SOIL SURVEY

Sedgwick County Colorado

OUR SOIL ★ OUR STRENGTH

Issued December 1969

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
COLORADO AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1956–63. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station; it is part of the technical assistance furnished to the Sedgwick County Soil Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

Interpretations not given in this publication can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

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

Game managers and sportsmen can find information of interest in the section "Use of the Soils for Wildlife."

Ranchers and others interested in range can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and descriptions of the vegetation on each range site.

Community planners and others concerned with recreational development can find in the section "Use of the Soils for Recreation" information about the relative limitations of different parts of the county as hunting areas, as sites for cottages and camps, and as locations for picnic grounds and other vacation facilities.

Engineers and builders will find, under "Engineering Uses of the Soils," tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

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

Newcomers in Sedgwick County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

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BY JOHN I. BRUBACHER and TOM R. MOORE, SOIL CONSERVATION SERVICE

FIELDWORK BY JOHN I. BRUBACHER, TOM R. MOORE, CLAYTON F. SPEARS, and EVERETT E. GEIB, SOIL CONSERVATION SERVICE

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

SEDGWICK COUNTY is in the far northeastern corner of Colorado (fig. 1). Its total land area is 348,160 acres, or 544 square miles. The county is about 31 miles wide from east to west and about 17 miles long from north to south. Julesburg is the county seat.

This county is characterized by a mild climate, a 143-day average growing season, a 16.3-inch average yearly rainfall, altitudes betwen 3,435 and 4,100 feet above sea level, and, except in the sandhills and the low hills adjacent to the valley of the South Platte River, level to slightly rolling topography. The northern part of the county is drained by the South Platte River and its tributaries, and the southern part by Sand Creek and numerous other small drainageways, which are in the watershed of the Republican River. Water from the South Platte River is stored in the Julesburg Reservoir and is used to irrigate a substantial acreage in the valley of the South Platte River.

More than 6 percent of the acreage is irrigated, and 55 percent is dryfarmed. One-third of the farms are partly or entirely irrigated. Alfalfa, sugar beets, corn, potatoes, and beans are among the important irrigated crops. Winter wheat, sorghum, and corn are the major crops on nonirrigated farms. The sandhills and the moderately steep areas adjacent to the valley of the South Platte River are used for grazing beef cattle.

How This Survey Was Made

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

They went into the county knowing they were likely to find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rocks; and many facts about the soils. They dug or bored 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 publication efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Haxtun and Keith, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a

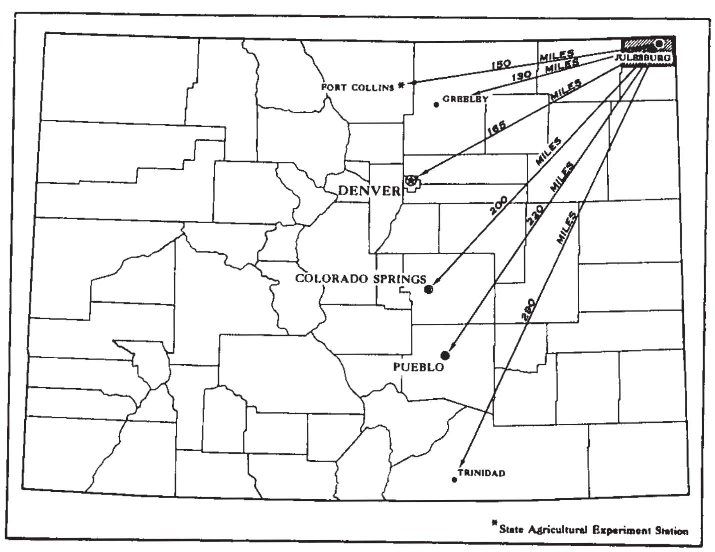

Figure 1.—**Location of Sedgwick County in Colorado.**

series, all the soils having a surface layer of the same texture belong to one soil type. Haxtun loamy sand and Haxtun sandy loam are two soil types in the Haxtun series. The difference in the texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Haxtun loamy sand, 0 to 1 percent slopes, is one of three phases of Haxtun loamy sand, a soil type that has a slope range of 0 to 5 percent.

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

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. They show such a 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, Keith-Kuma silt loams, 0 to 3 percent slopes.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences are so slight that the separation is not important for the objectives of the survey. An example of an undifferentiated group is Keith, Goshen, and Kuma silt loams, 0 to 3 percent slopes.

Also, most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units but are given descriptive names, such as Sandy alluvial land or Slickspots, and are called land types.

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 predicted for some of the soils.

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

General Soil Map

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

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The six soil associations in Sedgwick County are described in this section. Terms for texture used in the title of an association apply to the surface layer. For example, in the title of association 1, the word "loamy" refers to texture of the surface layer. More detailed information about the individual soils in each association can be obtained by studying the detailed map and by reading the section "Descriptions of the Soils."

1. Rago-Richfield-Kuma association

Deep, nearly level to gently sloping, loamy soils on uplands

This association is characterized by slopes of less than 1 percent. Only the areas adjacent to and parallel to the drainageways have slopes of more than 2 or 3 percent. There are numerous small potholes and playas. This association occupies a small area north of Sedgwick and a large area that includes much of the southern and eastern parts of the county, south of the South Platte River. The total area is about 186,000 acres, or 52 percent of the county.

Rago soils make up about 31 percent of this association. Richfield soils about 30 percent, Kuma soils about 19 percent, and playas and potholes 5 percent. The rest is made up of Keith and Goshen soils, which are generally in slight depressions and along minor draingeways; Wages soils, which are in the more sloping areas; and Campus soils, which are in the extreme southeastern part of the association.

Rago soils have a surface layer of very dark gray silt loam and a subsoil of dark-gray or dark grayish-brown loam over black clay loam. The lowermost layer of the subsoil is light olive-brown loam. Whitish nodules and threadlike filaments of lime are visible at a depth of about 2½ feet.

Richfield soils have a surface layer of very dark grayish-brown loam over very dark grayish-brown clay loam. The subsoil is very dark grayish-brown clay loam over dark grayish-brown loam and is limy at a depth of about 20 inches.

Kuma soils have a surface layer of very dark grayish-brown silt loam and a subsoil of silt loam that is dark brown in the uppermost layer, black in the next layer, and brown below this. The lowermost layer of the subsoil contains a moderate amount of accumulated lime below a depth of about 3 feet.

This association is used mostly for cultivated crops, but a few small areas are used for grazing. The farms generally are 500 to 1,000 acres in size and have modern, well-maintained dwellings. The major risks are inadequate rainfall and hailstorms. The potholes and playas interfere with cultivation. Irrigation is feasible, and at the time this survey was completed, four deep wells were supplying water for irrigation. Winter wheat is the main crop. Other common crops are barley, grain sorghum, forage sorghum, and grass, dominantly blue grama.

2. *Keith-Tripp-Bridgeport association*

Deep, nearly level to very gently sloping, loamy soils on river terraces

This association occupies most of the slightly higher parts of the terraces north of the South Platte River. Near the river, the slope is generally 1 to 3 percent, but in many fields it is less than 1 percent. The total area is about 27,000 acres, or 8 percent of the county.

Keith and Tripp soils together make up about 51 percent of this association, and Bridgeport soils about 18 percent. Of the minor soils, Chappell soils, which are in the more gravelly areas near the terrace edges, make up about 17 percent of the association; Haxtun soils, which are mainly east of Ovid where wind has deposited sand on loamy terraces, make up about 6 percent; Haverson soils, which occur along the drainageways, about 5 percent; and very small areas of Wet alluvial land and Wann and Eckley soils the remaining 3 percent.

Keith soils are deep and well drained. They have a surface layer of very dark grayish-brown loam and a subsoil of very dark brown to dark grayish-brown loam.

Tripp soils are deep and well drained. They have a surface layer of very dark brown loam and a subsoil of very dark brown clay loam over dark grayish-brown loam.

Bridgeport soils, which are set at the higher elevations, are deep and well drained. They have a surface layer of very dark grayish-brown loam, and the underlying material is dark grayish-brown loam.

Nearly all of this association is irrigated and used as cropland. In most years the supply of irrigation water is adequate. Most of the fields have been leveled so water can be spread evenly. The risk of erosion is slight except when unusually severe flooding occurs. Deposition causes more damage than erosion. Sugar beets, corn, alfalfa, potatoes, onions, beans, and barley are important crops.

3. *Alluvial land association*

Deep to shallow, nearly level, somewhat poorly drained to poorly drained soils on flood plains and low terraces

This association consists of nearly level soil materials on bottom lands and low terraces along the South Platte River where surface runoff is generally slow. Most areas are flooded occasionally, and some are flooded frequently. The water table is high in many areas, and outlets for drainage are lacking. The total area is 18,000 acres, or 5 percent of the county.

Slickspots make up about 45 percent of this association, and Wet alluvial land about 35 percent. Of the minor soils, Lamo soils, which are somewhat poorly drained, make up about 7 percent; Las soils, which have a fluctuating water table at a depth of 14 to 30 inches, about 4 percent; and Bridgeport, McCook, Haverson, Elsmere, and Wann soils and Sandy alluvial land make up the remaining 9 percent.

Slickspots are the deep part of the association. They consist of dark-colored, somewhat poorly drained, salty soil materials. At the surface is a very thin layer of loam. Below this is silty clay loam, in which white streaks and splotches of free lime and other salts are visible.

Wet alluvial land consists of shallow deposits of sandy and gravelly soil materials. It is wet most of the time because it is frequently flooded and surface runoff is slow. The surface is undulating.

Most of this association is grazed, but some of it is cultivated. The major limitations are lack of drainage outlets and lack of flood protection. All of the cultivated areas are irrigated, but the crops are likely to be chlorotic and the stand poorer than those in other irrigated areas of the county because of the salinity and the high water table. The main crops are sugar beets, barley, corn, alfalfa, and, in grazing areas, salt-tolerant grasses, rushes, and sedges. Cottonwood trees are abundant on Wet alluvial land.

