----	(?)-----	Deep; well drained; moderate permeability; medium plasticity; good structure.	Moderately low water-holding capacity; moderate permeability; moderate erodibility.	Sloping; moderate permeability.	Deep; moderate stability and erodibility; well drained; good structure.
Deep; moderate permeability; moderate shrink-swell potential.	Moderate shear strength, permeability, and plasticity; moderate to high compressibility.	Deep; well drained; moderate permeability; good structure; moderate to high erodibility.	Fertile; nearly level; high water-holding capacity; moderate to high permeability.	Deep; friable; nearly level; moderate to high erodibility.	Good structure; friable; moderate to high erodibility; moderate stability.
Moderately slow permeability.	Moderately slow permeability; low to moderate shear strength, stability, and plasticity; fair to good compaction.	Well drained-----	Deep; nearly level; high water-holding capacity; moderately slow permeability.	Deep; friable; nearly level; moderate erodibility and stability.	Deep; friable; moderate stability and erodibility.
(?)-----	(?)-----	Well drained-----	Deep; nearly level; moderately slow permeability; high water-holding capacity.	(?)-----	(?).

TABLE 6.—*Interpretation of engineering*

Soil series and map symbol	Suitability as source of—			Suitability for—		Soil features affecting—	
	Topsoil	Sand	Gravel	Fill <sup>1</sup>	Subgrade <sup>1</sup>	Highway location	Dikes and canals
Mansker (Mm)-----	Surface layer is fair; substratum is poor.	Poor; (localized pockets of variable quality).	Poor; (localized pockets of variable quality).	Good-----	Poor-----	High compressibility; moderate plasticity.	Moderate shrink-swell potential and plasticity; moderately slow permeability.
Manter (Mn, Mr)-----	Fair-----	Poor-----	Unsuitable-----	Good-----	Good-----	( <sup>3</sup> )-----	Deep; moderate permeability; medium erodibility.
Otero (Of, Oh)-----	Poor-----	Fair (localized deposits).	Fair (localized deposits).	Good-----	Good-----	( <sup>3</sup> )-----	( <sup>2</sup> )-----
Potter (Po)-----	Surface layer is fair; substratum is poor.	Poor (localized deposits of variable quality).	Poor (localized deposits of variable quality).	Good-----	Poor <sup>4</sup> -----	Shallow-----	( <sup>2</sup> )-----
Randall (Ra, Rb)-----	Poor-----	Unsuitable-----	Unsuitable-----	Poor-----	Poor-----	Depressions are filled with water from runoff.	Deep; slow permeability; high shrink-swell potential and plasticity.
Richfield (Rm, Rn).-----	Good-----	Unsuitable-----	Unsuitable-----	Fair to good.	Fair to poor.	( <sup>3</sup> )-----	Deep; moderate shear strength and stability; moderately slow permeability.
Tivoli (Ts)-----	Poor-----	Good-----	Unsuitable-----	Good if confined.	Good if confined.	Unstable slopes caused by high erodibility.	Poor to moderate stability; moderate to high permeability and erodibility.
Ulysses (Ua, Ub, Uc, Ue, Um, Us).-----	Good-----	Unsuitable-----	Unsuitable-----	Good-----	Fair to good.	( <sup>3</sup> )-----	Deep; moderate permeability; low to moderate shrink-swell potential, stability, erodibility, and plasticity.

<sup>1</sup> This column prepared with assistance from C. W. HECKATHORN, field soils engineer; and HERBERT E. WORLEY, soils research engineer, Kansas State Highway Commission.

<sup>2</sup> Not applicable because of location of soil, or physiographic position.

properties of the soils—Continued

Soil features affecting—					
Farm ponds		Agricultural drainage	Irrigation	Field terraces and diversion terraces	Waterways
Reservoir area	Embankment				
Moderately slow permeability.	Moderate shear strength, stability, shrink-swell potential, and permeability; high compressibility.	Well drained.....	Moderately shallow over caliche; sloping.	Moderately shallow; caliche at a depth of 12 to 36 inches.	Moderately shallow; moderate stability; low erodibility.
Moderate permeability.	Well graded; slight compressibility; good compaction; slight piping potential.	Well drained.....	Limited water-holding capacity; moderately rapid permeability.	Deep; friable.....	Deep; friable; moderate stability and erodibility.
(?).....	(?).....	Well drained.....	(?).....	Steep.....	Limited water-holding capacity; medium to high erodibility.
Moderate to rapid permeability; sand strata in places.	Moderate permeability; shallow outcrops of caliche.	Well drained.....	(?).....	Shallow; steep.....	Shallow; steep.
(?).....	(?).....	(?).....	Ponding occurs in depressions; outlets remote.	(?).....	(?).
Moderately slow permeability.	Moderate shear strength and stability; moderate to high shrink-swell potential; low to moderate erodibility; fair to good compaction.	Well drained.....	Deep; nearly level; high water-holding capacity; moderately slow permeability.	Deep; moderate stability; low to moderate erodibility; moderately slow permeability.	Deep; friable; moderate stability; low to moderate erodibility.
(?).....	Moderate to high permeability and erodibility; poor to moderate stability; fair to good compaction.	Well drained.....	(?).....	(?).....	(?).
Low to moderate shrink-swell potential; moderate permeability.	Moderate permeability; low to moderate shear strength, stability, plasticity, and erodibility; fair to good compaction.	Well drained.....	Deep; nearly level to gently sloping; high water-holding capacity; moderate permeability.	Deep; friable; low to moderate stability and erodibility.	Deep; friable; low to moderate stability and erodibility.

<sup>3</sup> No detrimental features affecting highway location.

<sup>4</sup> Caliche performs poorly in subgrade under a flexible surface but is useful for dry surfacing on local roads. Thick beds occur in localized pockets, and the material varies widely in characteristics.

## Genesis, Classification, and Morphology of the Soils

The first part of this section deals with the factors of soil formation, the second with classification of the soils, and the third with morphology of the soils. Physical and chemical data are limited for the soils of this county, and the discussion of soil formation and morphology is correspondingly incomplete.

### Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials 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 in and on 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 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. A long time is usually 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 effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown. The five factors of soil formation, as they relate to the soils of this county, are next discussed.

*Parent material.*—Parent material is the unconsolidated material from which the soil has developed. This material is formed by the physical weathering of rocks, caused by freezing and thawing, wind erosion, grinding by rivers and glaciers, and by chemical weathering. Parent material affects the texture, structure, color, natural fertility, and many other properties of the soil. Soils differ partly because of differences in their parent material. The texture of the parent material regulates the downward movement of the water and greatly influences soil development.

Most of the soils of Scott County have formed from loess or similar silty sediments and alluvial deposits. The silty upland soils of the High Plains were derived from loess deposited over the area about one million years ago by great duststorms. The soils in alluvium have formed from sediments more recently deposited by intermittent streams. The sandy soils occurring in the southeastern part of the county have developed from partly reworked sandy deposits. A minor percentage of the soils has formed from outwash material of the High Plains. This material was eroded from the Rocky Mountain area and was deposited before the loess sediments.

The loess was deposited as a mantle a few to many feet thick over most of the area in the Wisconsin stage of Pleistocene time. More than 50 percent of this loess is pale-brown, calcareous, friable, porous silt. The Richfield and Ulysses soils are the dominant soils developed in loess in Scott County.

Alluvium consisting of mixtures of sand, gravel, silt, and clay was deposited in the stream valleys and to some extent in upland drainageways. Soil formation in alluvium varies according to topographic position and the type of material deposited (fig. 18). Loamy soils that developed in alluvium have formed along the upland drainageways and in swales. The Goshen soils are along the drainageway of White Woman Creek and in the swales.

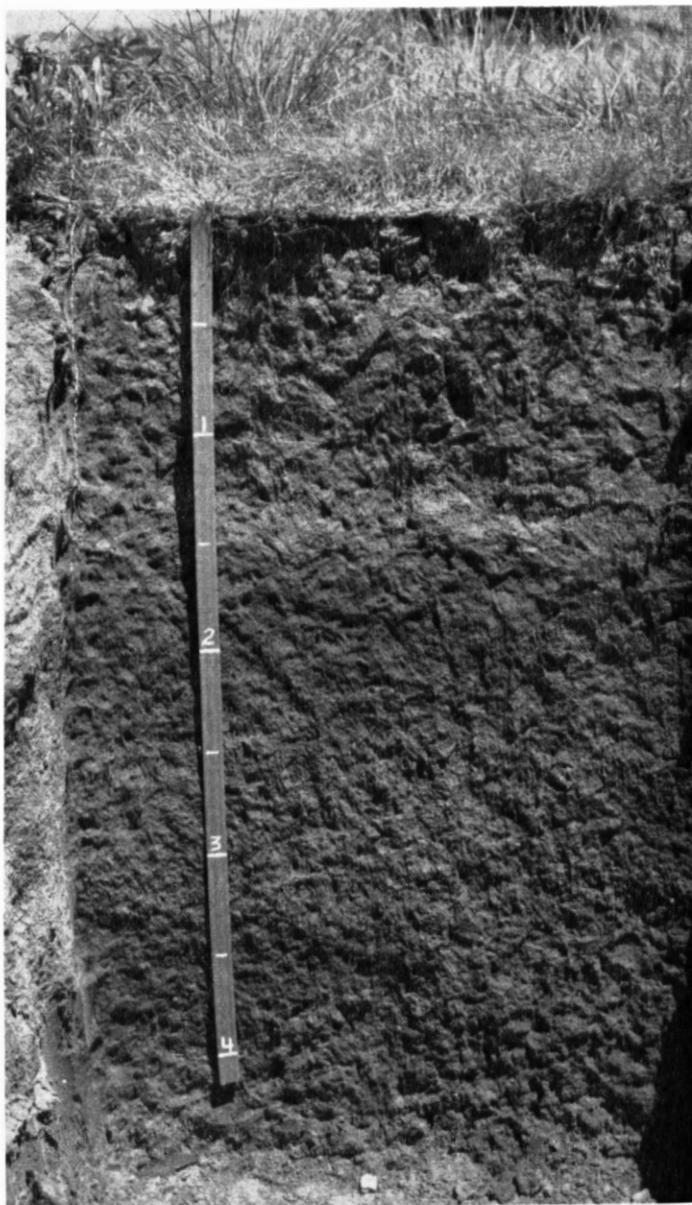


Figure 18.—Profile of a Goshen soil in the uplands showing a deposit of about 19 inches of lighter colored loam and silt loam. The marks on the scale are at 12-inch intervals.

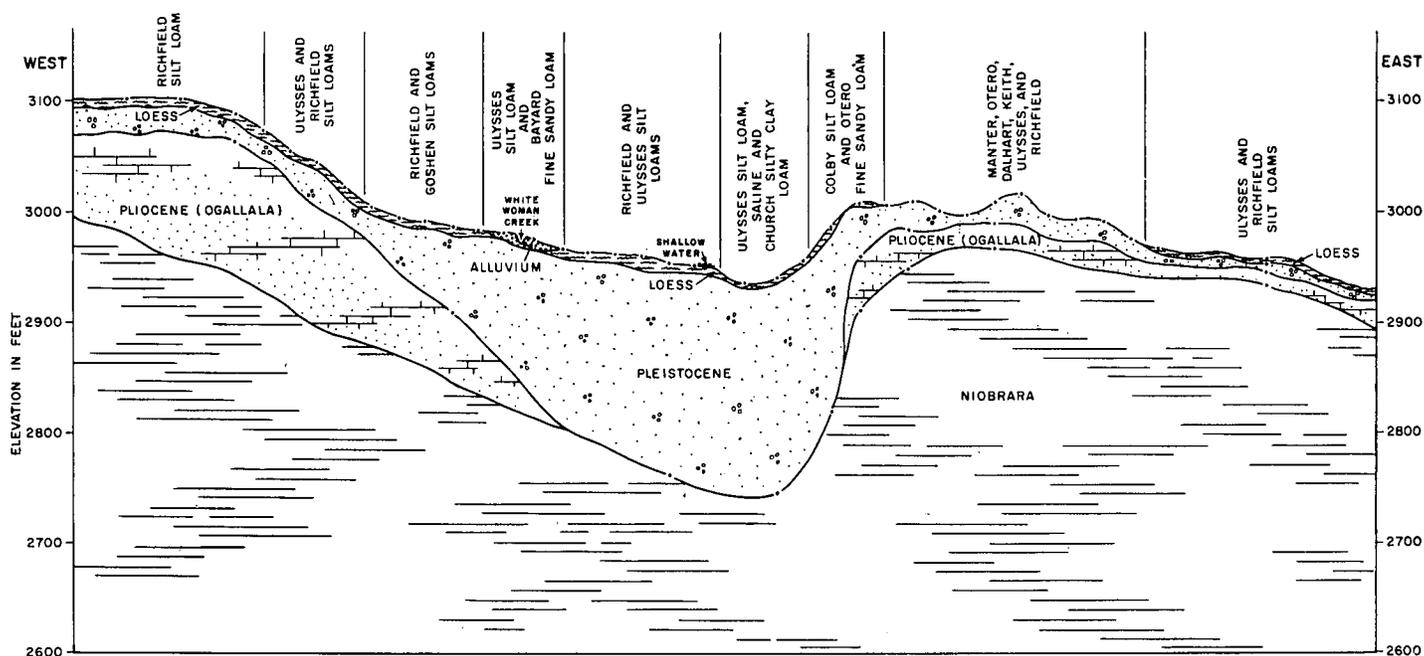


Figure 19.—An approximate geologic profile extending in an east-west direction across Scott County near Shallow Water.

The Bridgeport soils are on the alluvial fans and aprons along Ladder (Beaver) Creek. The alluvium along Ladder Creek ranges from a few to 30 feet in thickness.

Eolian sands were apparently deposited after the loess. These sandy deposits lie in the southeastern part of the county near the eastern edge of the Scott-Finney depression and southeast of Dry Lake. Most of the sandy area southeast of Dry Lake is on undulating and hummocky topography occupied by the Tivoli and Otero soils. The Manter and Otero soils developed in the partly reworked, sandy outwash sediments deposited by streams during Pliocene and Pleistocene times.

A few minor areas of soils developed from outwash material that was not reworked. The Mansker and Potter soils occur along the more deeply entrenched drainageways. They have weakly developed profiles in strongly calcareous, weakly consolidated sandy, gravelly, and silty caliche material that originated from outwash during Pliocene and Pleistocene times.

The age of the rocks exposed in Scott County ranges from Upper Cretaceous to Recent times. The exposed rocks of the Cretaceous time belong to the Smoky Hill chalk member of the Niobrara formation. This member is best exposed in the northeastern part of the county, where intermittent drainageways have cut through the surface of the plains into the underlying chalk. The exposure of vertical canyon walls, pinnacles, and barren areas of the Niobrara formation are characteristic of the land type mapped as Badland. The Smoky Hill chalk is overlain by the Ogallala formation of Tertiary time. This formation is exposed along many of the drainageways in the uplands. In large areas it is overlain by younger deposits of sand, silt, and gravel, which in turn, are overlain by loess, dune sand, and alluvium.