4. *Valentine association*

Deep, undulating to hilly, sandy soils on uplands

This association consists of sandhills and long, narrow valleys (fig. 2). Most of it is in the west-central part of the county, but a small area is in the north-central part, a few miles west of Julesburg. The total area is about 27,000 acres, or 8 percent of the county.

Valentine soils make up nearly 80 percent of this association. Of the minor soils, Dunday soils make up about 10 percent of the association, and Haxtun, Julesburg, and Ascalon soils, which are in the valleys, together make up about 10 percent.

Valentine soils have a 3-inch surface layer of very dark grayish-brown over dark-brown fine sand. The underlying material is dark grayish-brown fine sand over pale-brown sand.

Dunday soils have a 9-inch surface layer of very dark grayish-brown fine sand or loamy fine sand and a transitional layer of dark grayish-brown loamy fine sand. The underlying material is yellowish-brown fine sand.

This association is almost entirely range. Wind erosion is likely wherever the plant cover is depleted or destroyed. There are some blowouts. The native vegetation was sand-reed, sand bluestem, needle-and-thread, little bluestem, which is the most common species, and other tall grasses.

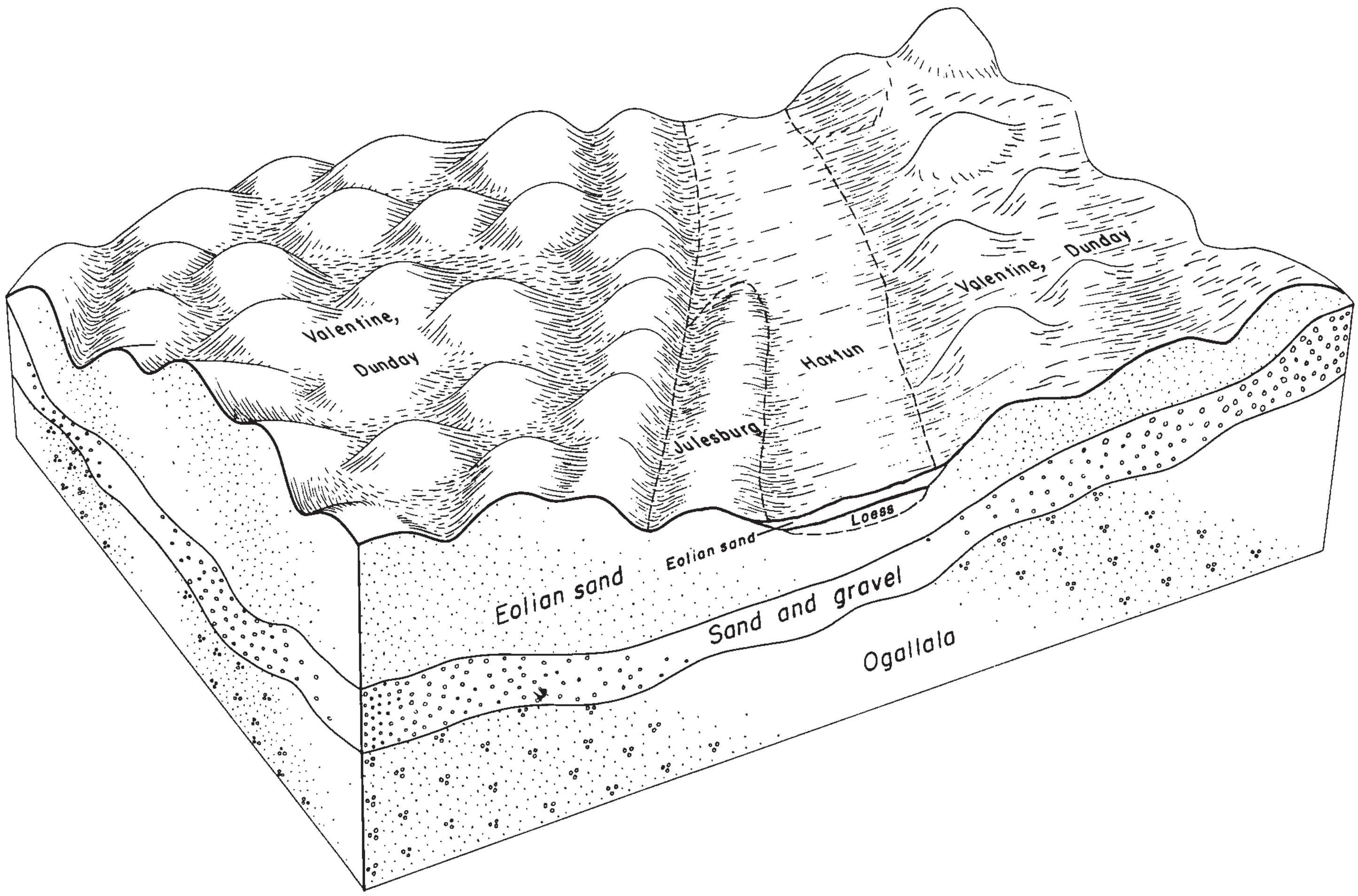

Figure 2.—**Parent material and position of soils in association 4.**

5. Eckley-Chappell association

Shallow to deep, moderately sloping to hilly, gravelly and sandy soils on upland breaks and on fans

This association consists partly of fans and partly of breaks between the uplands and the river terrace. It is along both sides of the South Platte River and is dissected by many intermittent tributaries of the river. The total area is about 63,000 acres, or 18 percent of the county.

Eckley soils, which are dominant on the breaks, make up slightly more than 40 percent of this association, and Chappell soils, which are mostly on the fans, slightly less than 40 percent. The minor soils making up the remaining 20 percent are Bayard, Ascalon, and Manter, all of which are strongly sloping; and Cheyenne and Wann soils, which are next to the streams.

Eckley soils have a surface layer of very dark grayish-brown gravelly loam and a subsoil of dark-brown gravelly loam. They are shallow to sand and gravel.

Chappell soils are deep and moderately deep. They have a surface layer of very dark brown sandy loam or loamy sand. The underlying material is very dark grayish-brown sandy loam. The content of gravel is small.

Most of this association is used as native pasture, but a few areas on the lower fans are used as cropland. Generally, pastures are used only in spring and summer, and cattle are moved to cropland in adjacent associations in fall and winter. Few farms or ranches are completely within this association. Some of the cropland is irrigated. The main crops are wheat, sorghum, corn, and alfalfa.

6. Haxtun-Julesburg-Ascalon association

Deep, nearly level to moderately sloping, sandy soils on uplands

Most of this association is in the southwestern corner of the county, but a smaller area is in the southeastern part. The total area is about 32,000 acres, or 9 percent of the county.

Haxtun soils make up about 65 percent of this association, Julesburg soils about 16 percent, and Ascalon soils about 16 percent. Of the minor soils, Valentine soils make up about 2 percent of the association, and Bayard and Canyon soils the remaining 1 percent.

Haxtun soils have a surface layer of very dark grayish-brown sandy loam or loamy sand and a subsoil of very dark grayish-brown sandy loam over sandy clay loam. Julesburg soils have a surface layer of a very dark grayish-brown loamy sand and a subsoil of very dark grayish-brown over dark grayish-brown sandy loam. Ascalon soils have a surface layer of very dark grayish-brown sandy loam and a subsoil of very dark grayish-brown sandy clay loam.

Most of this association is cultivated, but some of it remains in native grass. The sandy surface layer is susceptible to wind erosion. The native grasses were blue grama, side-oats grama, switchgrass, bluestem, and prairie sandreed. The common crops are wheat, corn, sorghum, and barley.

Descriptions of the Soils

In this section the soils of Sedgwick County are described in detail. The procedure is to describe first the soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

The description of the soil series includes a description of a profile that is considered representative of all the soils in the series. If the profile of a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, unless they are apparent from the name of the mapping unit. The colors described in the typical profiles are those of dry soil, unless otherwise noted; but all the colors described throughout the rest of this section are those of moist soil. Many of the terms used in describing soil series and mapping units are defined in the Glossary, and some are defined in the section "How This Survey Was Made."

The approximate acreage and proportionate extent of the soils are shown in table 1. At the back of this soil survey is the "Guide to Mapping Units," which lists the mapping units in the county and shows the capability unit, range site, and windbreak group each mapping unit is in and the page where each of these groups is described.

Ascalon Series

The Ascalon series consists of deep, nearly level to moderately sloping, well-drained, friable soils that formed in a mixture of sandy and reworked gravelly materials. The native vegetation was grass, mostly side-oats grama, little bluestem, and needle-and-thread. Most areas of these soils are in the southeastern part of the county, but a few small areas are on terraces near Sedgwick.

Typically, Ascalon soils have a 6-inch surface layer of very dark grayish-brown sandy loam. The subsoil is sandy clay loam that is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material, at a depth of about 25 inches, is light brownish-gray very fine sandy loam. This grades to light brownish-gray fine sand at a depth of about 37 inches. The underlying material contains some calcium carbonate and a few small pebbles.

These soils have moderate natural fertility. The surface layer absorbs water rapidly. The water-holding capacity is moderate. Surface runoff is very slow to medium. Some rills form during intense rainstorms.

Almost all the acreage is cultivated, but some areas are still in native grass.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Ascalon sandy loam, 0 to 3 percent slopes	2, 180	0. 6	Julesburg loamy sand, 0 to 3 percent slopes	2, 510	0. 7
Ascalon sandy loam, 3 to 5 percent slopes	3, 790	1. 1	Julesburg loamy sand, 3 to 5 percent slopes	2, 940	. 8
Ascalon sandy loam, 5 to 9 percent slopes	1, 390	. 4	Keith, Goshen, and Kuma silt loams, 0 to 3 percent slopes	6, 280	1. 8
Bayard-Ascalon-Manter sandy loams, 5 to 12 percent slopes	7, 150	2. 0	Keith-Kuma silt loams, 0 to 3 percent slopes	17, 490	5. 0
Bayard-Canyon complex, 5 to 12 percent slopes	8, 760	2. 5	Keith and Tripp loams, 0 to 1 percent slopes	12, 790	3. 7
Bridgeport loam, 0 to 1 percent slopes	1, 800	. 5	Keith and Tripp loams, 1 to 3 percent slopes	890	. 3
Bridgeport loam, 1 to 3 percent slopes	1, 980	. 6	Keith and Wages soils, 5 to 12 percent slopes	1, 790	. 5
Bridgeport loam, 0 to 3 percent slopes	510	. 1	Keota-Epping loams, 3 to 9 percent slopes	1, 110	. 3
Campus-Richfield loams, 0 to 3 percent slopes	800	. 2	Lamo clay loam	1, 620	. 5
Campus-Richfield loams, 3 to 5 percent slopes	3, 350	1. 0	Las loam	940	. 3
Canyon complex, 3 to 9 percent slopes	430	. 1	McCook loam	380	. 1
Chappell loamy sand, 1 to 3 percent slopes	3, 690	1. 1	Rago and Kuma silt loams, 0 to 3 percent slopes	73, 830	21. 2
Chappell sandy loam, 0 to 1 percent slopes	1, 880	. 5	Rago and Kuma silt loams, 3 to 5 percent slopes	2, 140	. 6
Chappell sandy loam, 1 to 3 percent slopes	2, 680	. 8	Richfield loam, 0 to 3 percent slopes	45, 390	13. 0
Cheyenne loam, 1 to 3 percent slopes	340	. 1	Richfield loam, 3 to 5 percent slopes	9, 000	2. 6
Colby-Ulysses silt loams, 3 to 5 percent slopes	1, 100	. 3	Sandy alluvial land	5, 160	1. 5
Colby-Ulysses silt loams, 5 to 9 percent slopes	350	. 1	Scott silt loam	1, 590	. 5
Eckley-Chappell complex, 9 to 20 percent slopes	37, 800	10. 9	Slickspots	7, 660	2. 2
Elsmere loamy fine sand	320	. 1	Valentine fine sand, rolling	16, 390	4. 7
Epping gravelly loam, 5 to 15 percent slopes	440	. 1	Valentine fine sand, hilly	4, 090	1. 2
Haverson loam, 0 to 1 percent slopes	710	. 2	Valentine-Dunday fine sands, undulating	2, 020	. 6
Haverson loam, 1 to 3 percent slopes	370	. 1	Wages gravelly loam, 3 to 5 percent slopes	9, 460	2. 7
Haxtun loamy sand, 0 to 1 percent slopes	480	. 1	Wages gravelly loam, 5 to 9 percent slopes	7, 860	2. 3
Haxtun loamy sand, 0 to 3 percent slopes	16, 680	4. 8	Wann soils	3, 100	. 9
Haxtun loamy sand, 3 to 5 percent slopes	1, 090	. 3	Wet alluvial land	7, 540	2. 2
Haxtun sandy loam, 0 to 1 percent slopes	1, 270	. 4			
Haxtun sandy loam, 0 to 3 percent slopes	2, 850	. 8	Total land	348, 160	100. 0

Typical profile of an Ascalon sandy loam, in a cultivated field 1,050 feet north and 75 feet west of the southeastern corner of sec. 7, T. 9 N., R. 43 W.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry and friable when moist; noncalcareous; clear, smooth boundary.

B2t—6 to 11 inches, grayish-brown (10YR 5/2) sandy clay loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry and friable when moist; thin, patchy clay films; noncalcareous; clear, smooth boundary.

B3—11 to 25 inches, light brownish-gray (10YR 6/2) light sandy clay loam; dark grayish brown (10YR 4/2) when moist; medium prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C1ca—25 to 37 inches, white (10YR 8/2) very fine sandy loam; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; visible lime in seams and streaks; clear, smooth boundary.

C2ca—37 to 60 inches, light-gray (10YR 7/2) fine sand; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous.

The A horizon ranges from 5 to 8 inches in thickness. The B2t horizon ranges from heavy sandy loam to light clay loam in texture and from 4 to 15 inches in thickness.

Ascalon soils are coarser textured than Richfield soils and formed in sandy and reworked gravelly materials instead of silty material.

Ascalon sandy loam, 0 to 3 percent slopes (AsB).—Areas of this soil are generally 10 to 40 acres in size and elongated in a northwest-southeast direction. Most areas are in the southeastern part of the county, but some are in the southwestern part. The profile of this soil is the one described for the series. Included in mapping were a few areas of Richfield loam and a few small eroded areas where the texture of the surface layer has been altered and is now loamy sand.

If not protected, this soil is susceptible to wind erosion. It takes in water readily and has moderate water-holding capacity. There is very little surface runoff.

Nearly all the acreage is cultivated, but a few areas are still in native grass. Winter wheat, winter barley, sorghum, and some corn are grown. (Capability unit IIe–2, nonirrigated; Sandy Plains range site; windbreak group 1)

Ascalon sandy loam, 3 to 5 percent slopes (AsC).—Most areas of this soil are in the southeastern part of the county, and a few areas are on the terraces of the South Platte River.

This soil has more eroded areas than Ascalon sandy loam, 0 to 3 percent slopes. Small outcrops of limestone occur in some areas.

If not protected, this soil is susceptible to wind erosion. It takes in water readily and has moderate water-holding capacity. Surface runoff is slow.

Almost all the acreage is cultivated, but a few small areas are still in native grass. Winter wheat, winter barley, and sorghum are grown. (Capability unit IIIe–2, irrigated, and capability unit IIIe–5, nonirrigated; Sandy Plains range site; windbreak group 1)

Ascalon sandy loam, 5 to 9 percent slopes (AsD).—This soil is on ridges and side slopes. Most areas are in the southeastern part of the county, some are in the southwestern part, and a few are on terraces of the South Platte River. Small eroded spots and outcrops of limestone are included.

If not protected at all times, this soil is susceptible to severe wind and water erosion. Surface runoff is medium.

Most of the acreage is cultivated, but some areas, mostly in the southwestern part of the county, are still in native grass. Winter wheat, winter barley, and sorghum are the main crops. (Capability unit IVe–2, irrigated, and capability unit IVe–6, nonirrigated; Sandy Plains range site; windbreak group 1)

Bayard Series

The Bayard series consists of deep, gently sloping to moderately sloping, well-drained, friable soils that formed in sandy eolian material. The native vegetation consisted of bluestem, needle-and-thread, and side-oats grama.

Typically, Bayard soils have a 27-inch surface layer of very dark grayish-brown sandy loam. Below a depth of 4 inches, this layer contains a large amount of calcium carbonate. The underlying material is very dark grayish-brown sandy loam that contains visible calcium carbonate in the form of soft concretions. The color grades to dark grayish brown below a depth of 43 inches.

If not protected, these soils are subject to wind erosion. They have rapid permeability, moderate to low water-holding capacity, and moderate natural fertility. Surface runoff is slow.

Most of the acreage is range.

The Bayard soils in Sedgwick County are mapped only in complexes with Ascalon and Manter soils and with Canyon soils.

Typical profile of a Bayard sandy loam, under native grass, 750 feet west of the southeast corner of sec. 5, T. 11 N., R. 44 W.

A11—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam; very dark grayish brown (10YR 3/2) when moist and crushed; moderate, very fine, granular structure; soft when dry and very friable when moist; noncalcareous; pH approximately 7.6; clear, smooth boundary.

A12ca—4 to 27 inches, brown (10YR 5/3) sandy loam; very dark grayish brown (10YR 3/2) when moist and crushed; massive, but breaks to weak, coarse, subangular blocky structure; slightly hard when dry and very friable when moist; strongly calcareous; pH approximately 8.0; clear, smooth boundary.

ACca—27 to 43 inches, grayish-brown (10YR 5/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; massive; visible lime in the form of small soft concretions; very strongly calcareous; pH approximately 8.2; gradual, smooth boundary.

Cca—43 to 60 inches, light brownish-gray (10YR 6/2) sandy loam; dark grayish brown (10YR 4/2) when moist; massive; very strongly calcareous; pH approximately 8.2.

The thickness of the very dark grayish-brown layers ranges from 20 to 50 inches. The depth to lime ranges from 0 to 8 inches.

Bayard soils do not have as much structural development as Julesburg soils, which are noncalcareous.

Bayard-Ascalon-Manter sandy loams, 5 to 12 percent slopes (BaE).—The soils of this complex are on hills south of the terraces of the South Platte River. About 40 percent of each area is Bayard soil, about 30 percent is Ascalon soil, and about 20 percent is Manter soil. Making up the remaining 10 percent of the acreage are small areas of Eckley and Chappell soils and Sandy alluvial land.

The Bayard soil in this unit has a profile similar to the one described as typical of the series. The Ascalon soil in this unit has a profile similar to the one described as typical under the heading "Ascalon Series," and the Manter soil has a profile similar to the one described as typical under the heading "Manter Series."

If not protected with a plant cover, these soils are subject to severe wind and water erosion. They have rapid permeability and low to moderate water-holding capacity. Surface runoff is medium.

Nearly all the acreage is used for native grass range. (Capability unit VIe–1, nonirrigated; Sandy Plains range site; windbreak group 1)

Bayard-Canyon complex, 5 to 12 percent slopes (BcE).—The soils of this complex are on breaks between the terraces of the South Platte River and the uplands, south of the towns of Julesburg and Ovid. About 70 percent of each area is Bayard soil, and about 25 percent is Canyon soil. Making up the remaining 5 percent of the acreage are small areas of Sandy alluvial land in intermittent streambeds.