Between 180 and 200 million years ago, a shallow sea covered the area that is now western Kansas. Marine

sediments deposited during this period formed the lower part of the Permian rocks. The middle and upper parts of the Permian system consist mainly of marine and non-marine deposits, many of which are red. This deposition was terminated by an uplift that brought the area above the level of the shallow sea. Streams that flowed over the exposed red beds eroded fine-textured materials and re-deposited them along the flood plains.

As the result of an uplift, the Cretaceous system began about 130 million years ago. At first there was a land surface. This was later covered by a body of shallow water, in which sediments were deposited that formed the sandstone and shale of the Cheyenne sandstone. Some material, however, was deposited on the beaches by wind. As the sea advanced northward, the clays of the Kiowa shale were formed on the bottom of the sea. In later Cretaceous time, the conditions were similar to those at the time the Cheyenne sandstone was laid down. The sandstone, shale, and clay of the Dakota formation were laid down on beaches near the shore when the sea receded far to the south during an uplift.

After the Dakota formation was deposited, there was a rapid change in sedimentation. From time to time marine conditions were interrupted by the emergence of land to a point at, or near, sea level. Shale, limestone, and chalk were deposited—beginning with Graneros shale, the Greenhorn limestone, the Carlile shale, and the Niobrara formation. At the close of Cretaceous time, a great uplift produced the Rocky Mountains and also affected part of the High Plains (?). The shape and relationship of the geologic formations in this county are shown in figure 19.

Probably at the beginning of Tertiary time (about 60 million years ago) the sediments of Upper Cretaceous time were truncated by a long period of erosion. At about the same time, a moderate folding of the land produced the

Scott-Finney depression. Next came a period of erosion in which the trough of the basin was deepened. At this time, much of the Upper Cretaceous sediment too was removed. Consequently, in this county all Cretaceous strata above the Niobrara formation and various parts of the Niobrara formation have been removed (11).

At the close of Tertiary time, the Rocky Mountains began to erode. Material, consisting of sand, silt, clay, and gravel, was carried considerable distances by swift streams and was deposited over the area. These calcareous, outwash sediments of Pliocene time make up the Ogallala formation, the principal water-bearing formation in the county. The sediments gradually built up to above the level of the High Plains, and downwarping of the Scott-Finney depression was probably renewed. Following the downwarping, there was a long period of aggrading and lateral shifting of streams. As a result, thick deposits of silt, sand, and gravel that resembled those of the Ogallala formation were laid down. These deposits are known as Pleistocene deposits of the Meade and Sanborn formations (5).

Continued movements and further displacements caused subsequent erosion and deposition. Much of the present topography originated during this period. In late Pleistocene time great duststorms deposited a mantle of loess over much of the area. These depositions probably continued intermittently into Recent time, as shown by the presence of buried soils underlying many of the soils of the county. At the same time the sand dunes in the southeastern corner of the county began to develop.

Erosion and deposition have occurred in Recent time and have formed the present topography. Many of the intermittent streams cut into the Pleistocene and Pliocene deposits were partly filled with alluvial and windblown sediments. These sediments formed alluvial benches and terraces in the valleys and nearly level basins and depressions in the Scott-Finney depression.

A Cretaceous ridge in the eastern part of the county may have affected the course of Ladder Creek and White Woman Creek (see fig. 19). Ladder (Beaver) Creek, a tributary of the Smoky Hill River, begins in eastern Colorado and enters the county from the west, then flows eastward about halfway across the county. Then it turns abruptly to the north and flows in this direction until in Logan County it joins Smoky Hill River. White Woman Creek begins in eastern Colorado, enters the county from the west, flows eastward, and terminates in the Scott (White Woman) Basin.

White Woman Creek deposited sediments over a broad area of the Scott-Finney depression. The old stream channels built up to a level higher than the surrounding soils and deposited material over a broad area. Then, these meandering channels would break and start a new channel, and old, abandoned channels were left throughout the area. Many of them have been covered, or partly covered, by the loess sediments deposited over the area during this same period. Most of the sediments laid down by White Woman Creek were silty materials having about the same characteristics as the silty (loessal) soils of the uplands. In most areas the materials were mapped as such.

The Scott (White Woman) Basin, in which the White Woman Creek terminates, is a broad, shallow depression near the center of the county. Drainage from about 1,300

square miles goes into this broad, enclosed basin. The floor of the basin is nearly level, but it increases slightly in elevation toward the west and south. Remnants of a few old stream channels occur throughout the area. Slopes on the north and east sides keep the water from flowing in those directions. As a result, the basin generally fills and spreads water over large areas to the west and south. In 1951 approximately 8,000 acres of the area was covered by water. The dark clayey soils in the area are slowly permeable. Consequently, water covers most of them until it evaporates or penetrates the soil.

The soils in this basin developed in sediments deposited over lacustrine deposits. The Randall series, which consists of dark-colored clayey soils occupies the lower part. The Church soils occupy the slightly higher areas, or benches, and the more friable, well-drained Lubbock soils are slightly higher and farther from the ponded area.

About the same time that the loess was deposited, or soon afterwards, wind action winnowed the plains sediment and created the moderately sandy, partly reworked ridges and knobs along the intermittent streams, around Dry Lake, and east of the Scott (White Woman) Basin. This basin makes up most of the northern part of the Scott-Finney depression. East of the Scott-Finney depression are loamy and sandy ridges and high spots that have a sandy substrata overlying a buried silty soil. This buried soil is at the same level as the surrounding loessal soils. The ridges and high spots are generally on the east side of a low spot, or depression, as shown in figure 20. This figure shows the relationships of some of the soils of the uplands to parent material and topography.

*Climate.*—Climate influences the physical and chemical processes of weathering and the biological forces at work in the soil material. Generally, the soil-forming processes become more active as the soil warms, if the moisture is adequate, but they are limited by either inadequate or excess moisture.

The soils of Scott County have developed under a dry, subhumid climate. Summers are hot, and winters are moderately cold. The average annual precipitation is 19.73 inches. The climate—precipitation, temperature, humidity, and wind—significantly affects soil development in several ways.

Temperature influences greatly the production and decomposition of organic matter and the speed of chemical reactions in soils. The downward movement of water is one of the main factors in the transformation of parent material into a soil with differentiated horizons. As water moves down through the soil, calcium carbonate and other salts and minerals are leached from the upper part and carried downward to form a horizon of lime, or other salt or mineral enrichment. The translocation of clay minerals into the subsoil is partly caused by the downward movement of water. The depth of the darkened upper horizons is partly the result of the leaching of organic stains downward into the lighter colored material. The effect of the leaching of organic stains is evident when the shallow depth of darkened soil material in the sloping areas is compared to the greater depth of dark material in the more nearly level areas or in areas receiving runoff from surrounding soils. The soils in Scott County with steeper slopes have less developed profiles than those with more nearly level relief. The amount of water that actually percolates downward through the soil depends on rainfall,

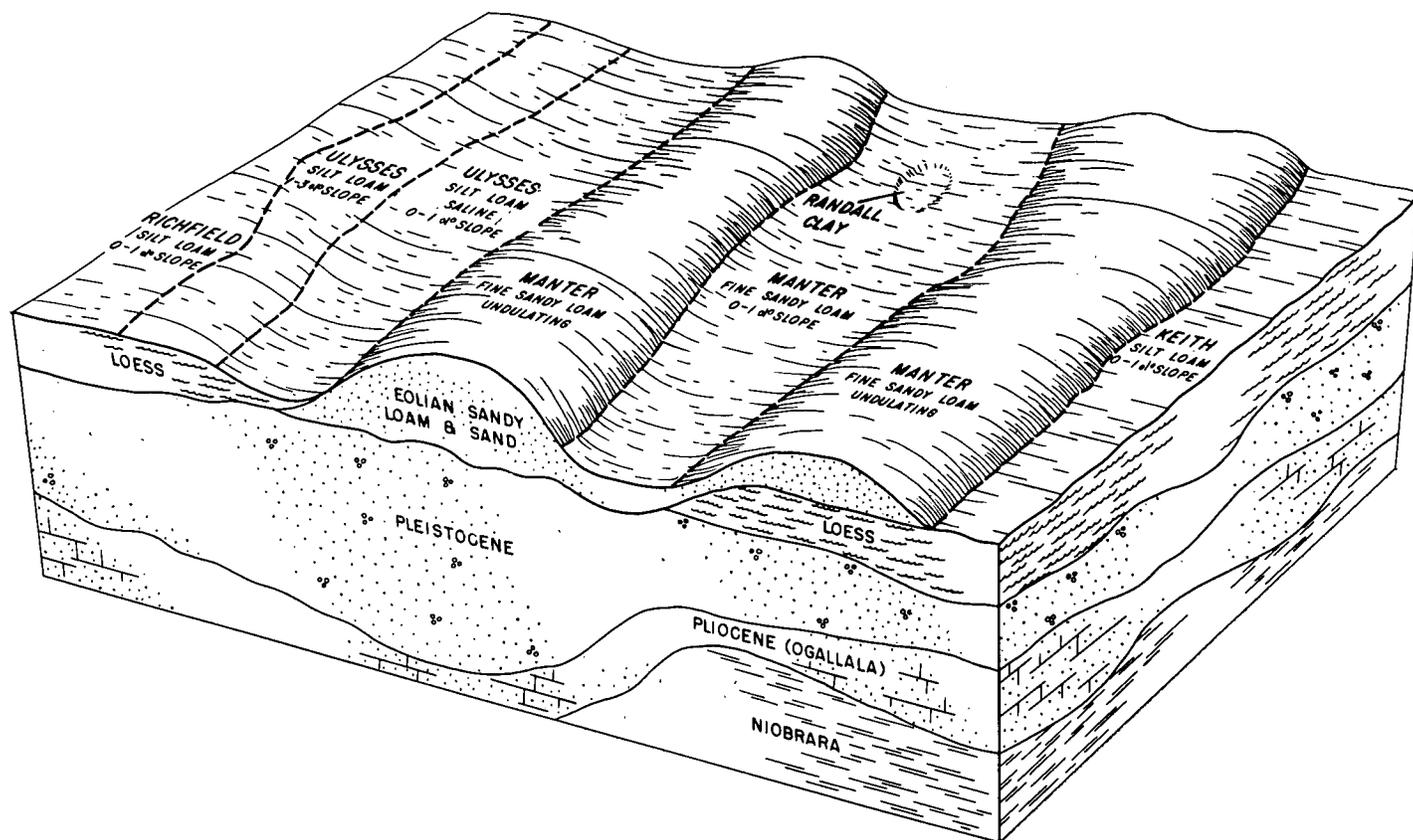


Figure 20.—Cross section of the Scott-Finney depression and part of sandy area to the east near the Scott-Finney county line.

humidity, relief, or lay of the land, temperature, and soil material. The soils differ in different regions as climate differs in those regions.

*Plant and animal life.*—Plant and animal life is essential in soil development. Soil formation occurs at the same time that vegetation develops. Plant cover adjusts itself according to changes in soil characteristics. The character of the parent material in a specific climatic region determines to a large extent the kind of vegetation. The kind and amount of vegetation influence the color, structure, and other physical and chemical properties of the soils. In Scott County the soils have developed under grass.

Bacteria, fungi, and other organisms help in the weathering of rocks and decomposition of organic matter. These organisms influence the chemical, physical, and biological processes that strongly affect soil formation.

Worms and larger animals modify soils. Many worm casts are present in the friable, calcareous, silty soils of this county.

*Relief.*—Relief affects soil development by its effect on (1) the amount of water retained, (2) erosion, (3) the direction that materials in suspension or solution are moved, and (4) plant cover. On the steep slopes, the continuous removal of surface soil and the loss of water by runoff slow down the processes of soil formation. The soils in the more nearly level and depressed areas receive the same amount of precipitation yearly as those on the steep slopes, plus the runoff and deposition from the sloping areas. Consequently, these soils are generally

more strongly developed than those in sloping areas and have a deeper and darker surface soil.

*Time.*—The length of time required for soil development depends mainly on the other factors of soil formation. Soils develop slowly in a dry climate under sparse vegetation and much more rapidly in a moist climate under dense vegetation. The type of parent material influences the length of time that the soil requires to reach a state of equilibrium with its environment. In Scott County the soils formed in loess in the sloping areas of the county show a different degree of development than those formed in the nearly level areas. The actual age of the loess is probably the same, but the apparent age differs, as indicated by the soil profiles. The continual loss of surface soil by erosion removes the developed material and exposes the material relatively unaltered by soil-forming processes. The soils in the nearly level areas lose little material; consequently, the soil development is deeper.

### Classification of Soils by Higher Categories

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. In the comprehensive system of soil classification followed in the United States (2), the soils are placed in six categories, one above the other. Beginning

at the top, the six categories are order, suborder, great soil group, family, series, and type.

In the highest category, the soils of the whole country are grouped into three orders, whereas thousands of soil types are recognized in the lowest category. The suborder and family categories have never been fully developed and thus have been little used. Attention has been given largely to the classification of soils into soil types and

series within counties or comparable areas and to the subsequent grouping of the series into great soil groups and orders.

Classes in the highest category of the classification scheme are the zonal, intrazonal, and azonal orders (9).

In table 7 the soil series of Scott County are classified by order and great soil group. The soil orders and great soil groups are described in the following paragraphs.

TABLE 7.—*Soil series, arranged by higher categories, and some important features of each series*

ZONAL ORDER				
Great soil group and series	Position	Relief	Parent material	Native vegetation
Chestnut soils:				
Dalhart.....	Uplands of the High Plains.	Gently sloping.....	Partly reworked, moderately sandy plains sediments.	Short and mid grasses and yucca.
Goshen.....	Swales and narrow, intermittent drainage-ways.	Nearly level.....	Colluvial-alluvial sediments.	Short and mid grasses.
Keith.....	Uplands of the High Plains.	Nearly level.....	Loess.....	Short grasses.
Lubbock.....	Benches and slight depressions of the uplands.	Nearly level.....	Loess and alluvial sediments.	Short and mid grasses.
Manter.....	Uplands of the High Plains.	Nearly level to undulating.	Partly reworked, moderately sandy plains sediments.	Short and mid grasses.
Richfield.....	Uplands of the High Plains.	Nearly level to gently sloping.	Loess.....	Short grasses.
Ulysses <sup>1</sup> .....	Uplands of the High Plains.	Nearly level to sloping.....	Loess.....	Short grasses.
INTRAZONAL ORDER				
Calcisols:				
Mansker.....	Sloping uplands.....	Gently to steeply sloping.	Calcareous plains outwash sediments.	Short and mid grasses.
Grumusols:				
Randall.....	Depressions in High Plains.	Nearly level.....	Fine loess and alluvial sediments.	Short grasses, weeds, or void of vegetation.
AZONAL ORDER				
Alluvial soils:				
Bayard.....	Alluvial fans and aprons.	Nearly level to gently undulating.	Moderately sandy alluvium.	Mid and tall grasses.
Bridgeport.....	Alluvial fans and aprons.	Nearly level to gently sloping.	Loamy alluvium.....	Short and mid grasses.
Lithosols:				
Potter.....	Uplands breaks.....	Steep and broken.....	Plains outwash sediments (caliche).	Short and mid grasses.
Regosols:				
Church <sup>2</sup> .....	Benches and depressions	Nearly level to gently sloping.	Alluvial and loess sediments over lacustrine deposits.	Short and mid grasses.
Colby.....	Sloping High Plains.....	Sloping to steeply sloping.	Loess.....	Short grasses.
Otero.....	Sloping uplands.....	Undulating and hummocky.	Partly reworked, moderately sandy plains sediments.	Short, mid, and tall grasses, sagebrush, and yucca.
Tivoli.....	Sandhills.....	Hummocky sand dunes.....	Stabilized eolian sands.....	Mid and tall grasses, sagebrush, and yucca.