The Bayard soil in this unit has a profile similar to the one described as typical for the series. The Canyon soil in this unit has a profile similar to the one described as typical under the heading "Canyon Series," but the surface layer is sandy loam instead of gravelly loam.

If not protected with a plant cover, these soils are subject to severe wind and water erosion. They have rapid permeability and low water-holding capacity.

All of the acreage is native grass range. (Both soils of complex in capability unit VIe–1, nonirrigated; Bayard soil in Sandy Plains range site and windbreak group 2; Canyon soil in Limestone Breaks range site and windbreak group 4)

Bridgeport Series

The Bridgeport series consists of deep, level to nearly level, well-drained soils. These soils are on terraces along the South Platte River.

Typically, Bridgeport soils have a 10-inch surface layer of very dark grayish-brown loam. The underlying material is dark grayish-brown, very friable loam. There is a large amount of lime throughout the profile.

Surface runoff is medium, permeability is moderate, and the water-holding capacity is high. Internal drainage is medium.

Most areas of Bridgeport soils are irrigated and used for corn, beans, beets, and alfalfa, but a few small areas west of Sedgwick, along Cottonwood Creek, are still in native grass, mainly western wheatgrass, blue grama, and little bluestem.

Typical profile of Bridgeport loam, 2,190 feet east and 180 feet north of the southwest corner of sec. 2, T. 11 N., R. 45 W.

Ap—0 to 10 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry and very friable when moist; strongly calcareous; clear, smooth boundary.

C1—10 to 57 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; massive in place, but breaks to weak, coarse, prismatic structure; soft when dry and very friable when moist; very strongly calcareous; micaceous; 10 to 15 percent mottling of material from the Ap horizon, which is very dark grayish brown (10YR 3/2) when moist; clear, smooth boundary.

C2ca—57 to 60 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; massive in place, but breaks to weak prismatic structure; soft when dry and very friable when moist; very strongly calcareous; highly micaceous.

The A horizon ranges from 7 to 15 inches in thickness. The C horizon extends to a depth of at least 5 feet. The lower part of it is stratified and contains lenses of loam, very fine sandy loam, and fine sandy loam.

Bridgeport soils are associated with Keith, Tripp, and Haverson soils. They lack a B2 horizon that is characteristic of Keith and Tripp soils. They are darker colored than Haverson soils.

Bridgeport loam, 0 to 1 percent slopes (BrA).—The profile (fig. 3) of this soil is the one described for the series. Nearly all the acreage is irrigated. (Capability unit I–1, irrigated; not placed in a range site; windbreak group 1)

Bridgeport loam, 1 to 3 percent slopes (BrB).—The profile of this soil is similar to the one described for the series, but in many areas the surface layer is only 7 or 8 inches thick. Included in mapping were areas of light-colored, erodible soil.

This soil has moderate permeability, high water-holding capacity, and moderate natural fertility. It is susceptible to wind and water erosion unless protected with a plant cover.

The entire acreage is irrigated. (Capability unit IIe–1, irrigated; not placed in a range site; windbreak group 1)

Figure 3.—Profile of Bridgeport loam, 0 to 1 percent slopes.

Bridgeport loam, 0 to 3 percent slopes (BrAB).—This soil is on the terraces of the South Platte River but above the irrigation canal system. It is susceptible to wind and water erosion unless protected with a plant cover. Nearly all the acreage is cultivated. Winter wheat, sorghum, and barley are the main crops. (Capability unit IIc-1, nonirrigated; Loamy Plains range site; windbreak group 1)

Campus Series

The Campus series consists of moderately deep, well-drained, loamy soils that contain a large amount of calcium carbonate. These soils formed in material weathered from limestone, mixed with silty eolian material. The native vegetation consisted of side-oats grama, blue grama, and little bluestem.

Typically, Campus soils have an 8-inch surface layer of very dark grayish-brown, very friable loam. Below this is a transitional layer of grayish-brown loam. This layer has visible calcium carbonate in seams and streaks. The underlying material, at a depth of about 15 inches, is pale-brown clay loam that contains a large amount of calcium carbonate. Marl or soft limestone occurs at a depth of about 24 inches.

These soils have moderate permeability, moderate water-holding capacity, and moderate natural fertility. They erode readily unless protected.

These soils are cultivated. They are suited to winter wheat, barley, and sorghum.

The Campus soils in Sedgwick County are mapped only in two complexes with Richfield soils.

Typical profile of a Campus loam, cultivated, 1,584 feet south and 20 feet east of the northwest corner of sec. 30, T. 10 N., R. 42 W.

A1—0 to 8 inches, grayish-brown (10YR 5/2) heavy loam; very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry and very friable when moist; calcareous; pH 8.0; this horizon contains some caliche gravel; clear, smooth boundary.

AC—8 to 15 inches, light-gray (10YR 7/2) heavy loam; grayish brown (10YR 5/2) when moist; weak, medium, subangular blocky structure breaking to fine granular; hard when dry and friable when moist; calcareous; pH 8.2; a few lime concretions in the lower part; gradual, smooth boundary.

Cca—15 to 24 inches, white (10YR 8/2) light clay loam; pale brown (10YR 6/3) when moist; massive; hard when dry and friable when moist; this is a strong ca horizon that has much visible calcium carbonate in finely divided form resembling marl; calcareous; pH 8.2.

R—24 inches +, marl or soft limestone.

The A1 horizon ranges from loam to very fine sandy loam in texture and from 7 to 12 inches in thickness. The depth to free calcium carbonate is less than 7 inches, and the depth to the R horizon is 20 to 40 inches.

Campus soils are thicker over bedrock than Canyon soils.

Campus-Richfield loams, 0 to 3 percent slopes (CaB).—This complex is mostly in the southeastern part of the county. About 60 percent of each area is made up of Campus loam, and about 30 percent of Richfield loam. The rest is made up of Rago and Kuma loams, which are in small depressions, and small areas of the Canyon complex, which is on knobs and ridgetops. Included are small outcrops of limestone, which are shown on the soil map by outcrop symbols.

The Campus soil in this complex has a profile similar to the one described as typical for the series. The Richfield soil in this unit has the profile described as typical under the heading "Richfield Series."

The soils in this complex have moderate permeability and moderate water-holding capacity. Surface runoff is medium. Crop residue should be left on the surface for protection against erosion.

These soils are suitable for winter wheat, winter barley, and sorghum. (Capability unit IIIs-1, nonirrigated; Loamy Plains range site; windbreak group 1)

Campus-Richfield loams, 3 to 5 percent slopes (CaC).—This complex is mostly in the southeastern part of the county. About 60 percent of each area is Campus loam, and about 30 percent is Richfield loam. The rest is made up of Rago and Kuma loams, which are in small depressions, and small areas of the Canyon complex, which is on the knobs and ridgetops. Outcrops of limestone, shown on the soil map by the outcrop symbol, are more numerous than in areas of Campus-Richfield loams, 0 to 3 percent slopes.

The Campus soil in this complex has the profile described as typical for the series. The Richfield soil has a profile similar to the one described as typical under the heading "Richfield Series."

If not protected with a plant cover, these soils erode severely. They have moderate permeability and moderate water-holding capacity.

These soils are suited to limited cultivation, and almost all the acreage is cultivated. Winter wheat and sorghum are the principal crops. (Capability unit IVe-4, nonirrigated; Loamy Plains range site; windbreak group 1)

Canyon Series

The Canyon series consists of shallow, well-drained, gently sloping to moderately sloping soils that formed in material weathered from limestone. The native vegetation consisted mainly of blue grama, buffalograss, western wheatgrass, and other short grasses, but it included little bluestem and other mid grasses. These soils occur as breaks along draws and intermittent streams and in ridgelike areas of the tablelands in the southeastern and southwestern parts of the county.

Typically, Canyon soils have a 4-inch surface layer of limy, very dark grayish-brown gravelly loam and a 3-inch transitional layer of dark grayish-brown gravelly loam. Below this layer, the underlying material is very pale brown gravelly loam. There are weathered fragments of caliche throughout. At a depth of 10 inches is limestone or a hard mortar bed.

These soils are highly susceptible to wind and water erosion. They have low water-holding capacity. Natural fertility is low to moderate.

Canyon soils are not suitable for cultivation.

Typical profile of a Canyon gravelly loam, 1,056 feet north of the southwest corner of sec. 36, T. 10 N., R. 43 W.

Ap—0 to 4 inches, grayish-brown (10YR 5/2) gravelly loam; very dark grayish brown (10YR 3/2) when moist; soft when dry and very friable when moist; moderate, fine, crumb structure; strongly calcareous; contains fragments of indurated caliche; gradual, smooth boundary.

AC—4 to 7 inches, grayish-brown (10YR 5/2) gravelly loam; dark grayish brown (10YR 4/2) when moist; slightly hard when dry and very friable when moist; massive, but breaks to very weak, coarse, subangular blocky structure; about 25 percent is caliche fragments; effervesces violently with acid; gradual, smooth boundary.

Cca—7 to 10 inches, very pale brown (10YR 8/3) gravelly loam; very pale brown (10YR 7/3) when moist; slightly hard when dry and very friable when moist; effervesces violently with acid; approximately 40 to 50 percent weathered fragments of caliche; a prominent horizon of lime accumulation; visible lime in finely divided forms; clear, smooth boundary.

R—10 inches +, hard mortar bed.

The A horizon ranges from loam to gravelly fine sandy loam or sandy loam in texture and is 2 to 6 inches thick. The AC and C horizons are loam or gravelly loam and contain variable amounts of caliche fragments. Combined, they range from 3 to 8 inches in thickness. The depth to bedrock is 8 to 12 inches.

Canyon soils are closely related to Campus soils, but they are shallower over bedrock and have less clayey underlying material.

Canyon complex, 3 to 9 percent slopes (CcD).—Most areas of these soils are in the southeastern part of the county, but some are in the southwestern and northwestern parts. The surface layer is gravelly loam or gravelly fine sandy loam. Included in mapping were small areas of Wages soils.