<sup>1</sup> The Ulysses soils have some properties of Regosols and are classified as Chestnut soils that intergrade toward Regosols.

<sup>2</sup> The Church soils have some properties of Grumusols and are classified as Regosols that intergrade toward Grumusols.

### Zonal soils

The zonal soils have well-developed characteristics that reflect the influence of the active factors of soil formation—climate and plant and animal life, chiefly vegetation. These soils generally developed on well-drained uplands from parent material that has been in place long enough to make a good balance between the forces of soil formation. In this county the zonal soils are members of the Chestnut great soil group.

*Chestnut soils.*—The soils in this group have developed in parent material of loess, sandy and silty plains sediments, and colluvial-alluvial sediments under tall, mid, and short grasses. The surface soil is dark grayish-brown and noncalcareous; textures range from fine sandy loam to silty clay loam. The subsoil is dark grayish-brown or brown sandy loam to silty clay loam. It has prismatic structure that breaks to granular or subangular blocky structure. The depth to lime accumulation generally ranges between 12 and 40 inches.

Soils of the Dalhart, Goshen, Keith, Lubbock, Manter, and Richfield series are members of the Chestnut great soil group. The Ulysses soils also are classified as Chestnut soils but have some characteristics of Regosols. In some areas under cultivation, they are weakly calcareous at the surface.

### Intrazonal soils

Intrazonal soils have more or less well-developed characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal influence of climate and vegetation. In Scott County the intrazonal soils are the Calcisols and Grumusols.

*Calcisols.*—The soils of this great soil group have an A horizon that varies in thickness and color and a prominent, deeper horizon of lime accumulation. The parent material has a high to very high content of carbonate.

The only Calcisols in this county are the Mansker soils. These soils were developed in medium-textured, calcareous plains outwash sediments of Pliocene and Pleistocene time. They have minimal development; the A1 and Cca horizons are prominent, but no B horizon is evident.

*Grumusols.*—This great soil group is made up of soils that have a profile rather high in content of clay. The profile is also relatively uniform in texture and is marked by signs of local soil movement resulting from shrinking when the soils are dry and swelling when they are wet. The Randall soils are the only Grumusols in the county.

The Randall soils have minimal horizonation. They consist of very slowly permeable, fine-textured alluvial sediments occupying the lower part of Scott (White Woman) Basin and the upland depressions, locally called potholes and lagoons. Weak gilgai microrelief, consisting of a succession of nearly level, enclosed microknolls and basins, occurs in some undisturbed areas.

### Azonal soils

Azonal soils are soils without well-developed profile characteristics because of their youth, or because the nature of the parent material or the relief prevents normal development of such characteristics. In Scott County the azonal soils are those of the Alluvial, Lithosol, and Regosol great soil groups.

*Alluvial soils.*—These soils developed from transported and relatively recently deposited alluvium. They are characterized by only a weak modification of the original material by soil-forming processes. The soils vary from place to place because of variations in the sediment that makes up the parent material. The color, texture, and arrangement of layers vary within short distances. Alluvial soils lack a soil profile with genetically related horizons. Their properties are closely related to those of the alluvial deposit from which they originated. In this county the Bayard and Bridgeport series are in the Alluvial great soil group.

In the Bayard and Bridgeport series are young soils formed from relatively recent deposits of alluvium. They occupy the alluvial fans and aprons along White Woman and Ladder (Beaver) Creeks. The soils are occasionally flooded and are developing slowly.

The soils of the Bayard series are well drained, relatively light colored, calcareous, and moderately sandy. They occur in rather narrow areas along the channel of White Woman Creek and upland drainageways.

The Bridgeport series consists of deep, well-drained, calcareous, medium to moderately fine textured soils. In most areas these soils have an A1 horizon that is relatively distinct in color but lacks a B horizon of clay accumulation. A dark-colored layer that formerly was the surface layer of a soil now buried occurs in some areas. The Bridgeport soils are mainly in the alluvial valley of Ladder Creek.

*Lithosols.*—This great soil group consists of very shallow, young soils less than 10 inches deep. They are weakly developed and occupy strongly calcareous, indurated or semi-indurated beds of caliche of the Ogallala formation. The Lithosols stay young because they are on steep slopes and the soil covering is thin. A deep solum cannot form, as erosion removes the soil material as it is formed from the rocks. The only Lithosols in this county are the Potter soils.

The Potter soils have a thin, slightly darkened surface layer. These soils are mostly on steep and rough, broken slopes. Geologic erosion has stripped away the silty and loamy sediments and has exposed the underlying caliche, limestone, and shale. The soils support a sparse stand of native mid and short grasses.

*Regosols.*—This great soil group consists of deep, unconsolidated material in which few, if any, clearly expressed soil characteristics have developed. In this county the Colby, Otero, and Tivoli series represent this great soil group. The Church soils also are classified as Regosols, but have some characteristics of Grumusols. The Regosols are similar to the Lithosols in their stage of development. The youthfulness of some Regosols can be attributed to the recent deposition of parent material. In others the forces of erosion remove the soil material at such a rate that distinct, genetically related horizons cannot develop.

The Church series consists of dark, moderately fine textured, calcareous soils that developed on lacustrine deposits. These soils have an AC profile. They occupy nearly level benches around and slightly higher than Dry Lake and the intermittent lakes in the Scott-Finney depression.

The Colby series consists of deep, friable, light-colored, calcareous soils weakly developed in loess. They have an

AC profile. They occupy sloping to steep, convex slopes along the upland drainageways.

The Otero series consists of deep, light-colored, calcareous, moderately sandy soils. These soils developed in somewhat reworked, moderately sandy calcareous outwash deposits of the High Plains. They occupy gently undulating to hummocky areas adjacent to the sand dunes in the southeastern part of the county.

The Tivoli series consists of dry sands derived from recently deposited eolian sands of Pleistocene origin. These non-Chernozemic Regosols have a slightly darkened, weak A1 horizon over light-colored fine sand. They occupy hummocky, dune-type topography that was stabilized by perennial vegetation.

## Morphology of Soils

In the following pages, each soil series is described, and a detailed profile description representative of the series in Scott County is given. The profile descriptions were prepared after studying profiles at specific sites in the county. Unless otherwise indicated, the color is that of a dry soil.

*Bayard series.*—In the Bayard series are deep, friable, well-drained, light-colored, weakly developed soils in alluvium. These soils developed under mixed native grasses from sandy sediments deposited over loamy sediments.

The Bayard soils are lighter colored than the Manter soils and are less deeply leached of lime. They are more sandy throughout the profile than the Bridgeport soils.

Typical profile (770 feet north and 430 feet west of the SE. corner of sec. 21, T. 19 S., R. 33 W., in a cultivated field of less than 1 percent slope) :

- A1—0 to 11 inches, dark grayish-brown (10YR 4.5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; slightly hard when dry, very friable when moist; weakly calcareous; gradual boundary.
- AC—11 to 19 inches, grayish-brown (10YR 5.5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, granular structure; slightly hard when dry, very friable when moist; porous and permeable; calcareous; gradual boundary.
- IIC1—19 to 25 inches, grayish-brown (10YR 5/2) light loam, very dark grayish brown (10YR 3.5/2) moist; weak, granular structure; slightly hard when dry, friable when moist; porous and permeable; calcareous; gradual boundary.
- IIC2—25 to 51 inches, grayish-brown (10YR 5/2) loam to light clay loam, very dark grayish brown (10YR 3.5/2) moist; weak, granular structure; hard when dry, friable when moist; strongly calcareous; gradual boundary.
- IIC3—51 to 65 inches, brown (10YR 5.5/3) silt loam, dark brown (10YR 3.5/3) moist; weak, granular structure; hard when dry, friable when moist; calcareous.

The A horizon ranges from 6 to 14 inches in thickness. The thickness of sandy loam over the substratum of loam and light clay loam ranges from 6 to 30 inches. The Bayard soils are calcareous throughout, but in some places in the deeper sandy loam they are noncalcareous to a depth of 5 inches.

*Bridgeport series.*—The Bridgeport series is made up of deep, well-drained, moderately dark colored, calcareous, weakly developed soils in alluvial deposits. These relatively recent deposits have not been in place long enough for the profile to show definite influences of soil formation.

The soils are on nearly level to gentle slopes on the alluvial fans and terraces along Ladder (Beaver) Creek.

The Bridgeport soils are less deeply leached of lime and are lighter colored than the Goshen soils. They are more clayey throughout the profile than the Bayard soils. Bridgeport soils have profile characteristics much like those of the Ulysses soils, but they formed in alluvial deposits rather than in loess.

Typical profile (1,390 feet west and 1,320 feet north of the SE. corner of sec. 24, T. 16 S., R. 33 W., in a dry-farmed alfalfa field with less than 1 percent slope) :

- Ap—0 to 8 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard when dry, friable when moist; weakly calcareous; clear boundary.
- AC—8 to 37 inches, grayish-brown (10YR 5.5/2) heavy loam, dark grayish brown (10YR 4/2) moist; weak, granular structure; slightly hard when dry, friable when moist; calcareous; few, scattered worm casts; clear boundary.
- C—37 to 54 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate, medium and fine, granular structure; hard when dry, friable when moist; calcareous; a few, small, soft concretions of lime.

The A horizon ranges from loam to light clay loam in texture and from grayish brown (10YR 5.5/2) to dark grayish brown (10YR 4/2) in color. The texture of the subsoil and substratum ranges from loam to silty clay loam but in most places is light clay loam. The C horizon ranges from dark grayish brown to pale brown in color. Generally, these soils are calcareous throughout, but in areas that receive runoff from surrounding soils, they are leached of lime to a depth of about 10 inches.

*Church series.*—The soils of the Church series are deep, somewhat imperfectly drained, dark-colored Regosols that intergrade toward Grumusols. They have a silty clay loam texture. The soils developed on benches around intermittent lakes and around Dry Lake in mixed, calcareous, alluvial and loessal sediments over saline lacustrine deposits.

The Church soils are less clayey throughout the profile than the Randall soils. They are not so mature or so deeply leached of lime as the Goshen, Lubbock, and Richfield soils. The Church soils are darker and more clayey throughout the profile than the Ulysses and Colby soils.

Typical profile (1,020 feet west and 230 feet north of the SE. corner of sec. 20, T. 20 S., R. 31 W., in native grass) :

- A1—0 to 9 inches, gray (10YR 5.5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate, fine, granular structure; slightly hard when dry, slightly firm when moist; few, scattered worm casts; calcareous; gradual boundary.
- AC—9 to 28 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate, medium, prismatic structure breaking to moderate, medium, granular; slightly hard when dry, slightly firm when moist; calcareous; gradual boundary.
- C1cs—28 to 56 inches, grayish-brown (10YR 5/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine to medium, subangular blocky structure; hard when dry, firm when moist; strongly calcareous; streaks and films of lime concentrations; many films and nests of white, crystalline salts (gypsum); gradual boundary.
- C2cs—56 to 64 inches, light brownish-gray (2.5Y 6.5/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; calcareous; few scattered nests of white crystalline salts (gypsum).

The A horizon ranges from 6 to 15 inches in thickness, from gray to grayish brown in color, and from heavy silt loam to silty clay loam in texture. In most areas these soils are calcareous throughout, but in small, local areas they are noncalcareous to a depth of 12 inches. The depth over light brownish-gray to olive-gray lacustrine deposits ranges from nearly 20 to 74 inches but averages about 35.

*Colby series.*—The soils of the Colby series are deep, well-drained, grayish-brown Regosols of the uplands. The surface soil is silt loam and has granular structure. These are young, calcareous, friable soils that formed in loess or similar silty sediments. Most areas in this county have steep slopes adjacent to or on the streambanks of the intermittent drainageways of the uplands. The slopes range from 5 to 15 percent.

The Colby soils are not so dark or so deeply leached of lime as the Ulysses soils. They are lighter colored, less deeply leached of lime, and less mature than the Keith and Richfield soils. In addition, they lack a distinct B horizon, or horizon of clay accumulation. The Colby soils are deeper than the Mansker soils and have no prominent Cca horizon.

Typical profile (2,525 feet north and 420 feet east of the SW. corner of sec. 1, T. 16 S., R. 32 W., in native vegetation):

- A1—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; calcareous; clear boundary.
- AC—5 to 10 inches, grayish-brown (10YR 5.5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, prismatic structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; many nests and scattered worm casts; strongly calcareous; clear boundary.
- C—10 to 56 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 4.5/3) moist; weak, granular structure to massive; soft when dry, very friable when moist; porous and permeable; strongly calcareous; faint evidence of lime concentration.

The A horizon ranges from 2 to 6 inches in thickness, from dark grayish brown to pale brown in color, and from silt loam to loam in texture. The color of the A1 horizon when moist is no darker than 10YR 3.5/2, except in areas under native grass. In these areas the surface layer is less than 6 inches thick and is as dark as 10YR 3/2 when moist. In a few areas, some rounded pieces of gravel are scattered over the surface.

*Dalhart series.*—In the Dalhart series are noncalcareous, dark grayish-brown to brown Chestnut soils. These soils have an A horizon of sandy loam grading to a B horizon of sandy loam to light sandy clay loam. The underlying material is somewhat variable and has developed from strongly calcareous, generally moderately sandy outwash sediments of the High Plains. In most areas the sediments are partly reworked eolian mantles deposited relatively late in Pleistocene time.

The Dalhart soils have a more distinct and more clayey B horizon than the associated Manter soils. They are darker than the Otero soils and are more deeply leached of lime. The Dalhart soils are more sandy throughout the profile than the Richfield soils of loess origin.

In this county Dalhart sandy loam was mapped in a complex with Richfield loam on the more gently sloping

ridges and other areas intermingled with the more sandy soils.

Typical profile (795 feet west and 115 feet north of the SE. corner of sec. 2, T. 20 S., R. 32 W., in a cultivated field with slopes of about 2 percent):

- Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.
- B2t—5 to 14 inches, brown (10YR 4/3) light sandy clay loam, dark brown (10YR 3/3) moist; moderate, coarse, prismatic structure breaking to weak, granular; slightly hard when dry, friable when moist; noncalcareous; few scattered worm casts; many fine pores; clear, wavy boundary.
- B3ca—14 to 23 inches, grayish-brown (10YR 5/2) sandy loam to light sandy clay loam, very dark grayish brown (10YR 3.5/2) moist; weak, granular structure; slightly hard when dry, friable when moist; many very fine pores; strongly calcareous; few, scattered, fine concentrations of lime; few scattered worm casts; gradual boundary.
- Cca—23 to 35 inches, brown (10YR 5/3) light sandy clay loam, dark brown (10YR 4/3) moist; weak, granular structure; slightly hard when dry, friable when moist; strongly calcareous; threadlike streaks and films of lime concentration; gradual boundary.
- IIBb—35 to 44 inches, brown (10YR 5/3) heavy loam, dark brown (10YR 3/3) moist; weak, granular structure; slightly hard when dry, friable when moist; many fine pores; strongly calcareous; a few streaks and threads of lime concentration; gradual boundary.
- IICb—44 to 64 inches, pale-brown (10YR 6/3) heavy loam to clay loam, brown (10YR 5/3) moist; massive; slightly hard when dry, friable when moist; strongly calcareous.

The A horizon ranges from 3 to 7 inches in thickness and from light sandy loam to heavy sandy loam in texture. The B horizon ranges from heavy sandy loam to sandy clay loam in texture and from about 5 to 20 inches in thickness. The depth to calcareous material ranges from 12 to 23 inches but averages about 15 inches. A darkened buried soil is evident in places. The texture of the material below the Cca horizon ranges from loamy fine sand to silt loam according to the composition of the reworked material.

*Goshen series.*—The Goshen series consists of deep, dark-colored, friable, nearly level Chestnut soils. These soils developed in alluvium in swales and along narrow, intermittent drainageways of the uplands. Slopes are mainly less than 1 percent.

The Goshen soils are darker and are more deeply leached of lime than the Keith and Richfield soils. They are more deeply leached of lime than the Bridgeport soils and have a more strongly developed profile. The Goshen soils are less clayey than the Lubbock soils and have a less strongly developed profile.

Typical profile (2,600 feet east and 1,520 feet south of the NW. corner of sec. 17, T. 18 S., R. 33 W., in a nearly level, cultivated swale):

- Ap—0 to 5 inches, dark grayish-brown (10YR 4.5/2) silt loam, very dark brown (10YR 2.5/2) moist; massive to weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.
- A1—5 to 17 inches, dark-gray to dark grayish-brown (10YR 4/1.5) heavy silt loam, very dark brown (10YR 2/2) moist; moderate, fine, granular structure; porous; slightly hard when dry, friable when moist; noncalcareous; few scattered worm casts; gradual boundary.

- B2—17 to 29 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular and fine, moderate, subangular blocky structure; hard when dry, friable when moist; noncalcareous; many worm casts; gradual boundary.
- B3—29 to 35 inches, brown (10YR 5.5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, fine to medium, granular structure; slightly hard when dry, friable when moist; calcareous; gradual boundary.
- Cca—35 to 64 inches, very pale brown (10YR 7/3) heavy silt loam, brown (10YR 5/3) moist; massive to weak, granular structure; soft when dry, very friable when moist; calcareous; films and threads of lime; porous and permeable.

The A horizon ranges from light loam to silt loam in texture. The B and C horizons range from heavy silt loam to silty clay loam. The finer textured soils are in the broader swales. The depth to calcareous material ranges from 18 to 36 inches.

*Keith series.*—In the Keith series are deep, well-drained, dark grayish-brown Chestnut soils of the uplands. The surface soil is silt loam. These soils developed under native short grasses from unconsolidated, pale-brown, calcareous, friable, porous loess.

The Keith soils have a thicker surface layer and a more clayey, more strongly developed subsoil than the Ulysses soils. Also they are deeper and have been leached of lime to a greater depth. They have a more friable and less clayey B horizon than the Richfield soils. They are lighter colored and less deeply leached of lime than the Goshen soils and were formed in loess instead of in alluvium.

Typical profile (2,600 feet west and 70 feet north of the SE. corner of sec. 10 T. 20 S., R. 32 W., in a cultivated field of less than 1 percent slope) :

- A1—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 2.5/2) moist; weak, granular structure; slightly hard when dry, friable when moist; noncalcareous; few, scattered granules from worm casts; clear, smooth boundary.
- AB—7 to 12 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 2.5/2) moist; weak, medium, prismatic structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; noncalcareous; few worm casts; porous and relatively permeable; gradual boundary.
- B21t—12 to 16 inches, dark grayish-brown (10YR 4.5/2) light silty clay loam, dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure breaking to moderate, medium, granular and weak, subangular blocky; hard when dry, friable when moist; noncalcareous; weak, patchy clay films on structural aggregates; porous and relatively permeable; clear boundary.
- B22t—16 to 23 inches, brown (10YR 4.5/3) silty clay loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; weak, continuous clay films; few small krotovinas filled with darker colored material; noncalcareous; clear boundary.
- B3ca—23 to 31 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; few, small krotovinas; strongly calcareous; faint concentrations of calcium carbonate; gradual boundary.
- Cca—31 to 52 inches, pale-brown (10YR 6/3) light silty clay loam, brown (10YR 4.5/3) moist; massive (structureless); hard when dry, friable when moist; strongly calcareous; many, small friable concretions of lime; diffuse boundary.

- C—52 to 64 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; porous; slightly hard when dry, very friable when moist; strongly calcareous.

The A horizon ranges from silt loam to loam in texture and from 8 to 14 inches in thickness. The B horizon ranges from about 12 to 30 inches in thickness, and the lower part is calcareous. The depth to calcareous material ranges from 17 to 30 inches.

*Lubbock series.*—The Lubbock series is made up of deep, very dark colored, nearly level Chestnut soils. The soils developed in calcareous Pleistocene sediments, or in more recent sediments, alluvial or eolian, or a mixture of both. They occupy broad, slightly depressed areas on benches around intermittent lakes and basins. Their slope is mainly less than 1 percent.

The Lubbock soils are darker and deeper, have more clay throughout the profile, and are more deeply leached of lime than the Richfield and Keith soils. Also, they developed in sediments that were more clayey. The Lubbock soils are less clayey and less firm than the Randall soils. They are more deeply leached of lime and are also more strongly developed than the Church soils. They are more clayey and more firm throughout than the Goshen soils and have developed in sediments that were more clayey.

Typical profile (165 feet north and 95 feet west of the SE. corner of sec. 15, T. 18 S., R. 33 W., in an irrigated, cultivated field) :

- A1—0 to 7 inches, dark-gray (10YR 4/1) light silty clay loam, very dark brown (10YR 2/2) moist; weak, fine and medium, granular structure; slightly hard when dry, friable when moist; many fine pores; few scattered worm casts; noncalcareous; abrupt boundary.
- A3—7 to 12 inches, dark-gray (10YR 4/1) silty clay loam, grayish brown (10YR 2.5/2) moist; moderate, medium, granular structure; hard when dry, friable when moist; few, scattered worm casts; clay movement indicated by shiny peds; noncalcareous; gradual boundary.
- B21t—12 to 21 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium and fine, subangular blocky structure; hard when dry, slightly firm when moist; thin, patchy clay films; many fine pores; a few scattered worm casts; noncalcareous; gradual boundary.
- B22t—21 to 27 inches, grayish-brown (10YR 5/2) heavy silty clay loam, very dark grayish brown (10YR 3.5/2) moist; moderate, medium and fine, subangular blocky structure; hard when dry, slightly firm when moist; few fine pores; small krotovinas; noncalcareous; thin, patchy clay films; gradual boundary.
- B3ca—27 to 32 inches, grayish-brown (10YR 5/2) silty clay loam, very dark brown (10YR 3/3) moist; medium and fine, moderate, subangular blocky structure; hard when dry, firm when moist; calcareous; a few threads and films of lime between peds; gradual boundary.
- C—32 to 47 inches, gray to light-gray (10YR 6/1) silty clay loam, dark gray (10YR 4.5/1.5) moist; moderate, medium and fine, subangular blocky structure; hard when dry, firm when moist; many fine pores; strongly calcareous; between peds, many fine threads and small, soft concretions of lime; gradual boundary.
- Cca—47 to 65 inches, light brownish-gray (2.5Y 6.5/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, granular structure; hard when dry, firm when moist; strongly calcareous; splotches and small, soft concretions of lime.

The A1 horizon ranges from heavy silt loam to silty clay loam in texture, from dark gray to gray in color, and from

4 to 14 inches in thickness. In some places where the A1 horizon is thicker, the A3 horizon is lacking. The B horizon ranges from silty clay loam to light clay in texture and from moderate, medium, granular to strong, sub-angular blocky to blocky in structure. The depth to calcareous material ranges from 18 to 30 inches. The Cca horizon generally occurs at a depth below 25 inches. Below a depth of 50 inches, white crystalline salts may occur, especially in Dry Lake and the Scott (White Woman) Basin.

*Mansker series.*—The Mansker series consists of moderately deep Calcisols. These are young soils weakly developed from calcareous outwash sediments. They occur along the entrenched upland drainageways on gentle to steep slopes that range from about 5 to 25 percent.

The Mansker soils are deeper and have smoother slopes than the associated Potter. They are shallower than the Colby and Ulysses soils and were formed from outwash sediments rather than loess.

Typical profile (2,400 feet west and 200 feet north of the SE. corner of sec. 25, T. 16 S., R. 33 W., in a native-grass pasture):

A1—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3.5/2) moist; weak, fine, granular structure; soft when dry, friable when moist; calcareous; few scattered worm casts; gradual boundary.

AC—7 to 16 inches, light brownish-gray (10YR 6/2) light clay loam, dark grayish brown (10YR 4.5/2) moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; strongly calcareous; few, small, soft and hard concretions of lime in lower part; clear boundary.

C1ca—16 to 28 inches, light-gray (10YR 7/2) clay loam, light brownish-gray (10YR 6/2) moist; massive; hard when dry, slightly friable when moist; much of layer is partly indurated calcium carbonate; abrupt boundary.

C2ca—28 to 31 inches +, white, extremely hard caliche.

The A horizon ranges from sandy loam to silt loam in texture and from 4 to 9 inches in thickness; the average thickness is about 5 inches. Dry colors range from grayish brown to pale brown. The depth to the Cca horizon ranges from 10 to 30 inches. The hard caliche layer is not present in all areas. Below the A horizon, the texture varies according to the composition of the underlying calcareous conglomerate from which the soils were formed.

*Manter series.*—The Manter series consists of deep, well-drained, moderately dark colored Chestnut soils of the uplands. The surface soil has sandy loam texture and granular structure. These soils developed under mixed native grasses from somewhat reworked, calcareous outwash sediment of the High Plains. They have nearly level to undulating slopes ranging from 0 to 5 percent.

The Manter soils are darker colored and are leached of lime to a greater depth than the Bayard soils. They formed in reworked outwash instead of in alluvium. They are more mature and darker than the Otero soils, which in most areas are calcareous throughout. The Manter soils are less clayey than the Dalhart soils and have a less distinct B horizon. Compared with the Keith, Ulysses, and Richfield soils, these soils are more sandy throughout the profile.

Typical profile (1,305 feet south and 70 feet east of the NW. corner of sec. 29, T. 19 S., R. 31 W., in a cultivated field on gently undulating slopes ranging from 1 to 3 percent):

Ap—0 to 4 inches, dark grayish-brown to grayish-brown (10YR 4.5/2) light fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt boundary.

A1—4 to 10 inches, dark grayish-brown to grayish-brown (10YR 4.5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure breaking to weak, granular; slightly hard when dry, very friable when moist; porous and permeable; few scattered worm casts; noncalcareous; gradual boundary.

B2—10 to 31 inches, dark grayish-brown to brown (10YR 4.2/5) heavy sandy loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure breaking to weak, granular; slightly hard when dry, friable when moist; porous and permeable; some pedis have shiny surfaces; few scattered worm casts; noncalcareous; clear boundary.

Cca—31 to 64 inches, light brownish-gray (10YR 6/2) loam to sandy clay loam, dark grayish brown (10YR 4.5/2) moist; weak, granular structure; slightly hard when dry, friable when moist; porous; strongly calcareous; many, fine, friable seams, threads, and splotches of lime.

The texture of the A horizon ranges from heavy loamy fine sand to light loam, but in most areas it is fine sandy loam. In some areas there is a faint B horizon that resulted from clay movement. In many areas there is no textural change from the surface layer to within the C horizon. Siltier material commonly occurs below a depth of 30 inches. The depth to calcareous material ranges from 12 to 40 inches but is generally more than 20 inches.

Below a depth of 30 inches remnants of darkened layers of buried soils commonly occur. These buried soils are generally silty in texture. In most of the more gently sloping areas, the substratum is loamy or silty. In the steeper, more ridgelike areas, however, it is generally stratified with loamy sand or fine and coarse sand.

*Otero series.*—The Otero series consists of deep, light-colored, calcareous Regosols that are weakly developed in somewhat reworked calcareous outwash sediments of the High Plains. These well-drained soils of the upland are so young that a clayey B horizon has not had time to develop. They developed on gently undulating to hummocky topography in the southeastern quarter of the county. Free lime occurs throughout the profile.

The Otero soils are lighter colored and are calcareous nearer the surface than the Manter soils. They are more sandy throughout the profile than the Ulysses and Colby soils. The Otero soils, compared with the associated Tivoli soils, are less sandy throughout the profile and are calcareous nearer the surface.

Typical profile (1,770 feet south and 300 feet east of the NW. corner of sec. 24, T. 20 S., R. 31 W., in a cultivated field):

Ap—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, granular structure; slightly hard when dry, very friable when moist; calcareous; clear boundary.

AC—5 to 18 inches, brown (10YR 5.5/3) fine sandy loam, brown (10YR 4.5/3) moist; weak, granular structure; slightly hard when dry; very friable when moist; few scattered worm casts; strongly calcareous; gradual boundary.

Cca—18 to 31 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; a few threads and films of lime; diffuse boundary.

C—31 to 64 inches, near very pale brown (10YR 6.5/3) heavy sandy loam, brown (10YR 5/3) moist; stratified with thin layers of loamy fine sand and fine sand; weak, granular structure; slightly hard when dry, very friable when moist; strongly calcareous.

The A horizon ranges from 3 to 8 inches in thickness, from loamy fine sand to fine sandy loam in texture, and from grayish brown to brown in color. The AC horizon ranges from fine sandy loam to loamy fine sand. The substratum varies from place to place according to the composition of the reworked sediments.

*Potter series.*—The Potter series consists of very shallow Lithosols. These young soils are weakly developed over partly weathered caliche that is a part of the calcareous conglomerate outwash sediments of the Ogallala formation. They are excessively drained. These soils are not extensive in this county and occur on steep slopes and broken topography well below the summit of the High Plains, along deeply entrenched uplands drainageways. Slopes range from about 5 to 40 percent. Geologic erosion has stripped away the mantle of loamy sediments and exposed the basal caliche and limestone.

The Potter soils are shallower and occur on more sloping and broken slopes than the associated Mansker and Colby soils.

Typical profile (0.5 mile west and 180 feet north of the SE. corner of sec. 25, T. 16 S., R. 33 W., in a native-grass pasture):

- A1—0 to 5 inches, grayish-brown (10YR 5.5/2) loam, dark grayish brown (10YR 4/2) moist; weak, granular structure; slightly hard when dry, friable when moist; strongly calcareous; fragments of hard caliche on the surface and mixed with the soil; gradual boundary.
- AC—5 to 10 inches, grayish-brown and white loam mixed with fragments of caliche; abrupt boundary.
- C—10 to 21 inches, nearly white, partly weathered caliche, cracked and broken in upper part and moderately dense in lower part.
- R—21 inches +, white, hard caliche.