Surface runoff is rapid, and natural fertility is low.

These soils are not suitable for cultivation. Most of the acreage is in grass. A few small areas are cultivated, but these areas should be reseeded to little bluestem, blue grama, side-oats grama, western wheatgrass, and other grasses. The use of seeding machinery is hazardous because of surface stones and rock outcrops. (Capability unit VIIs–1, nonirrigated; Limestone Breaks range site; windbreak group 4)

Chappell Series

The Chappell series consists of moderately deep to deep, well-drained, nearly level to gently sloping soils that formed in sandy stratified alluvium. The native vegetation consisted of mid and tall grasses, dominantly needle-and-thread, three-awn, and sandreed, and a considerable amount of sand sage. These soils are on fans and terraces in the northern part of the county.

Typically, Chappell soils have a 9-inch surface layer of very dark brown sandy loam or loamy sand. The underlying material is sandy loam.

Chappell soils have little or no surface runoff, rapid to very rapid permeability, and moderate to low water-holding capacity. If not protected, they are susceptible to severe wind and water erosion.

These soils are used for both irrigated and nonirrigated crops, as well as for native range.

Typical profile of a Chappell sandy loam, 1,000 feet south and 50 feet west of the northeast corner of sec. 24, T. 12 N., R. 44 W.

Ap—0 to 9 inches, grayish-brown (10YR 5/2) sandy loam; very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry and friable when moist; noncalcareous; clear, smooth boundary.

C1—9 to 22 inches, dark grayish-brown (10YR 4/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C2—22 to 28 inches, dark grayish-brown (10YR 4/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary; 10 percent gravel.

C3—28 to 46 inches, sandy loam; dark grayish brown (10YR 4/2) when dry or moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C4—46 to 60 inches, light-gray (10YR 7/2) fine sandy loam; dark grayish brown (10YR 4/2) when moist; massive, but breaks to weak, coarse, prismatic structure; slightly hard when dry and very friable when moist; weakly calcareous; few, small, lime-coated pebbles in upper part.

The A horizon ranges from sandy loam to loamy sand in texture and from 7 to 15 inches in thickness. Below a depth of 15 inches in some places are thin layers of fine sand, dark-colored silty material, or fine gravel. On the surface in some areas are pebbles ranging from ¼ inch to 3 inches in diameter.

Chappell soils are similar to Julesburg soils, but they have a wider range of texture in the surface layer, and they formed in stratified alluvium rather than in eolian sand.

Chappell loamy sand, 1 to 3 percent slopes (ChB).—Most areas of this soil are in the northern part of the county. Some areas are on terraces along intermittent streams, and others are on alluvial fans. The profile of this soil is similar to the one described as typical of the series, but the surface layer is loamy sand instead of sandy loam. Included in mapping were small areas of Sandy alluvial land.

If not protected, this soil is subject to severe wind erosion. It has very rapid permeability, low water-holding capacity, and moderate natural fertility.

Most of the acreage is used for crops. Crop residue should be used to protect the soil, especially in dryfarmed areas. (Capability unit IIIe–3, irrigated, and capability unit IIIe–7, nonirrigated; Sandy Plains range site; windbreak group 2)

Chappell sandy loam, 0 to 1 percent slopes (CpA).—Most areas of this soil are in the northern part of the county. Many areas are on the terraces of the South Platte River, some are along the terraces of intermittent streams, and others are on alluvial fans. The profile of this soil is the one described as typical for the series. Included in mapping were small areas of Keith and Tripp silt loams in depressed areas on terraces.

This soil has rapid permeability, moderate water-holding capacity, and moderate natural fertility. It is susceptible to wind erosion.

The entire acreage is irrigated. The response to commercial fertilizer is good. Erosion can be controlled by the use of crop residue. (Capability unit IIs–1, irrigated; not placed in a range site; windbreak group 1)

Chappell sandy loam, 1 to 3 percent slopes (CpB).—If not protected with a plant cover, this soil is subject to severe wind erosion. It has rapid permeability and moderate water-holding capacity.

Cover crops and tillage by methods that roughen the surface help to control erosion in irrigated areas. Leveling makes the distribution of irrigation water easier. Manure is needed. Irrigated crops respond well to commercial fertilizer. Stubble mulching helps to control erosion in dryfarmed areas. (Capability unit IIIe–3, irrigated, and capability unit IIIe–6, nonirrigated; Sandy Plains range site; windbreak group 1)

Cheyenne Series

The Cheyenne series consists of well-drained, nearly level to gently sloping, loamy soils that formed in lime-free, loamy alluvium. They are moderately deep to sand and gravel. The native vegetation consists mainly of blue grama, buffalograss, and needle-and-thread. Sage and yucca are common also. Areas of these soils are along intermittent drainageways and on alluvial fans, mostly in the northern part of the county.

Typically, Cheyenne soils have a 4-inch surface layer and a 6-inch transitional layer of very dark grayish-brown loam. The underlying material, to a depth of 15 inches, consists of dark grayish-brown light sandy loam. Below this are stratified lenses of loam to sandy loam over sand and gravel.

If not protected with a plant cover, these soils are subject to wind erosion and water erosion. They have only moderate water-holding capacity and, consequently, do not supply enough water to plants during prolonged periods of dry weather. The organic-matter content of the surface layer is high.

Dryfarmed areas are used for small grain, and irrigated areas for sugar beets, alfalfa, and corn.

Typical profile of Cheyenne loam, in native pasture, 530 feet south and 60 feet east of the northwest corner of lot 1 in sec. 20, T. 12 N., R. 43 W.

A—0 to 4 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist and crushed; weak, fine, crumb structure; soft when dry and very friable when moist; noncalcareous; high organic-matter content; clear, smooth boundary.

AC—4 to 10 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist and crushed; weak, medium, subangular blocky structure breaking to weak, fine, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C1—10 to 15 inches, grayish-brown (10YR 5/2) light sandy loam; dark grayish brown (10YR 4/2) when moist and crushed; massive; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

IIAb—15 to 36 inches, dark grayish-brown (10YR 4/2), stratified lenses of loam to sandy loam; very dark brown (10YR 2/2) when moist.

IIC2—36 to 60 inches, sand and gravel.

The A and AC horizons, together, range from a total of 7 inches to a total of 20 inches in thickness. In some areas the A horizon contains a scattering of fine gravel. The depth to sand and gravel is generally between 20 and 36 inches.

Cheyenne soils are similar to Keith and Tripp soils in color, but they are more gravelly and have less distinct layers. They are shallower and finer textured than Chappell soils.

Cheyenne loam, 1 to 3 percent slopes (CrB).—This soil is in the northern part of the county, on terraces along intermittent drainageways and on alluvial fans. It is likely to be flooded after heavy rain. Included in mapping were small areas of Sandy alluvial land.

This soil has moderate permeability and moderate water-holding capacity.

Most of the acreage is native grass range. Some of the few small cultivated areas are irrigated, and others are dryfarmed. Erosion can be controlled by the use of crop residue. Leveling the soil for irrigation is feasible. (Capability unit IIe–1, irrigated, and capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Colby Series

The Colby series consists of deep, well-drained soils that formed in silty eolian material. The native vegetation consisted principally of short grasses, mainly blue grama. Areas of these soils are on side slopes and on high rounded ridges, mostly in the northwestern part of the county.

Typically, Colby soils have a 3-inch surface layer of very dark grayish-brown silt loam and a 3-inch transitional layer of dark grayish-brown silt loam. The underlying material, below a depth of about 6 inches, consists of brown, strongly calcareous silt loam over brown, strongly calcareous very fine sandy loam.

These soils have moderate permeability and high water-holding capacity. The content of organic matter and the supply of nitrogen are low.

Only a small acreage of these soils is irrigated. Small grain and sorghum are the main dryfarmed crops.

The Colby soils in Sedgwick County are mapped only in two complexes with Ulysses soils.

Typical profile of a Colby silt loam, in native pasture, 1,850 feet north and 105 feet east of the southwest corner of sec. 11, T. 11 N., R. 47 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) silt loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, blocky structure breaking to weak, fine, granular; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

AC—3 to 6 inches, grayish-brown (10YR 5/2) silt loam; dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, blocky; hard when dry and very friable when moist; strongly calcareous; streaks of soil material from A1 horizon; gradual, smooth boundary.

C1ca—6 to 14 inches, very pale brown (10YR 7/3) silt loam; brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, blocky; soft when dry and very friable when moist; strongly calcareous; this is a weak horizon of lime accumulation; clear, smooth boundary.

C2ca—14 to 46 inches, very pale brown (10YR 7/3) silt loam; brown (10YR 5/3) when moist; massive; slightly hard when dry and very friable when moist; strongly calcareous; gradual, smooth boundary.

C3ca—46 to 60 inches, very pale brown (10YR 7/3) very fine sandy loam; brown (10YR 5/3) when moist; massive; soft when dry and very friable when moist; strongly calcareous; few pebbles and small fragments below a depth of 54 inches.

The A1 horizon ranges from 1 inch to 6 inches in thickness. Colby soils have a thinner surface layer and are less deeply leached of lime than Ulysses soils.

Colby-Ulysses silt loams, 3 to 5 percent slopes (CuC).—This complex is on side slopes, ridges, and knobs, mostly in the northwestern part of the county. About 65 percent of each area is Colby silt loam, and about 35 percent is Ulysses silt loam. Ulysses silt loam is commonly in small concave areas and on the lee side of hills. Included in mapping were small areas of Wages gravelly loam.

The Colby soil in this unit has a profile similar to the one described as typical of the Colby series. The Ulysses soil in this unit has a profile like the one described as typical under the heading "Ulysses Series."

Most of the acreage is either irrigated or dryfarmed. A plant cover is needed at all times. Contour farming and stubble mulching help to control erosion in dryfarmed fields. Irrigated crops respond well to fertilizer. (Capability unit IIIe–1, irrigated, and capability unit IVe–4, nonirrigated; Loamy Plains range site; windbreak group 1)

Colby-Ulysses silt loams, 5 to 9 percent slopes (CuD).—This complex is on ridges and side slopes in the northwestern part of the county. About 75 percent of each area is Colby soil, and about 25 percent is Ulysses soil. Included in mapping were small areas of Wages gravelly loam.

The Colby soil in this unit has a profile similar to the one described as typical of the series. The Ulysses soil in this unit has the profile described as typical under the heading "Ulysses Series."

These soils are moderately permeable. They have a high water table. Runoff is rapid to very rapid, and the erosion hazard is severe. Erosion has already removed the thin surface layer from a few small areas.

Some of this complex is irrigated. Irrigated crops respond well to fertilizer, but because of the erosion hazard, only close-growing crops are suitable. The nonirrigated parts of the complex are suited to grass. Reseeding of these areas is successful if enough residue remains on the surface to provide protection against erosion. (Capability unit IVe–1, irrigated, and capability unit VIe–2, nonirrigated; Loamy Plains range site; windbreak group 1)

Dunday Series

The Dunday series consists of deep, excessively drained soils that formed in sandy eolian material. Most areas of these soils are on flats and in valleys in the southwestern part of the county.

Typically, Dunday soils have a 9-inch surface layer of very dark grayish-brown, very friable fine sand or loamy fine sand and a 9-inch transitional layer of dark grayish-brown, very friable loamy fine sand. Below this layer the underlying material is yellowish-brown, loose fine sand.

These soils are subject to wind erosion. They have low water-holding capacity and low natural fertility. There is no surface runoff.

Most of the acreage remains in native grass.

The Dunday soils in Sedgwick County are mapped only in a complex with Valentine soils. This mapping unit is described under the heading "Valentine Series."

Typical profile of a Dunday fine sand, in native pasture, 1,320 feet south and 150 feet east of the center of sec. 6, T. 9 N., R. 47 W.

A1—0 to 9 inches, grayish-brown (10YR 5/2) fine sand; very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

AC—9 to 18 inches, grayish-brown (10YR 5/2) loamy fine sand; dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C—18 to 60 inches, very pale brown (10YR 7/4) fine sand; yellowish brown (10YR 5/4) when moist; loose; single grain.

The A1 horizon ranges from 6 to 12 inches in thickness. At a depth of about 5 feet, in some areas, is a buried soil.

Dunday soils are less sandy and have a thicker surface layer than Valentine soils. They are sandier than Julesburg soils.

Eckley Series

The Eckley series consists of excessively drained soils that formed in a thin mantle of gravelly alluvium. They are shallow over sand and gravel. Most areas of these soils are moderately steep.

Typically, Eckley soils have a 4-inch surface layer of very dark grayish-brown gravelly loam and a 4-inch subsoil of dark-brown gravelly loam. The sand grains in the subsoil are bridged with a very thin coating of clay particles. Beneath the subsoil is water-deposited sand and gravel that is brown in the upper part but grades to reddish brown with increasing depth.

These soils take in water rapidly, have low water-holding capacity, and have low natural fertility. Surface runoff is slow.

Almost all the acreage is native grass range. Only a few areas are cultivated.

The Eckley soils in Sedgwick County are mapped only in a complex with Chappell soils.

Typical profile of an Eckley gravelly loam, in native grass, 2,340 feet north and 20 feet east of the southwest corner of sec. 25, T. 12 N., R. 46 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) gravelly loam; very dark grayish brown (10YR 3/2) when moist; soft when dry and very friable when moist; weak, fine, granular structure; noncalcareous; clear, wavy boundary.

B2t—4 to 8 inches, brown (10YR 4/3) gravelly loam; dark brown (10YR 3/3) when moist; soft when dry and very friable when moist; weak, very fine, subangular blocky structure; noncalcareous; very thin bridging of sand grains with continuous clay films; clear, wavy boundary.

IIC—8 to 60 inches, very pale brown (10YR 7/3) sand and gravel; brown (10YR 5/3) when moist; noncalcareous; grades to reddish brown (5YR 5/4) with increasing depth.

The A1 horizon is loam, gravelly loam, or gravelly sandy loam. It ranges from 4 to 8 inches in thickness. The B2t horizon is gravelly loam or gravelly sandy clay loam and is 3 to 13 inches thick. In many places there is a 3-inch B3 horizon. The IIC horizon contains pockets of concentrated calcium carbonate. In some places this horizon is hard, clayey, and shalelike. Depth to the IIC horizon ranges from 8 to 20 inches.

Eckley soils are shallower than Wages soils, and they lack a horizon of lime accumulation. Also, they are coarser textured below the A horizon.

Eckley-Chappell complex, 9 to 20 percent slopes (EcE).—This complex is in the northern part of the county. The larger of the two areas is in the "breaks" south of the South Platte River, and the other is north of Sedgwick. Both are hilly and dissected by many small drainageways. The Eckley soil is on ridgetops and hilltops, and the Chappell soil is on side slopes and in depressions. About 60 percent of each area is Eckley soil, about 35 percent is Chappell soil, and the rest is Sandy alluvial land.

The Eckley soil in this unit has the profile described as typical of the series. The Chappell soil in this unit has a profile similar to the one described as typical under the heading "Chappell Series."

These soils have rapid permeability, low water-holding capacity, and low natural fertility. Surface runoff is slow. Erosion is rapid and severe in areas that have been overgrazed.

These soils are not suitable for cultivation and should remain in grass. Nearly all the acreage is used for range. (Both soils of complex in capability unit VIs–2, nonirrigated; Eckley soil is in Gravel Breaks range site and windbreak group 4; Chappell soil is in Sandy Plains range site and windbreak group 2)

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained soils that formed in sandy eolian material. The native vegetation consisted mostly of tall grasses, dominantly sandreed, sand bluestem, and switchgrass. It also includes some blue grama and sage. These soils are in an area about 1 mile southwest of Julesburg.

Typically, Elsmere soils have a 13-inch surface layer of very dark grayish-brown loamy fine sand. The underlying material is mottled, grayish-brown fine sand.

If not protected by a plant cover, these soils are highly susceptible to wind erosion. They have low natural fertility, and there is little or no surface runoff, even during intense rain.

Typical profile of Elsmere loamy fine sand, in native pasture, 1,400 feet south and 1,800 feet west of the northeast corner of sec. 6, T. 11 N., R. 44 W.

A1—0 to 13 inches, grayish-brown (10YR 5/2) loamy fine sand; very dark grayish brown (10YR 3/2) when moist; single grain or weak, very fine, granular structure; soft when dry and very friable when moist; noncalcareous; pH 7.3; clear, smooth boundary.

C1g—13 to 23 inches, light-gray (10YR 7/2) fine sand; grayish brown (10YR 5/2) when moist; single grain; loose when dry or moist; few, fine, faint mottles of brown (10YR 4/3); noncalcareous; pH 8.0; gradual, smooth boundary.

C2cag—23 to 60 inches, light-gray (10YR 7/2) fine sand; grayish brown (10YR 5/2) when moist; single grain; loose when dry or moist; common, medium, distinct mottles of olive brown (2.5Y 4/4); this is a very weak ca horizon that contains some calcium carbonate concretions; calcareous; pH 8.2; gradual, smooth boundary.

The A horizon ranges from 7 to 20 inches in thickness, and in some places there are a few mottles in the lowermost part. Lime is leached out of these soils to depths ranging from 20 to 40 inches.

Elsmere soils differ from Dunday soils in having a high water table, mottles below a depth of 13 inches, and lime at a depth of 2 feet.

Elsmere loamy fine sand (1 to 3 percent slopes) (El).—The profile of this soil is the one described as typical of the series. Included in mapping were small areas of Valentine-Dunday fine sands.

This soil has low water-holding capacity. It is highly susceptible to wind erosion.

The entire acreage is still in grass. Areas that have been overgrazed can be reseeded to grass if care is taken to protect the soil until the grass is established. Plant-residue management and other practices are necessary. (Capability unit VIe-3, nonirrigated; Sandy Meadow range site; windbreak group 3)

Epping Series

The Epping series consists of shallow, excessively drained, gently sloping to strongly sloping soils that formed in material weathered from siltstone that contained a large amount of volcanic ash and glass. In most places there are many pebbles and small stones on the surface.

Typically, Epping soils have a 4-inch surface layer of dark grayish-brown, calcareous gravelly loam and a 4-inch transitional layer of very dark grayish-brown, calcareous loam or very light clay loam. The underlying material, at a depth of 8 inches, is dark grayish-brown, strongly calcareous loam. The depth to bedrock is only 12 inches.

These soils are subject to wind erosion and water erosion. They have low water-holding capacity and low natural fertility. Surface runoff is rapid.

Typical profile of Epping gravelly loam, in native pasture, 2,000 feet east and 900 feet north of the southwest corner of sec. 32, T. 12 S., R. 46 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) gravelly loam; dark grayish brown (10YR 4/2) when moist; weak, fine, crumb structure breaking to weak, fine, granular; soft when dry and very friable when moist; calcareous; clear, smooth boundary.

AC—4 to 8 inches, dark grayish-brown (10YR 4/2) loam or very light clay loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry and friable when moist; calcareous; clear, smooth boundary.

Cca—8 to 12 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; weak, fine, subangular blocky structure breaking to weak, fine, granular; soft when dry and very friable when moist; strongly calcareous; clear, smooth boundary.

R—12 inches +, unweathered, semi-indurated, calcareous siltstone.

Epping soils are shallower than Keota soils, with which they are closely associated.

Epping gravelly loam, 5 to 15 percent slopes (EpE).—This soil is on knobs and ridgetops in the northwestern part of the county. The profile is the one described as typical of the series.