The A horizon ranges from 3 to 8 inches in thickness and from grayish brown to pale brown in color. The texture ranges from loam to sandy loam and may grade from one to the other within a short distance. The amount of gravel varies according to the composition of the underlying caliche. In places the thickness of the soil over caliche is as much as 12 inches, but on the average it is about 6 or 7 inches.

*Randall series.*—In this series are deep, gray Grumusols with weak gilgai microrelief in some places. These poorly drained soils developed in enclosed depressions in the uplands during intermittent, extremely wet and dry periods. The depressions range from a few to about 3,600 acres in size. Water may cover them for a period of several days to a year or more before it drains into the soil or evaporates.

The Randall soils are more clayey throughout the profile than the Church and Lubbock soils. They are associated mainly with broad, nearly level areas of Richfield silt loams that have poorly defined drainage patterns. The surface soil and subsoil of the Randall soils are darker and more clayey than those of the Richfield soils.

Typical profile (210 feet east and 70 feet north of the southwestern corner of sec. 35, T. 17 S., R. 33 W., in an enclosed depression approximately 30 acres in size):

- Ap—0 to 6 inches, dark-gray (10YR 4.5/1) clay, very dark gray (10YR 3/1) moist; moderate, fine, subangular blocky and blocky structure; extremely hard when

dry, very firm when moist; noncalcareous; abrupt boundary.

- A11—6 to 21 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate to strong, medium, blocky structure; extremely hard when dry, very firm and sticky when moist; few, very fine pores and root channels; noncalcareous; diffuse boundary.
- A12—21 to 41 inches, gray (10YR 5.5/1) light clay, dark gray (10YR 4/1.5) moist; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; few very fine pores and root channels; noncalcareous; gradual boundary.
- C1—41 to 56 inches, grayish-brown (2.5Y 5/2) heavy silty clay loam to light clay, dark grayish brown (10YR 4/2) moist; weak, granular structure; hard when dry, firm when moist; few roots present; strongly calcareous; few small seams and concretions of lime; gradual boundary.
- C2—56 to 64 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard when dry, friable when moist; strongly calcareous; many, small, friable concentrations of lime.

Because of deposits, the surface layer ranges from silt loam to clay. The depth to calcareous material ranges from about 30 to more than 60 inches in the upland depressions. Nevertheless, the soil is calcareous at the surface in the Scott Basin.

Randall clay, occasionally flooded, covers about 3,600 acres of the Scott (White Woman) Basin. It has developed in sediments deposited over saline lacustrine deposits. Below 3 feet the soil is saline and is light gray (5Y 7/2) in color. This horizon is streaked with darker material that has fallen from the surface into cracks.

*Richfield series.*—In the Richfield series are deep, dark-colored, noncalcareous Chestnut soils of the upland. These well-drained soils developed in Wisconsin loess. They are the most extensive soils in Scott County and occupy wide areas throughout the tablelands. Most slopes are nearly level, but the range is from 0 to 3 percent. The native vegetation was short grasses.

The Richfield soils are deeper, more mature, and less friable than the Ulysses soils. They are not so deeply leached of lime as the Keith soils and have a more clayey B horizon. The Richfield soils are not so dark and so deeply leached of lime as the Goshen and Lubbock soils.

Typical profile (1,050 feet east and 84 feet south of the NW. corner of sec. 18, T. 18 S., R. 33 W., in a cultivated field on about 0.5 percent slope):

- Ap—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.
- AB—4 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2.5/2) moist; moderate, medium, prismatic structure breaking to moderate, medium, granular; hard when dry, slightly firm when moist; faint evidence of clay films; many very fine, open pores; many scattered worm casts; noncalcareous; clear boundary.
- B21t—8 to 12 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure breaking to moderate, medium, granular and fine, subangular blocky; hard when dry, moderately firm when moist; many, fine, open pores; many scattered worm casts and a few nests; thin, patchy clay films; noncalcareous; clear boundary.
- B22t—12 to 18 inches, brown (10YR 4.5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; thin, patchy to continuous clay films; many, fine, open

pores and root channels; noncalcareous; clear boundary.

- B3ca—18 to 28 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 4.5/3) moist; moderate, medium, sub-angular blocky structure; thin, patchy clay films; hard when dry, firm when moist; many, fine, open pores and root channels; few small krotovinas filled with darker material; strongly calcareous; threads and films of segregated lime and some friable concretions that increase with depth; gradual boundary.
- Cca—28 to 54 inches, very pale brown (10YR 7/3) heavy silt loam, brown (10YR 5/3) moist; massive; slightly hard when dry, friable when moist; strongly calcareous; masses of lime concretion; diffuse boundary.
- C—54 to 65 inches, very pale brown to white (10YR 7.5/3) silt loam, brown (10YR 5.5/3) moist; massive; porous and permeable; soft when dry, friable when moist; strongly calcareous; a few, scattered, small, soft concretions of lime.

The A horizon ranges from 4 to 10 inches in thickness. The AB horizon commonly occurs in most parts of the county. The depth to calcareous material ranges from 12 to 25 inches but averages about 17 inches.

In some places darkened layers that are remnants of buried soils occur 24 to 48 inches or more below the surface. Layers of buried soils occur but are not typical of the Richfield soils, nor are they related to any features of the landscape.

*Tivoli series.*—The Tivoli series consists of light-colored, noncalcareous Regosols that formed in deep, wind-deposited sands. The soils have weakly developed profiles. They are on hummocky sand dunes that have been stabilized by the growth of perennial vegetation. These excessively well drained soils occupy an inextensive acreage in Scott County, mainly in the southeastern corner.

The Tivoli soils are more sandy and more deeply leached of lime than the Otero soils. They are lighter colored and less fertile than the Manter soils and have less distinct horizons.

Typical profile (145 feet north of the SW. corner of sec. 36, T. 20 S., R. 31 W., in native range):

- A1—0 to 4 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3.5/3) moist; weak, granular structure to massive; soft when dry, very friable when moist; noncalcareous; gradual boundary.
- AC—4 to 13 inches, brown (10YR 5/3) loamy fine sand to fine sand, brown (10YR 4/3) moist; single grained to massive; very soft when dry, very friable when moist; noncalcareous; gradual boundary.
- C—13 to 48 inches, near very pale brown (10YR 6.5/3) fine sand, brown (10YR 5/3) moist; single grained; loose and incoherent; noncalcareous.

The A1 horizon ranges from grayish brown to pale brown in color, from loamy fine sand to fine sand in texture, and from 2 to 7 inches in thickness. The AC horizon ranges from loamy fine sand to fine sand in texture and from 4 to 16 inches in thickness.

In many small, low, flat areas throughout these soils, the loamy fine sand and fine sand are less than 20 inches deep over olive-colored clay loam and clay that have not been reworked.

*Ulysses series.*—The Ulysses soils are Chestnut soils that intergrade toward Regosols. These deep, dark-colored, well-drained, granular soils developed in loess. They are scattered throughout the uplands, mainly on areas with nearly level to gentle slopes.

The Ulysses soils are slightly darker and deeper than the Colby soils. They are generally leached of lime to a

greater depth. They are less clayey and less strongly developed than the Richfield soils. They have a thinner A horizon than the Keith soils, are calcareous at a shallower depth, and have a more weakly developed profile. The Ulysses soils are less sandy than the Manter soils.

Typical profile (2,250 feet west and 92 feet north of the SE. corner of sec. 15, T. 18 S., R. 32 W., in a cultivated field with slopes of about 2 percent):

- Ap—0 to 4 inches, dark grayish-brown (10YR 4.5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard when dry, friable when moist; noncalcareous; clear boundary.
- B2—4 to 11 inches, dark grayish-brown (10YR 4.5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; hard when dry, moderately friable when moist; many fine pores; few scattered worm casts; noncalcareous; clear boundary.
- B3—11 to 16 inches, grayish-brown (10YR 5.5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; many fine pores and scattered worm casts; weakly calcareous; diffuse boundary.
- Cca—16 to 37 inches, pale-brown (10YR 6.5/3) light silty clay loam, brown (10YR 5/3) moist; massive; slightly hard when dry, friable when moist; strongly calcareous; films and small friable concretions of lime; diffuse boundary.
- C—37 to 56 inches, very pale brown (10YR 7/3) heavy silt loam, brown (10YR 5/3) moist; massive; soft when dry, very friable when moist; strongly calcareous.

The A horizon ranges from 3 to 7 inches in thickness and from silt loam to loam in texture. In some areas a weak textural B horizon is evident; the clay content ranges between 25 and 32 percent. Under native grass, the depth to calcareous material is as much as 15 inches, but in cultivated areas the soil may be calcareous throughout.

## *Climate*<sup>7</sup>

Scott County, located in the High Plains area of the Great Plains, has a dry but invigorating, continental climate. The area is deficient in rainfall because the moist air that flows northward from the gulf passes mostly to the east, and the Rockies to the west form a barrier to precipitation from the Pacific. Native short grasses and treeless plains are evidence of the deficient rainfall.

Wide ranges occur in daily, seasonal, and annual temperatures, but the range is favorable for human comfort. Intensive heat occurs sometimes in summer but is made bearable by low humidity and a prevalent breeze. High winds may intensify cold in winter, but the low humidity helps to make the chill less penetrating. There is much sunshine and almost constant wind.

Periods of hot, droughty weather alternate with those of greater precipitation and more moderate temperatures, but there is no regular pattern.

The more noticeable and frequent changes in weather are in spring and fall. In autumn the cold spells gradually intensify, but often during harvest there is a spell of fine Indian-summer weather. This pleasant weather gives

<sup>7</sup>By A. D. ROBB, State climatologist, U.S. Weather Bureau, Topeka, Kans.

way to low clouds and slow-falling, light rain or snow. In spring the cold spells wane and showers begin. Summer heat and thunderstorms follow.

Some precipitation records have been kept by the U.S. Weather Bureau in Scott County since July 1889. Temperature records, however, were not kept consistently until February 1906.

Temperature and precipitation data for the county are given in table 8. These data are based on records from

1945, all monthly totals for May and July were more than 0.25 inch, and 90 percent of the totals for May, June, and July were more than 0.75 inch. During May and June, 60 percent of the monthly totals were more than 2 inches. Only 2 percent of the January totals were more than 2.00 inches, and 60 percent were 0.25 inch or less (6).

Figure 21 shows the probability, in percent, of receiving 0.02, 0.20, 0.60, 1.00, and 2.00 inches or more of precipitation in any 1 week. The probabilities are based on data

TABLE 8.—Temperature and precipitation

Month	Temperature				Precipitation		
	Average daily <sup>1</sup> maximum	Average daily <sup>1</sup> minimum	Two years in 10 will have at least 4 days with—		Average monthly total <sup>3</sup>	One year in 10 will have—	
			Maximum temperature equal to or higher than <sup>2</sup> —	Minimum temperature equal to or lower than <sup>2</sup> —		Less than <sup>3</sup> —	More than <sup>3</sup> —
	°F.	°F.	°F.	°F.	Inches	Inches	Inches
January	44.2	16.1	62	-2	0.43	0.02	1.02
February	49.7	20.0	69	8	.68	.14	1.63
March	56.8	26.4	75	9	1.10	.10	2.33
April	67.8	37.3	85	25	1.84	.52	3.35
May	76.5	47.7	91	37	2.85	.76	5.22
June	87.3	58.0	101	47	3.14	.87	6.13
July	93.1	63.3	103	57	2.78	1.02	4.69
August	91.7	61.9	102	55	2.56	.70	5.23
September	83.8	52.9	97	38	1.53	.31	3.07
October	71.9	40.2	86	28	1.39	.11	2.80
November	57.0	26.3	73	12	.80	.02	2.17
December	45.6	18.9	65	8	.63	.05	1.35
Year	68.8	39.1	<sup>4</sup> 105	<sup>5</sup> -11	19.73	<sup>6</sup> 13.12	<sup>7</sup> 26.71

<sup>1</sup> Data in column for period 1906-61.

<sup>2</sup> Data in column for period 1937-61.

<sup>3</sup> Data in column for periods 1898-1902 and 1906-61.

<sup>4</sup> Average annual highest maximum.

<sup>5</sup> Average annual lowest minimum.

<sup>6</sup> Annual values less than.

<sup>7</sup> Annual values more than.

the U.S. Weather Bureau at Scott City. The columns entitled "Maximum temperature equal to or higher than" and "Minimum temperature equal to or lower than" show the expected frequency of given temperatures for each month. For example, although 114° F. is the highest temperature recorded in July, a temperature of 103° or higher may be expected on 4 days of July in only 2 years in 10. The same frequency is also expected in January for the temperature -2° or lower.

**Precipitation.**—Under "Precipitation" in table 8, the column headed "Average monthly total" shows that there is a regular increase from less than a half an inch in January to more than 3 inches in June, and then a gradual decrease to midwinter. Also, the monthly precipitation that can be expected 1 year in 10 is given. For example, a precipitation of 1.02 inches or less, or a precipitation of 4.69 inches or more, may be expected in July once in 10 years. The precipitation in the other 8 years ranges between the two given amounts.

Only three months on record have received as much as 10 inches of rainfall. August of 1933 had 10.70 inches; July 1950, the greatest monthly total, 13.48 inches; and June 1951, 11.33 inches. At the other extreme, all months except May, June, and July have once or more received less than a measurable total. During the period, 1889-

from the U.S. Weather Bureau at Healy, 4 miles east of this county in Lane County.

Figure 21 indicates a number of features not detected in monthly averages; for example, (1) the period of occurrence of the weekly amounts of precipitation; (2) the marked rate of increase through April, and the corresponding decrease during the last of August and most of September; and (3) the notable decrease in the probability of rain the last of June and first of July (4).

There is a better chance of receiving rain early in June and late in July than in the interim, and the chance of receiving precipitation in a week in mid-January is only one-third of that early in June. The chance of receiving weekly totals of 1 inch is almost negligible in midwinter; 2 inches would be exceptional.

Lack of sufficient precipitation through the crop-growing season, April-September is important. The crop growth and the need for irrigation in dryland farming areas depends on the rainfall during this period. On the average, at least one period of 30 consecutive days with not more than 0.25 inch of rainfall on any 1 day has occurred each summer. Such dry periods may continue for more than 30 days. In 1911, and again in 1922, there were 65 consecutive days without 0.25 inch of rainfall on any day (6).

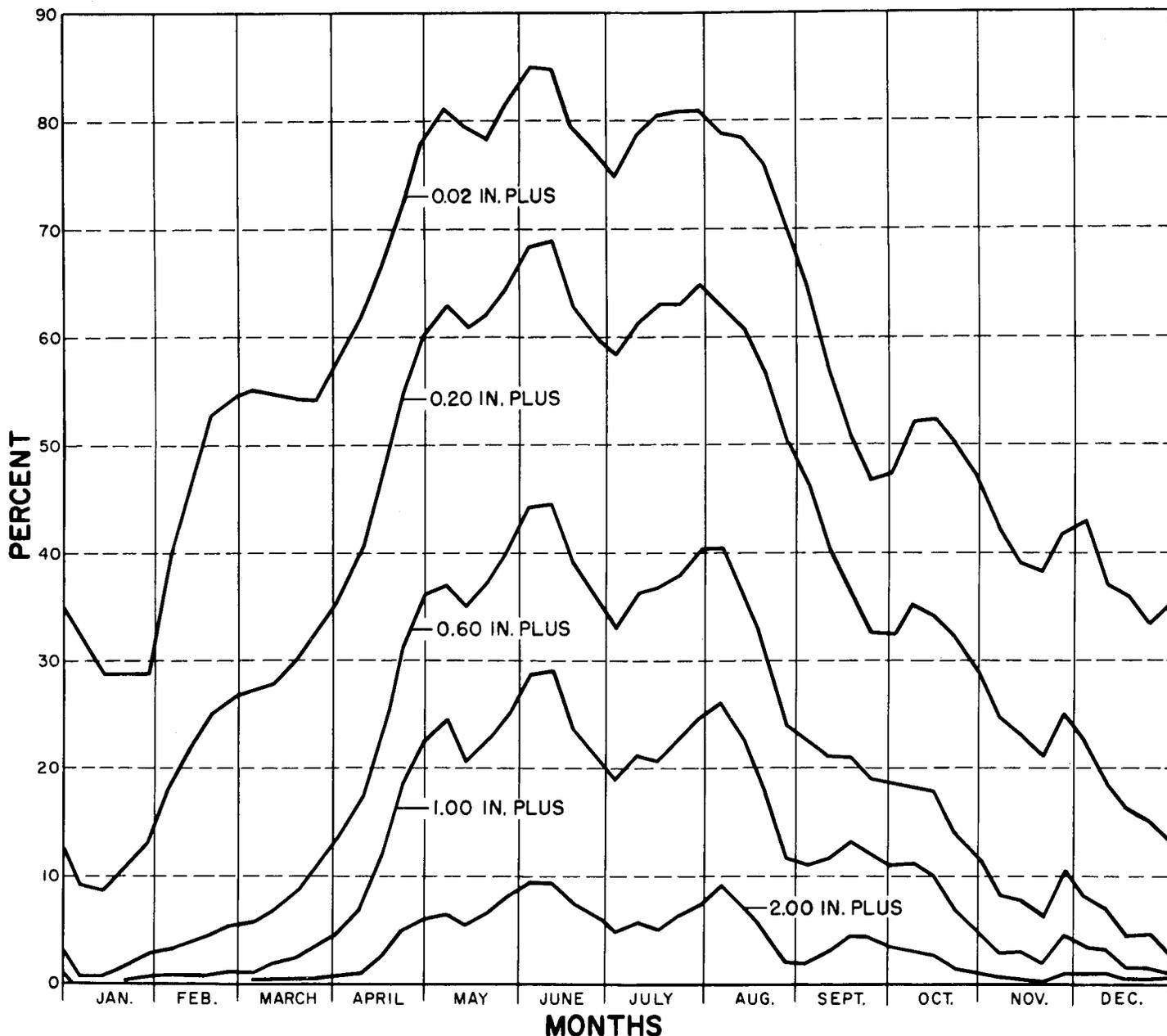


Figure 21.—The probability, in percent, of receiving stated amounts of precipitation in a 7-day period.

About three-fourths of the annual precipitation, however, falls during the growing season, April–September. This is a definite advantage to crop growth. Figure 22 shows the annual and crop-season precipitation at Scott City, Kans., based on records of the U.S. Weather Bureau, from 1898–1902, inclusive, and from 1906–61, inclusive. As shown by figure 22, in only 3 years, 1911, 1918, and 1946 (all dry years), more precipitation fell in the colder 6 months of the year than in the growing season. Also, only 4 years received 30 inches or more of precipitation. Consecutive summers that have heavy rains are limited. The rare exceptions occurred during 1949, 1950, and 1951, when the rainfall in the 6 summer months exceeded the

total of a normal year. Figure 22 also shows the number of consecutive dry summers having precipitation less than average for the growing season. The longest period of consecutive dry summers was 5 years, 1910–14, inclusive. The second longest period was of 4-year duration 1945–48, inclusive. There were 5 times when 3 consecutive summers had less than normal rainfall. Fortunately, an occasional wet period in one or more summers replenishes the water table.

As the need for summer rainfall is so important, the probability of receiving specified amounts of rainfall during the summer (April–September) is shown in figure 23,

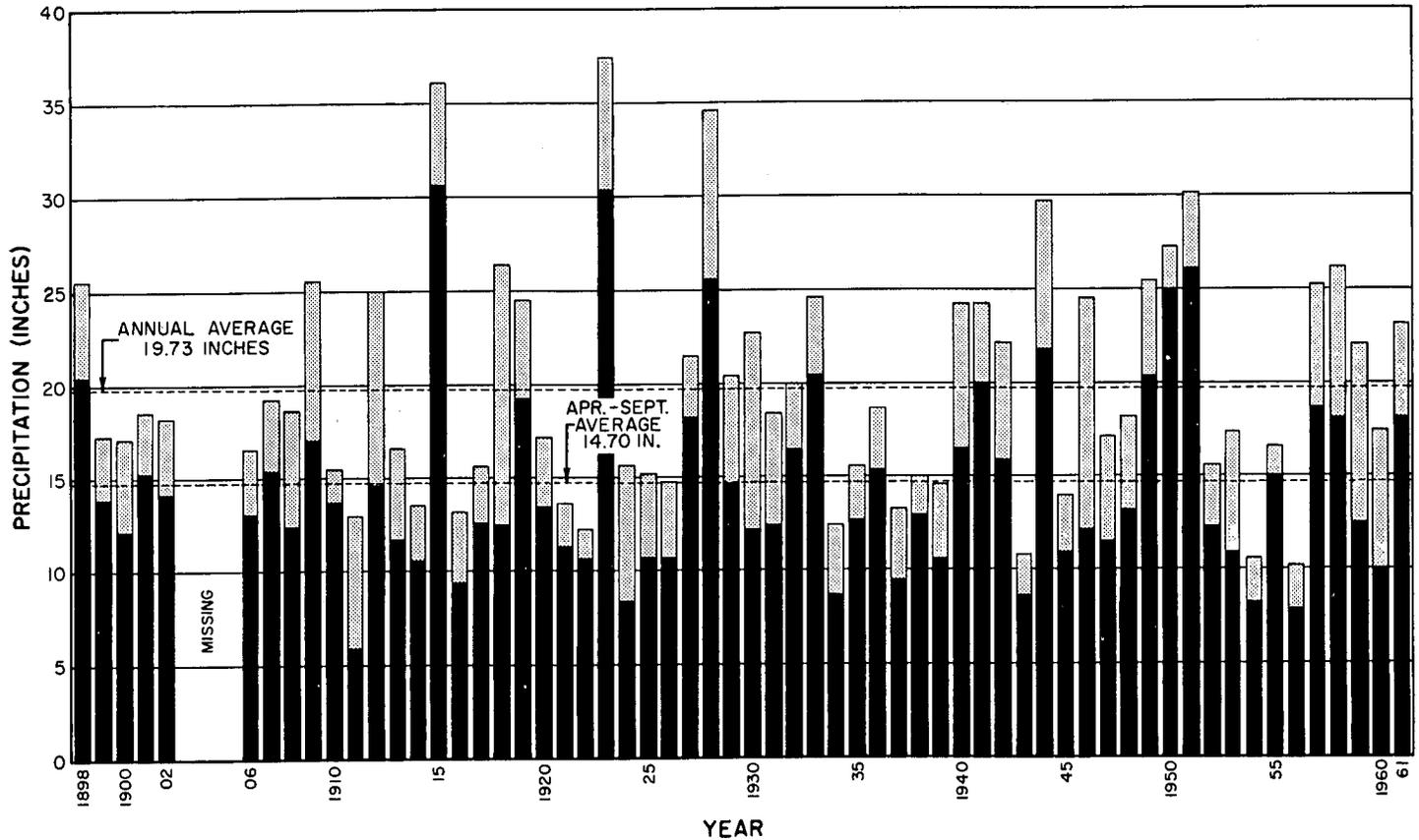


Figure 22.—Annual and crop-season precipitation at Scott City, Kans. The black, or lower, part of each bar shows the amount of precipitation during the growing season (April-September).

A total of 16.50 inches or more can be expected in about 25 percent of the summers. About an equal number of summers will have 10.00 inches or less, and rain in half the summers will range from 10.00 to 16.50 inches. The value of the rain is not only in the amount of the summer total. The frequency of the rain, the timeliness of significant amounts, the soil moisture, and the rate of evaporation are all important to the agriculture of the county.

Following are the 10 wettest years on record at the weather station at Scott City and the total amount of precipitation for each. The data were recorded during the periods 1898-1902 and 1906-61.

Year:	Amount of precipitation (Inches)	Year:	Amount of precipitation (Inches)
1923	37.93	1950	27.02
1915	36.15	1918	26.71
1928	34.23	1958	26.04
1951	30.31	1909	25.67
1944	29.92	1949	25.46

Following are given the 10 driest years on record at the weather station at Scott City and the total amount of precipitation for each. The data are for the periods 1898-1902 and 1906-61.

Year:	Amount of precipitation (Inches)	Year:	Amount of precipitation (Inches)
1956	10.15	1937	13.11
1943	10.38	1911	13.12
1954	10.93	1914	13.46
1922	12.22	1916	13.49
1934	12.65	1921	13.58

The rate of intensity of rainfall is a factor in building dams, waterways, culverts, and many other structures. The frequency of intensive rainfall in specified periods is shown in table 9 (10).

TABLE 9.—Frequency of intense rainfall

Duration	Amount of rain to be expected during time given at left, once in—						
	1 year	2 years	5 years	10 years	25 years	50 years	100 years
30 minutes	0.9	1.1	1.6	1.9	2.2	2.5	2.8
1 hour	1.2	1.4	2.0	2.4	2.8	3.2	3.5
2 hours	1.3	1.6	2.2	2.6	3.1	3.5	3.9
3 hours	1.4	1.8	2.3	2.8	3.2	3.7	4.1
6 hours	1.5	1.9	2.6	3.0	3.6	4.1	4.6
12 hours	1.7	2.2	2.9	3.5	4.1	4.6	5.2
24 hours	1.8	2.4	3.2	3.8	4.3	5.1	5.7

The most variable factor in weather is probably snowfall. In 52 seasons the greatest amount, 74 inches, was in the winter of 1911-12. In this winter December had 12.5 inches; February, 17.0 inches; and March, 32.5 inches. The lightest seasonal snowfall, 5.0 inches, fell in the winter of 1945-46. Of 52 seasons having complete records, 13 winters had 15 inches or less of snow; that is, light snow-

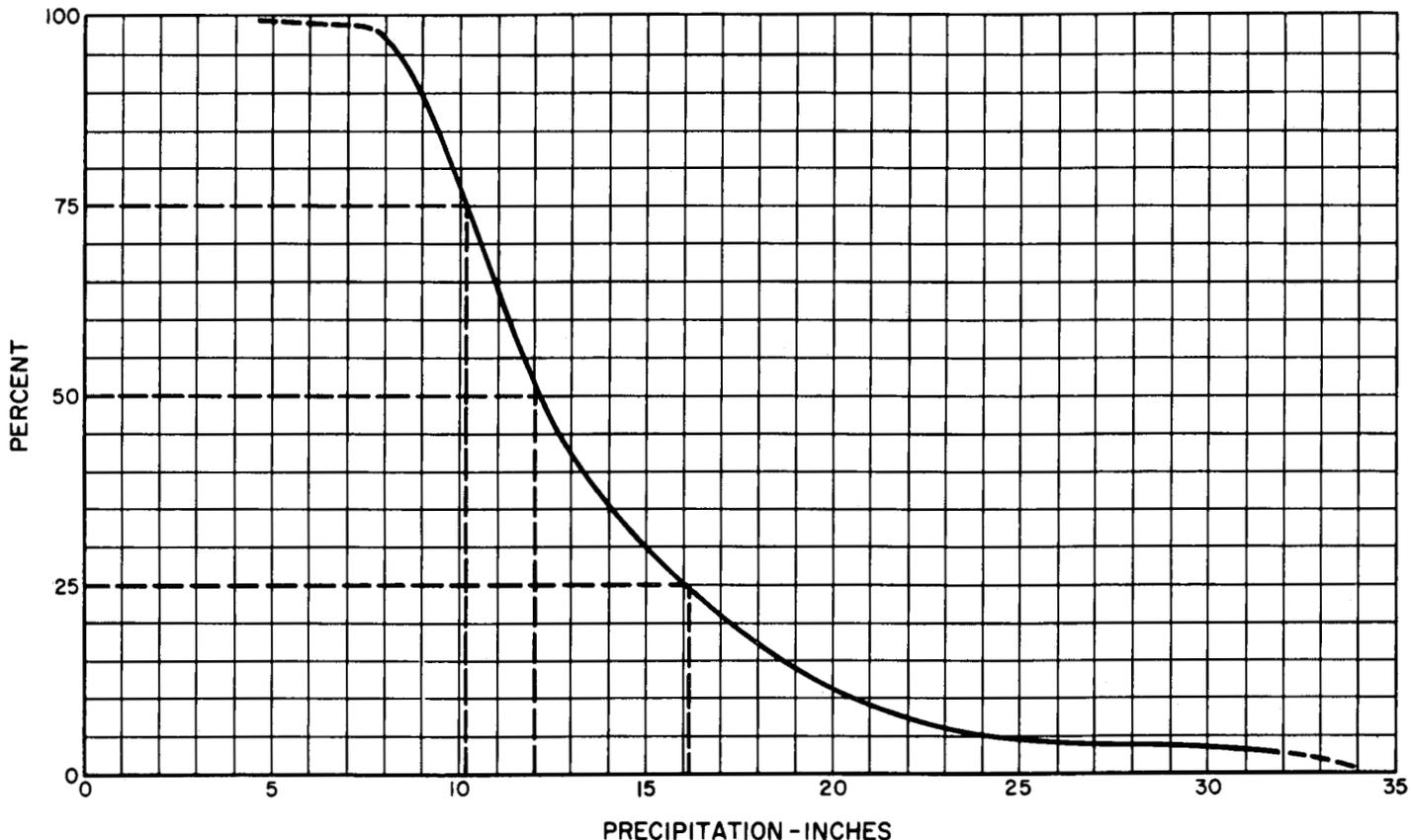


Figure 23.—Probability of receiving specified amounts of precipitation during the summer (April-September).

fall occurs about one-fourth of the time. About 1 winter in 7 has heavy snows of 45 inches or more. About three-fifths of the winters have from 15 to 45 inches, which is distributed throughout the winter season.

Much of the time the accompanying high winds drift the snow badly, but occasionally the even distribution provides good cover for wheat and moisture for the fields as the snow melts. One of the longest periods with a consistent snow cover was 39 days (December 23, 1939 to January 30, 1940).