This soil has moderate permeability, low water-holding capacity, and low natural fertility. Almost all the acreage is in native grasses, mainly blue grama and little bluestem. (Capability unit VIe-5, nonirrigated; Siltstone Plains range site; windbreak group 4)

Goshen Series

The Goshen series consists of deep, well-drained, nearly level to gently sloping soils that formed in a mixture of silty eolian material, colluvium, and alluvium. These soils are along or near the head of upland drainageways in basins, narrow valleys, and swales. They receive runoff from higher areas and are flooded during periods of heavy rainfall. The dominant native grasses were western wheatgrass, blue grama, and buffalograss.

Typically, Goshen soils have a 6-inch surface layer of very dark brown, very friable silt loam and a 25-inch subsoil that consists of very dark brown clay loam over very dark grayish-brown loam. The underlying material is very dark grayish-brown and light olive-brown loam. This layer contains visible calcium carbonate and a small amount of gravel.

These soils have moderate permeability, high water-holding capacity, and adequate internal drainage. Surface runoff is generally good. Natural fertility is high.

Cultivated areas are used mostly for winter wheat, barley, and sorghum.

The Goshen soils in Sedgwick County are mapped only in an undifferentiated group with Keith and Kuma soils. This mapping unit is described under the heading "Keith Series."

Typical profile of a Goshen silt loam, in a cultivated field, 200 feet north and 2,400 feet west of the southeast corner of sec. 12, T. 10 N., R. 46 W.

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; very dark brown (10YR 2/2) when moist; weak to moderate, medium, subangular blocky structure breaking to moderate to strong, very fine, granular; hard when dry and very friable when moist; noncalcareous; pH 7.0; abrupt, smooth boundary.

B1—6 to 11 inches, grayish-brown (10YR 4/2) clay loam; very dark brown (10YR 2/2) when moist; weak to moderate, medium, subangular blocky structure; few, thin, patchy clay films, principally on vertical faces of aggregates; small amount of gravel; noncalcareous; pH 7.0; clear, smooth boundary.

B2t—11 to 23 inches, dark grayish-brown (10YR 4/2) clay loam; very dark brown (10YR 2/2) when moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry and very friable when moist; many, thin, patchy clay films on faces of aggregates; small amount of gravel; noncalcareous; pH 6.8; gradual, wavy boundary.

B3—23 to 31 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; weak to moderate, medium, subangular blocky structure; hard when dry and very friable when moist; few, thin, patchy clay films on faces of aggregates; small amount of gravel; noncalcareous; pH 6.8; gradual, wavy boundary.

C1—31 to 47 inches, grayish-brown (2.5Y 5/2) loam; very dark grayish brown (2.5Y 3/2) when moist; massive; hard when dry and very friable when moist; small amount of gravel; noncalcareous; pH 7.0; clear, wavy boundary.

C2ca—47 to 60 inches, light yellowish-brown (2.5Y 6/3) loam; light olive brown (2.5Y 5/3) when moist; massive; hard when dry and very friable when moist; small amount of gravel; this is a weak ca horizon that has visible calcium carbonate in thin seams and streaks and in the form of concretions; calcareous; pH 8.2.

The A horizon ranges from very fine sandy loam to silt loam or light clay loam in texture and is 6 to 12 inches thick. In the lower part of the subsoil are layers of a very dark brown buried soil. The depth to visible lime ranges from 20 to 48 inches.

Goshen soils are similar to Rago and Keith soils. They have more stratified and more mixed parent material than Rago soils, and they have layers of buried soil that extend to a greater depth. Goshen soils are darker colored to a greater depth than Keith soils, and they have a more clayey subsoil and are leached of lime to a greater depth.

Haverson Series

The Haverson series consists of deep, well-drained, nearly level to gently sloping, calcareous soils that formed in alluvium that had been only slightly weathered. The native vegetation consisted of mixed grasses, mainly blue grama, western wheatgrass, and needle-and-thread. Woody shrubs and cottonwood trees are common along streambanks in many places. Areas of these soils are on the higher part of flood plains and on low terraces along the South Platte River. They are likely to be flooded at least once a year.

Typically, Haverson soils have an 11-inch surface layer of dark grayish-brown, very strongly calcareous loam. The underlying material also is dark grayish-brown, very strongly calcareous loam.

These soils have moderate to rapid permeability and high water-holding capacity. The water table generally is several feet below the surface. Natural fertility is moderate.

All of the acreage is irrigated. Alfalfa, small grain, sugar beets, and corn are the important crops.

Typical profile of a Haverson loam, in native pasture, 300 feet north and 300 feet east of the southwest corner of sec. 2, T. 11 N., R. 45 W.

A1—0 to 11 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry and very friable when moist; very strongly calcareous; clear, smooth boundary.

C—11 to 40 inches +, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; soft when dry and very friable when moist; very strongly calcareous; clear, smooth boundary.

The A horizon is loam or very fine sandy loam. It ranges from 7 to 15 inches in thickness. The C horizon is stratified; it has thin layers of fine sandy loam and, below a depth of 40 inches, layers of coarse sand or gravel and very dark grayish-brown loam or clay loam.

Haverson soils are lighter colored and less well developed than Tripp soils, with which they are closely associated. They have a lighter colored surface layer than Bridgeport soils.

Haverson loam, 0 to 1 percent slopes (HaA).—This soil is on terraces along the South Platte River. The areas are small and irregularly shaped. The profile is the one described as typical of the series.

This soil has moderate natural fertility. It is susceptible to wind erosion

The entire acreage is irrigated. Crops respond to commercial fertilizer, zinc, and manure. Heavy applications are beneficial if the soil has eroded or has been leveled. Crop residue can be used to help control erosion. (Capability unit I–1, irrigated; not placed in a range site; windbreak group 1)

Haverson loam, 1 to 3 percent slopes (HaB).—This soil is on terraces along the South Platte River. It has a few more eroded spots than Haverson loam, 0 to 1 percent slopes, and more areas that have been leveled.

This soil has moderate fertility. It is susceptible to wind erosion.

The entire acreage is irrigated. Crops respond to manure and commercial fertilizer. Corn, beets, and beans respond to zinc fertilizer. Crop residue can be used to help control erosion. (Capability unit IIe–1, irrigated; not placed in a range site; windbreak group 1)

Haxtun Series

The Haxtun series consists of deep, well-drained, nearly level to gently sloping soils that formed in a mixture of silty and sandy eolian materials over sand and gravel. The native vegetation consisted of mid and short grasses, mainly western wheatgrass, needle-and-thread, sand dropseed, and sandreed. Most areas of these soils are on uplands in the southwestern part of the county, but some small areas are on terraces of the South Platte River between the towns of Julesburg and Ovid.

Typically, Haxtun soils have a 10-inch surface layer of very dark grayish-brown, very friable loamy sand. The upper part of the subsoil is very dark grayish-brown sandy loam over sandy clay loam. The lower part is very dark grayish-brown or dark grayish-brown clay loam, and at a depth of 33 inches, dark grayish-brown loam. The clay loam and loam are parts of a buried soil. Underlying these buried soil materials is light brownish-gray loam over light brownish-gray very fine sandy loam.

If not protected with a plant cover, these soils erode readily. Permeability is rapid in the surface layer and moderate in the subsoil. The water-holding capacity is moderate in the surface layer and upper part of the subsoil and high in the lower part of the subsoil. There is very little surface runoff.

Most of the acreage is dryfarmed, but a few small areas remain in native grass. Winter wheat, barley, corn, and sorghum are the main crops.

Typical profile of a Haxtun loamy sand, in a cultivated field, 2,470 feet north and 70 feet east of the southwest corner of sec. 18, T. 9 N., R. 47 W.

Ap—0 to 10 inches, grayish-brown (10YR 5/2) loamy sand; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure breaking to single grain; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B1—10 to 19 inches, grayish-brown (10YR 5/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, subangular blocky structure; soft when dry and very friable when moist; noncalcareous; very thin but nearly continuous clay bridging between sand grains; clear, smooth boundary.

B21t—19 to 24 inches, dark grayish-brown (10YR 4/2) sandy clay loam; very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry and friable when moist; noncalcareous; thin, patchy films; clear, smooth boundary.

IIB22tb—24 to 28 inches, dark grayish-brown (10YR 4/2) clay loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry and firm when moist; noncalcareous; thin, continuous clay films; clear, smooth boundary.

IIB31b—28 to 33 inches, light brownish-gray (10YR 6/2) clay loam; dark grayish brown (10YR 4/2) when moist; weak to moderate, medium, prismatic structure breaking to weak to moderate, fine, subangular blocky; slightly hard when dry and friable when moist; noncalcareous; thin, continuous clay films; streaks and pockets of darker material from the IIB2 horizon; clear, smooth boundary.

IIB32b—33 to 39 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

IIC1—39 to 45 inches, light-gray (10YR 7/2) loam; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; noncalcareous; gradual, wavy boundary.

IIC2ca—45 to 60 inches, white (10YR 8/2) very fine sandy loam; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; gradual boundary.

The A horizon is loamy sand or sandy loam and is 7 to 15 inches thick. The B2t horizon is clay loam or sandy clay loam and is 5 to 15 inches thick. The IIB22tb horizon is black, very dark brown, or very dark grayish brown. The depth to the IIB22tb horizon ranges from 15 to 30 inches.

Haxtun soils are associated with Julesburg soils, but they have a thicker, finer textured subsoil. They are coarser textured than Rago soils.

Haxtun loamy sand, 0 to 1 percent slopes (HtA).—Areas of this soil are on the terraces of the South Platte River, 1 mile to 2 miles southwest of Julesburg. The profile is the one described as typical of the series.

If not protected, this soil erodes readily. It takes in water very rapidly and stores water in the clay loam layers of the subsoil. Surface runoff is slow, and permeability is moderate in the subsoil. The natural fertility is moderate.