*Temperature.*—Figure 24 shows the means and extremes of temperature, and the possible periods when a temperature of 100° F., 32°, or 0° will occur. The information is based on records of the U.S. Weather Bureau at Scott City during the period 1906-61. Also shown are the monthly highest and lowest temperatures on record and the dates of occurrence.

A much wider range in extremes of temperature has been recorded in the colder seasons than in summers. The period during which 100° temperatures have occurred is 18 days longer than the freeze-free period. The length of the period from the first recorded freeze of 32° in fall to the latest in spring is approximately 4 months longer than the period from the first zero temperature recorded to the last recorded.

During the period 1906-61, the maximum temperature recorded by the U.S. Weather Bureau at Scott City was 114° F. on July 13, 1913. The lowest temperature recorded during the same period was 26° below zero on January 12,

1912 and January 11, 1918. The absolute range in temperatures recorded was 140°. July 1934, with a mean maximum temperature of 101.5°, was the hottest month of record. This temperature exceeded by 0.5° that of August 1913, the only other month on record when the mean maximum temperature was 100° or higher.

Generally, the hottest summers are those with the greatest number of days having a maximum temperature of 100° or higher. Listed below are data for the three hottest summers:

Year:	<i>Number of days when the temperature was 100° or higher</i>
1934.....	44
1913.....	39
1936.....	38

Dates:	<i>Number of consecutive days when the temperature was 100° or higher</i>
July 8-22, 1934.....	15
July 29-Aug. 12, 1934.....	15
Aug. 3-9, 1913.....	7
Aug. 9-19, 1936.....	11

In 1934 the 6-day interlude between the two periods when the temperature was 100° or higher included 1 day with a temperature of 102°; 4 days in the 90's; and 1 day with a maximum temperature of 89°. Traces of rain fell on 3 days but provided little relief from the excessive heat.

Temperatures of 100° F. have occurred as early as May 6 (1916) and as late as September 22 (1944). No tem-

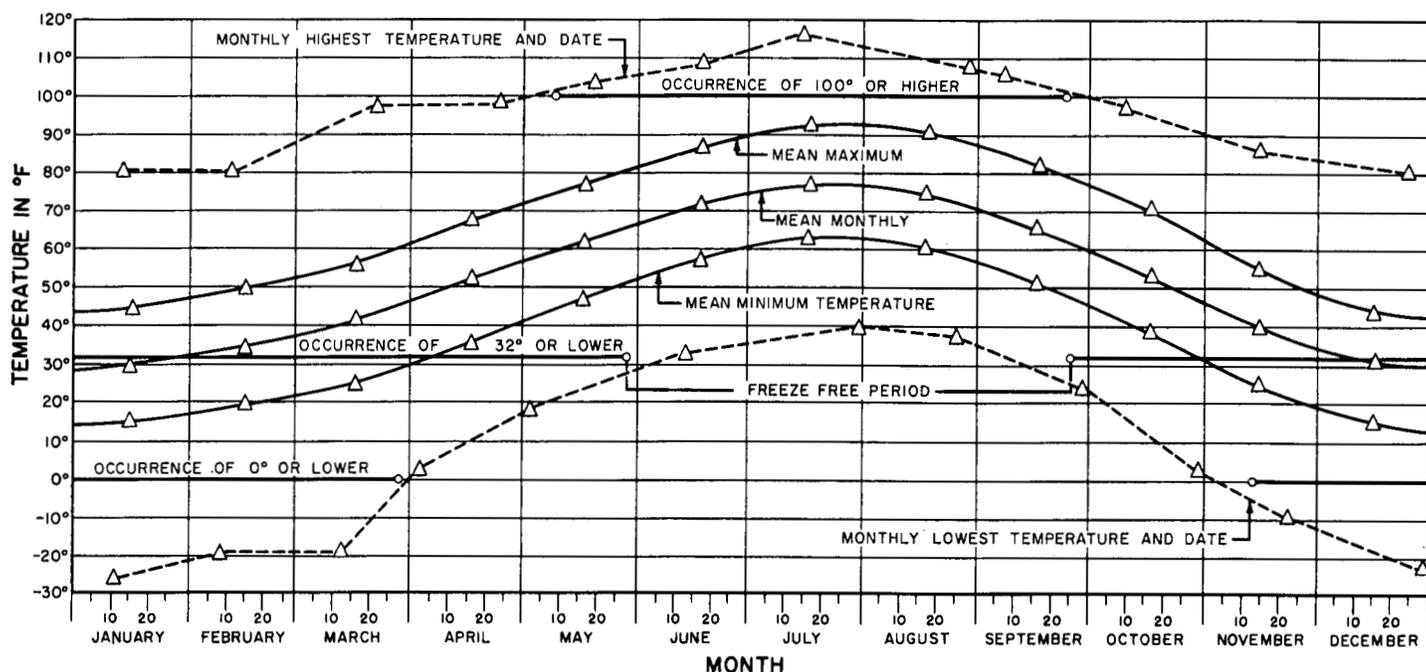


Figure 24.—Means and extremes of temperature at Scott City, Kans.

perature of 100° was recorded during the summers of 1915, 1923, and 1958.

The monthly mean minimum temperatures have been below 10° six times in January and twice in both February and December. From January through February 1929, the longest cold spell occurred—the mean minimum temperature was 11.3° in January and 9.1° in February. January 1930 had a mean minimum temperature of 4.5°.

Zero temperatures have occurred at least once each winter, except that of 1960–61, when the lowest temperature was 2° above zero. From November 14, 1916 through March 4, 1917, the temperature was zero or below during 18 days. In January 1913, beginning with January 1, there were 13 consecutive days when the temperature was zero or below. The preceding December (1912) had 4 consecutive days when the temperature was zero or below. The total for the winter was 17 days with zero readings. Zero temperatures have occurred as early as November 14 (1916 and 1959) and as late as March 27 (1931).

Winter days when the temperature does not rise above zero are rare. From mid-November to March 1, most nights have a temperature of 32° or below.

The probabilities of freezing temperatures in spring and fall are given in table 10 (3). Damaging freezes are not a great hazard in this area because the crops are adapted to the climate. Probably, the greatest hazard is an occasional freeze in early fall that damages grain sorghum that has not matured because planting was delayed by a cold spring. Freezing temperatures have occurred as early as September 25 (1961) and as late as May 27 (1907).

*Winds.*—Good air movement is one of the important factors in the weather. The annual windspeed averages about 14 miles per hour. The highest monthly average is about 17 miles per hour during March and April, and the lowest is 12 or 13 miles per hour during July and August.

Southerly winds prevail, especially in the warm season. Winds from the northwest are prevalent during the colder part of the year.

TABLE 10.—Probabilities of last freezing temperatures in spring and first in fall

[All data from Scott City for period 1906–58]

Probability	Dates for given probability and temperature				
	16° F., or lower	20° F., or lower	24° F., or lower	28° F., or lower	32° F., or lower
Spring:					
1 year in 10 later than.....	Apr. 11	Apr. 14	Apr. 20	May 3	May 17
2 years in 10 later than.....	Apr. 5	Apr. 8	Apr. 15	Apr. 28	May 12
5 years in 10 later than.....	Mar. 24	Mar. 29	Apr. 6	Apr. 18	May 2
Fall:					
1 year in 10 earlier than.....	Oct. 28	Oct. 25	Oct. 17	Oct. 8	Sept. 29
2 years in 10 earlier than.....	Nov. 3	Oct. 29	Oct. 21	Oct. 13	Oct. 3
5 years in 10 earlier than.....	Nov. 15	Nov. 9	Oct. 31	Oct. 22	Oct. 13

Soil erosion and snow drifting result from occasionally sustained high winds. Damaging winds include sudden thunderstorms, and those that are associated with wind and shift lines are particularly destructive to buildings.

Improved tillage practices, the use of cover crops, and management adapted to the climate have helped control soil erosion.

*Storms.*—On the average, nearly 50 thunderstorms occur yearly, but hail does the most damage. Hail in some quantity may be expected about four times yearly at any point in the area. Thunderstorms are most frequent early in the season—just before grain harvest in June. Hailstones range from those of the size of peas or marbles that are driven by strong winds and damage the grain harvest to those the size of walnuts or baseballs that damage livestock and buildings.

Tornadoes are not frequent, and because of the scattered population they have caused little loss of life or damage to property. Lightning damages mainly high-tension lines, small appliances, and livestock.

Severe winter storms consisting of fine snow, strong winds, and intense cold are also characteristic of weather in the Great Plains. Heavy snows and glaze storms in winter are hazards to traffic. Though blizzards are uncommon, they are threats to traffic in winter and to livestock on the open range.

### ***Additional Facts About the County***

Some of the general characteristics of the county are discussed in this section. These are history and population; relief and drainage; water supply; agriculture; community facilities; transportation and markets; and industries.

### **History and Population**

Before 1884 the area that is now Scott County was inhabited by Indians and nomadic stockmen. The first settlement was made in 1884. Most of the early settlers were cattlemen and farmers. It is believed that irrigation was started in the county about 1650 by the Taos Indians, who lived along Ladder Creek in an area now known as Scott County State Park. The Indians constructed a canal to divert water from the creek, vestiges of which can still be seen. There are ruins of the old pueblo of El Quartejejo north of Scott City in the Scott County State Park. The pueblo was established about 1702 by the Pueblo Indians from New Mexico.

Since 1888 water has been pumped from wells. Windmills were first used to pump water for irrigating alfalfa patches and small gardens. A canal was built before 1900 that extended from the Arkansas River into Scott County. This canal was discontinued because there was not enough water to justify the cost of operation.

Scott County was named for Gen. Winfield Scott, a hero of the Mexican War. The county was created in 1873 and was organized on June 29, 1886. The chief town and county seat, now Scott City, was founded in 1885 as Scott Center.

Construction of the Santa Fe Lines to Garden City (Finney County) toward the south in the early 1870's opened the area to settlers. Both the Santa Fe and Missouri Pacific railroads were built to Scott City in 1887.

The population decreases rapidly during prolonged droughts but increases as new settlers arrive during pe-

riods when rainfall is adequate to produce crops. In 1886 the population of the county was 2,675; in 1950, 4,921; and in 1960, 5,228. In 1961 the population of Scott City was 3,754.

### **Relief and Drainage**

Scott County lies in the central part of the High Plains in the Great Plains physiographic province. It occupies the high, nearly level tablelands between the drainage areas of the Arkansas and Smoky Hill Rivers. Elevations in the county range from about 3,160 feet in the western part to about 2,815 feet in the northeastern corner. The land slopes gently to the southeast, about 12 feet to the mile.

White Woman and Ladder (Beaver) Creeks rise in eastern Colorado and flow intermittently into the county from the west (fig. 25). Ladder Creek enters the northwestern part of the county, flows eastward about halfway across the county, turns abruptly to the north, and intercepts the Smoky Hill River (Logan County). White Woman Creek enters the county in the southwestern part. It flows northeast, then empties into the Scott (White Woman) Basin, a large, depressed area that makes up the most northern part of the Scott-Finney depression. Along the northern county line, a few, small drainageways drain northward into the Smoky Hill River.

Sand Creek enters the county a few miles south of White Woman Creek and empties into this creek. Lion Creek and Rocky Draw enter the county between Ladder and White Woman Creeks and empty into the Scott-Finney depression.

The eastern part of the county slopes eastward, and excess water drains into Lane County. A large depression, known as Dry Lake, covers about 430 acres and is surrounded by soils in nearly level depressions. Water from an area of several square miles drains into Dry Lake.

Most of the southeastern part of the county has undulating topography. It includes small areas of sandhills made up of large dunes. In general, the uplands consist of broad, nearly level areas with many small, shallow depressions.

### **Water Supply**

Water is obtained from wells drilled into the huge reservoir of ground water in the Ogallala formation. The depth to the water table in the uplands ranges from about 25 to more than 150 feet. The water-bearing material ranges from about 20 to 150 feet in thickness.

Except in small areas in the northern and southeastern parts, wells supply enough water for domestic use and for watering livestock. A large amount of irrigation water for field crops is obtained northwest of Scott City and in the Scott-Finney depression, but a limited amount is obtained in the southwestern and southeastern parts. Although satisfactory for domestic purposes and for watering livestock, the water from wells drilled in the Ogallala formation is moderately hard.

In some areas in the uplands, small dams were constructed across intermittently flowing streams to impound water for livestock. In the northern part of the county, water from springs is used to supply homes and livestock.

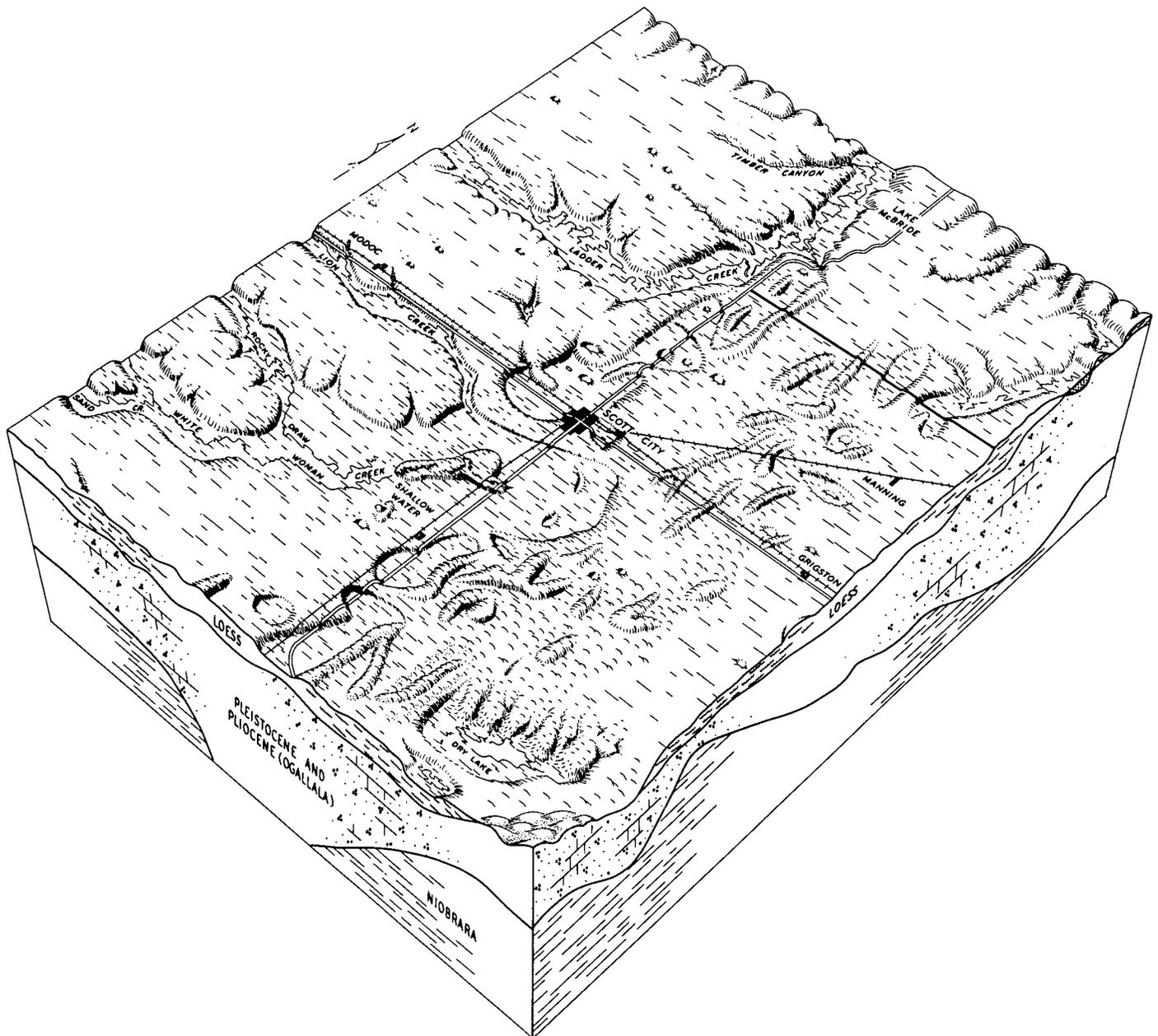


Figure 25.—Landscape of Scott County, Kans.

## Agriculture

Until the First World War, the agriculture of the area was mostly a subsistence type of farming, but there were some large ranches. Native grass covered most of the soil. Grain and forage for domestic livestock were the main crops. After the tractor was used for farm power, more grassland was plowed and wheat became an important crop. Large acreages were plowed in the late 1920's and in the 1940's.

The farming in the county is on a large scale and is highly mechanized. Most of the cultivated land is planted in wheat and sorghum.

Farmers became concerned about soil erosion and land deterioration during the droughts and duststorms in the

1930's. In 1944 the farmers and landowners organized the Scott County Soil Conservation District. The district was formed to promote practices for conserving soil and water, such as terracing, contour farming, stubble-mulch farming, stripcropping, and proper irrigation.

*Crops and range.*—Wheat and sorghum, the only important crops in this section of the High Plains, are usually grown in a cropping system that allows the land to be fallow every other year. During the fallow period, moisture is stored for use by the following crop, and weeds are controlled to conserve moisture. High yields are obtained during the years when rainfall is normal or above normal. Crop failures, or near failures, are common during years when rainfall is below average. The acre-

age of principal crops planted in stated years is given in table 11.

TABLE 11.—*Acreage of principal crops planted in stated years*<sup>1</sup>

Crop	1944	1950	1955	1960
Wheat.....	142,000	154,000	124,000	126,000
Sorghum:				
Grain.....	27,780	36,990	41,200	80,000
Forage.....	13,460	12,510	37,200	6,000
Corn.....	700	300	3,600	6,000
Barley.....	30,180	9,300	3,500	5,800
Alfalfa.....	930	1,320	3,910	1,900
Prairie hay.....	20	20	100	50
Oats.....	1,560	250	80	100
Sugar beets.....	860	700	( <sup>2</sup> )	( <sup>2</sup> )
Irish potatoes.....	295	15	( <sup>2</sup> )	( <sup>2</sup> )

<sup>1</sup> Based on biennial reports of the Kansas State Board of Agriculture.

<sup>2</sup> Not reported.

In 1940 about 17,000 acres were irrigated. The acreage of irrigated land increased to about 80,000 acres in 1961. The principal crops grown under irrigation are corn, wheat, sorghum, and alfalfa.

About 24 percent of the acreage of Scott County is in native grass and is used for range. Most of this land is nonarable or marginal for cultivation.

**Livestock.**—The raising of livestock, mainly feeder-stocker cattle, is the second largest agricultural enterprise in Scott County. There are a few cattle-breeding herds. During fall and spring, the number of cattle and sheep is usually high, particularly following favorable growing seasons. These animals are brought in from other areas in the State and from other States when wheat pasture or sorghum stubble, or both, are available. In the past few years, the number of cattle fed in feedlots has greatly increased. The number of livestock in the county in stated years is shown in table 12.

TABLE 12.—*Number of livestock on farms in stated years*<sup>1</sup>

Livestock	1944	1950	1955	1960
Horses and mules.....	900	640	680	550
Milk cows.....	2,030	820	1,000	600
Other cattle.....	25,740	29,980	25,500	38,400
Sheep.....	3,610	17,100	7,770	11,720
Swine.....	4,580	1,600	1,250	2,000
Chickens.....	55,740	48,700	25,000	12,000

<sup>1</sup> Based on biennial reports of the Kansas State Board of Agriculture.

**Tenure and size of farms.**—In 1959, according to the Federal census, there were 397 farms in the county, and the average farm was more than 1,300 acres in size. A few farmers own all the land they farm. It is common, however, for one operator to rent additional land from four or more owners. According to the census, 50 operators were full owners; 216, part owners; 130, tenants; and 1 was a manager. Leasing arrangements are usually on a crop-share basis. Part of the land is owned by people who live outside the county.

**Farm equipment and labor.**—Tillage and harvesting is done entirely with mechanically powered equipment. Generally, the industrial type wheeled tractor is used. Wheat and grain sorghum are harvested with large, self-propelled combines. Most farmers own enough equipment for tillage and planting, but some must hire all or part of the machinery for harvesting. Custom operators from outside the area usually furnish much of the labor and most of the combines and trucks necessary for harvesting grain crops.

The demand for labor is seasonal. The local labor supply is about adequate for planting and tillage, but transient labor is generally needed during the harvest. Irrigation farming and feeder-cattle operations require hired help the year round.

## Community Facilities

There are seven elementary schools in the county, two of which are in rural areas. The high schools and churches are located in the towns of Scott City and Shallow Water. Scott City also has a hospital.

In 1930 the Scott County State Park was opened by the Kansas Forestry, Fish, and Game Commission in the northern part of the county. This park, consisting of 1,280 acres and a 110-acre lake (Lake McBride), offers facilities for fishing, picnicking, and camping.

## Transportation and Markets

Except in some areas of sandy land and in deeply entrenched drainageways, there are improved roads throughout the county. U.S. Highway No. 83 passes through Scott City. Kansas Highway No. 96 crosses the county from east to west. It intersects U.S. Highway No. 83 at Scott City. Motortruck lines use both highways.

The Missouri Pacific Railroad passes through Manning, Scott City, and Modoc. A branch line of the Santa Fe Lines passes through Shallow Water, Scott City, and Grigston.

Most farm products, chiefly wheat and grain sorghum, are marketed locally. Scott City, Shallow Water, Modoc, Grigston, and Manning have facilities for handling and storing grain; the grain is shipped by railroad and truck to the terminal elevators and markets to the east. Beef cattle and sheep are marketed outside the county.

## Industries

The production, collection, refining, and transportation of oil is the only important nonagricultural industry in the county. The first well in the Shallow Water oil pool began production in December 1934. Crude oil from this oil pool and from pools in other counties is processed at a refinery in Scott County.

Sand and gravel used locally for road surfacing are obtained in limited amounts along Ladder (Beaver) Creek and in the Scott-Finney depression. Calcareous beds of hard caliche of the Ogallala formation are used in places for road surfacing.

Electricity is produced by a plant near Scott City. This plant furnishes power for most of the county and parts of surrounding counties.

One company carries on research and development of hybrid corn, forage and grain sorghum, wheat, barley, and alfalfa. The buying, selling, and distribution of agricultural products are important enterprises in the county.

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## Glossary

**Aggregate, soil.** Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

**Alkali soil.** Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern.

**Buried soil.** The soil of an original land surface that is buried to considerable depths by subsequent geologic deposition.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly if treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

**Colluvium.** Mixed deposits of soil material and rock fragments, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

*Loose.*—Noncoherent; will not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Indurated.*—Very strongly cemented; brittle; does not soften under prolonged wetting, and is so extremely hard that for breakage a sharp blow with a hammer is required.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

**Deep soil.** Generally a soil deeper than 40 inches to rock or other strongly contrasting material.

**Drainage, natural.** Refers to moisture conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

*Well-drained* soils are nearly free from mottling and are commonly of intermediate texture.

*Imperfectly or somewhat poorly drained* soils are wet for significant periods but not all the time, and in podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

*Poorly drained* soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

**Eolian soil material.** Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

**Genesis, soil.** The manner in which the soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

**Gilgai.** The microrelief of those 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 slopes.

**Horizon, soil.** A layer of soil approximately parallel to the surface that has distinct characteristics produced by soil-forming processes.

**Krotovina.** A former animal burrow in one soil horizon, which has been filled with material from another horizon.

**Loam.** Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

**Loess.** Geological deposit consisting of fairly uniform, fine material, mostly silt, that presumably was transported by wind.

**Morphology, soil.** The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

- Mottled.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.
- Phase, soil.** The subdivision of a soil type having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of the soil types are differences in slopes, stoniness, and erosion.
- Profile, soil.** A vertical section of the soil extending from the surface into the parent material.
- Relief.** The elevation or inequalities of a land surface considered collectively.
- Saline soil.** A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.
- Sand.** Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.079 inch). Most sand grains consist chiefly of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.
- Sandy clay.** Soil material that contains 35 percent or more clay and 45 percent or more sand.
- Sandy clay loam.** Soil material that contains 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.
- Sandy loam.** Soil material that contains either 20 percent clay or less, and the percentage of silt plus twice the percentage of clay exceeds 30, and 52 percent or more sand; or less than 7 percent clay, less than 50 percent silt, and between 43 percent and 52 percent sand.
- Series, soil.** A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.
- Silt.** Small mineral soil grains ranging from 0.05 millimeter (0.002 inch) to 0.002 millimeter (0.000079 inch) in diameter. Soils of the textural class silt contain 80 percent or more of silt and less than 12 percent of clay.
- Silt loam.** Soil material that contains 50 percent or more silt and 12 to 27 percent clay (or) 50 to 80 percent silt and less than 12 percent clay.
- Silty clay.** Soil material that contains 40 percent or more clay and 40 percent or more silt.
- Silty clay loam.** Soil that contains 27 to 40 percent clay and less than 20 percent sand.
- Slick spots.** Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.
- Soil.** A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.
- Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in a mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.
- Structure, soil.** The natural arrangement or aggregation of primary soil particles into compound particles, or aggregates. Soil structure is classified according to grade, class, and type.
- Grade.** Degree of distinctness of aggregation. Grade expresses the differential between cohesion within aggregates and adhesion between aggregates. Terms: Structureless (single grain or massive), weak, moderate, and strong.
- Class.** Size of soil aggregates. Terms: Very fine or very thin, fine or thin, medium, coarse or thick, and very coarse or very thick.
- Type.** Shapes of soil aggregates. Terms: Platy, prismatic, columnar, blocky, subangular blocky, granular, and crumb.
- Subsoil.** That part of the soil profile commonly below plow depth and above the parent material. It may be the B horizon in soils with distinct profiles.
- Substratum.** Any layer lying beneath the solum or true soil. A term applied to the parent material, or to other layers unlike the parent material that lie below the B horizon, or subsoil.
- Surface soil.** Technically, the A horizon; commonly, the part of the upper profile usually stirred by tillage implements.
- Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."
- Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.
- Topsoil.** A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.
- Type, soil.** A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.
- Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places, an upper, or perched, water table may be separated from a lower one by a dry zone.

## GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 6, for approximate acreage and proportionate extent of the soils; table 2, p. 25, for expected average yields per acre of wheat and grain sorghum grown under dryland farming on soils suited to cultivation; and tables 5 and 6, pp. 36 and 40, for engineering uses of the soils]

Map sym- bol	Mapping unit	Page	Capability unit				Range site	
			Dryland	Page	Irrigated	Page	Name	Page
An	Alluvial land-----	5	VIw-1	24	(1/)		Loamy Lowland	29
Bd	Badland-----	6	VIIIIs-1	24	(1/)		(2/)	
Bl	Bayard fine sandy loam, loamy substratum-----	6	IIIe-2	22	IIs-1	28	Sandy	30
Br	Bridgeport loam-----	7	IIc-1	21	I-1	27	Loamy Upland	29
Ch	Church silty clay loam-----	7	IVs-1	23	IIIs-1	28	Saline Upland	30
Cd	Colby silt loam, 5 to 15 percent slopes-----	8	VIe-1	23	(1/)		Limy Upland	30
Dr	Dalhart-Richfield complex, 1 to 3 percent slopes-----	8	IIIe-2	22	IIe-1	27	Dalhart soil, Sandy; Richfield soil, Loamy Upland.	29
Go	Goshen silt loam-----	9	IIc-2	22	I-1	27	Loamy Lowland	29
Ka	Keith silt loam, 0 to 1 percent slopes-----	10	IIc-1	21	I-1	27	Loamy Upland	29
Lu	Lubbock silty clay loam-----	10	IIc-2	22	I-1	27	Loamy Lowland	29
Mm	Mansker-Potter complex-----	11	VIe-3	23	(1/)		Mansker soil, Limy Upland; Potter soil, Breaks.	30
Mn	Manter fine sandy loam, 0 to 1 per- cent slopes-----	11	IIe-2	21	IIs-1	28	Sandy	30
Mr	Manter fine sandy loam, undulating---	11	IIIe-2	22	IIe-1	27	Sandy	30
Mw	Marsh-----	11	Vw-1	23	(1/)		Saline Subirrigated	30
Of	Otero fine sandy loam, undulating---	12	IVe-2	23	(1/)		Sandy	30
Oh	Otero soils, hummocky-----	12	VIe-2	23	(1/)		Otero loamy fine sand and Tivoli loamy fine sand, Sands; Otero fine sandy loam, Sandy.	30
Po	Potter soils-----	12	VIIIs-1	24	(1/)		Breaks	30
Ra	Randall clay-----	13	VIw-2	24	(1/)		(3/)	
Rb	Randall clay, occasionally flooded---	13	VIw-2	24	IVw-1	28	(3/)	
Rm	Richfield silt loam, 0 to 1 percent slopes-----	14	IIc-1	21	I-1	27	Loamy Upland	29
Rn	Richfield silt loam, 1 to 3 percent slopes-----	14	IIe-1	21	IIe-2	27	Loamy Upland	29
Ts	Tivoli loamy fine sand-----	15	VIe-2	23	(1/)		Sands	30
Ua	Ulysses silt loam, 0 to 1 percent slopes-----	15	IIc-1	21	I-1	27	Loamy Upland	29
Ub	Ulysses silt loam, 1 to 3 percent slopes-----	15	IIIe-1	22	IIe-2	27	Loamy Upland	29
Uc	Ulysses silt loam, 3 to 5 percent slopes-----	16	IVe-1	22	(1/)		Loamy Upland	29
Ue	Ulysses-Colby sil- loams, 1 to 3 percent slopes, eroded-----	16	IIIe-1	22	IIe-2	27	Limy Upland	30
Um	Ulysses-Colby silt loams, 3 to 5 percent slopes, eroded-----	16	IVe-1	22	(1/)		Limy Upland	30
Us	Ulysses silt loam, saline, 0 to 1 percent slopes-----	16	IIIs-1	22	IIs-2	28	Saline Upland	30

1/

Unsuitable for irrigation.

2/

This land type is mostly barren rock; therefore, it has no range site.

3/

Because the soil and vegetation are unstable, this soil has not been placed in a range site.

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