Almost all the acreage is irrigated and cultivated, but a few small areas are still in grass. Most areas have been leveled to increase the efficiency of irrigation. The use of crop residue and close-growing crops and the proper management of irrigation water help to control erosion. The response to manure and commercial fertilizer is good. (Capability unit IIIe-3, irrigated; not placed in a range site; windbreak group 2)

Haxtun loamy sand, 0 to 3 percent slopes (HtB).—Areas of this soil range from 5 to 200 acres in size. Most areas are in the southwestern part of the county. Included in mapping were small areas of Julesburg and Ascalon soils and a few moderately sloping ridges less than 5 acres in size. There are some outcrops of hard limestone, which are shown on the soil map by the outcrop symbol.

If not protected, this soil erodes readily. It has rapid permeability in the surface layer and upper part of the subsoil. Surface runoff is slow. The lower part of the subsoil stores enough moisture for crops.

Almost all the acreage is used for winter wheat, barley, corn, and sorghum. Stubble mulching, use of crop residue, and wind stripcropping help to control erosion. In most years the response to nitrogen fertilizer is good. (Capability unit IIIe-7, nonirrigated; Sandy Plains range site; windbreak group 2)

Haxtun loamy sand, 3 to 5 percent slopes (HtC).—This soil is on narrow, southeast-trending ridges and side slopes in the southwestern part of the county. The profile is similar to the one described as typical of the series, but the surface layer is thinner. A few small outcrops of hard limestone occur, and these are shown on the soil map by the outcrop symbol. Included in mapping were small areas of Ascalon and Julesburg soils.

If not protected, this soil erodes readily. Permeability is rapid in the surface layer and the upper part of the subsoil. Surface runoff is slow. The water-holding capacity of the clay loam subsoil is good.

This soil is suitable for limited cultivation. Nearly all the acreage is used for winter wheat, corn, winter barley, and sorghum. Close-growing crops should be grown as much as possible. Stubble-mulch farming, use of crop residue, and wind stripcropping help to control erosion. The response to nitrogen fertilizer is good. (Capability unit IVe-5, nonirrigated; Sandy Plains range site; windbreak group 2)

Haxtun sandy loam, 0 to 1 percent slopes (HxA).—Large areas of this soil are on terraces of the South Platte River, about 3 miles west of Julesburg. The profile is similar to one described as typical of the series, but the surface layer is sandy loam.

This soil takes in water rapidly, has moderate to high water-holding capacity, and has moderate natural fertility. It is subject to wind erosion. Surface runoff is slow.

All the acreage is irrigated. Crops respond well to manure or commercial fertilizer. Erosion is controlled by the use of crop residue, good management of irrigation water, and tillage that roughens the surface. (Capability unit I-2, irrigated; not placed in a range site; windbreak group 1)

Haxtun sandy loam, 0 to 3 percent slopes (HxB).—Areas of this soil are in the southeastern and southwestern parts of the county. The profile is like the one described as typical of the series, but the surface layer is sandy loam instead of loamy sand. A few small outcrops of hard limestone occur, and these are shown on the soil map by the outcrop symbol.

If not protected, this soil is subject to wind erosion. Permeability is rapid in the surface layer and the upper part of the subsoil. Surface runoff is slow. The water-holding capacity of the clay loam subsoil is good.

Almost all the acreage is cultivated. The crops are winter wheat, corn, winter barley, and sorghum. Crops respond well to nitrogen fertilizer. Stubble mulching or other use of crop residue and wind stripcropping help to control erosion. (Capability unit IIe–2, nonirrigated; Sandy Plains range site; windbreak group 1)

Julesburg Series

The Julesburg series consists of deep, somewhat excessively drained soils that formed in sandy eolian deposits. The native vegetation consisted of sandreed, needle-and-thread, grama, and other grasses. Areas of these soils are on smooth uplands in the southwestern part of the county.

Typically, Julesburg soils have a 7-inch surface layer of very dark grayish-brown, friable loamy sand and a 26-inch subsoil that consists of very dark grayish-brown sandy loam over dark grayish-brown sandy loam. The underlying material is dark grayish-brown loamy sand over brown sand.

These soils have very rapid permeability, low water-holding capacity, and moderate natural fertility. There is very little surface runoff, and consequently surface drainage channels are lacking or only poorly established.

About 60 percent of the acreage is still in native grasses, but the rest is used for winter wheat, barley, sorghum, alfalfa, and corn. Some areas of native grass, especially those that have been overgrazed, have been invaded by cactus, yucca, and sand sage.

Typical profile of a Julesburg loamy sand, in native pasture, 1,043 feet north and 165 feet east of the southwest corner of sec. 17, T. 9 N., R. 46 W.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loamy sand; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry and friable when moist; noncalcareous; clear, smooth boundary.

B21t—7 to 13 inches, grayish-brown (10YR 5/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and very friable when moist; noncalcareous; thin, nearly continuous clay films; clear, smooth boundary.

B22t—13 to 19 inches, light brownish-gray (10YR 6/2) sandy loam; dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B3—19 to 33 inches, light brownish-gray (10YR 6/2) sandy loam; dark grayish brown (10YR 4/2) when moist and crushed; massive, but breaks to weak, medium, subangular blocky structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C1—33 to 47 inches, light brownish-gray (10YR 6/2) loamy sand; dark grayish brown (10YR 4/2) when moist; massive; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C2—47 to 60 inches, very pale brown (10YR 7/3) sand; brown (10YR 5/3) when moist; massive; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

The A horizon ranges from 6 to 10 inches in thickness, and the B2t horizon, from 12 to 30 inches. Generally, these soils are leached of lime to a depth of at least 48 inches, but a small area northeast of Ovid is leached to a depth of only 24 inches.

Julesburg soils are dark colored to a greater depth than Dunday soils. They differ from Haxtun soils in lacking layers of dark-colored clay loam in the lower part of the subsoil.

Julesburg loamy sand, 0 to 3 percent slopes (JuB).—Areas of this soil are small and irregularly shaped. They are in the southwestern part of the county, near areas of Haxtun, Valentine, and Ascalon soils. The profile is the typical one described for the series. Included in mapping were a few small areas of Haxtun and Ascalon soils.

This soil erodes readily. It has very rapid permeability, low water-holding capacity, and moderate natural fertility. Surface runoff is slow.

About half the acreage is in native grass, mainly little bluestem, side-oats grama, needle-and-thread, and western wheatgrass. The rest is dryfarmed and used for winter wheat, barley, sorghum, alfalfa, and some corn. Stubble-mulch farming, management of crop residue, and wind stripcropping are needed for control of erosion. (Capability unit IIIe–7, nonirrigated; Sandy Plains range site; windbreak group 2)

Julesburg loamy sand, 3 to 5 percent slopes (JuC).—Areas of this soil are on southeast-trending ridges and side slopes, mostly near areas of Valentine soils in the southwestern part of the county. Included in mapping were small areas of Valentine soils.

About 70 percent of the acreage is in native grass, mainly needle-and-thread, side-oats grama, western wheatgrass, little bluestem, and sand dropseed. The rest is cultivated. Dryfarmed areas are used for winter wheat, winter barley, sorghum, and alfalfa. In these areas close-growing crops are needed most of the time, and stubble-mulch farming and wind stripcropping are other good practices that help to control erosion. Some of the acreage northeast of Ovid is irrigated. The main crops are corn and alfalfa. In the irrigated areas, the use of crop residue and good management of irrigation water are necessary for control of erosion. (Capability unit IVe–3, irrigated, and capability unit IVe–5, nonirrigated; Sandy Plains range site; windbreak group 2)

Keith Series

The Keith series consists of deep, well-drained, nearly level to moderately sloping soils that formed in silty eolian material. The native vegetation consisted of mid and short grasses, mainly western wheatgrass and blue grama. Areas of these soils are on uplands and on terraces along the South Platte River.

Typically, Keith soils have a 7-inch surface layer of very dark grayish-brown loam and a 19-inch subsoil that consists of about 4 inches of very dark brown loam over dark grayish-brown heavy loam. The underlying material is brown, friable silt loam.

These soils absorb water well and have high water-holding capacity. Natural fertility is high.

Most of the acreage is dryfarmed, but a few small areas are still in native sod. Dryfarmed areas are used for winter wheat, winter barley, some spring grain, and sorghum.

The Keith soils in Sedgwick County are mapped only in complexes and undifferentiated groups with Goshen, Kuma, Tripp, and Wages soils.

Typical profile of a Keith loam, in a cultivated field, 1,320 feet west of the northeast corner of sec. 2, T. 10 N., R. 45 W.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; weak to moderate, fine, granular structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B1—7 to 11 inches, dark grayish-brown (10YR 4/2) loam; very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure; slightly hard when dry and friable when moist; noncalcareous; few, thin, patchy clay films on ped faces; clear, smooth boundary.

B2t—11 to 21 inches, grayish-brown (10YR 5/2) heavy loam; dark grayish brown (10YR 4/2) when moist; slightly hard when dry and friable when moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; noncalcareous; thin, patchy clay films on ped faces; clear, smooth boundary.

B3—21 to 26 inches, light brownish-gray (10YR 6/2) heavy loam; dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; soft when dry and friable when moist; noncalcareous; gradual, smooth boundary.

Cca—26 to 60 inches, very pale brown (10YR 7/3) silt loam; brown (10YR 5/3) when moist; massive; very strongly calcareous; this is a prominent horizon of lime accumulation and has visible lime in finely divided forms.

The A horizon ranges from 6 to 12 inches in thickness. The B2t horizon is loam or clay loam and is 8 to 20 inches thick. The depth to calcareous material ranges from 18 to 30 inches. The underlying material ranges from silt loam to very fine sandy loam.

Keith soils are associated with Goshen and Kuma soils. They are less deeply leached than Goshen soils, and they have a thinner surface layer and subsoil than Kuma soils. Keith soils have a less clayey subsoil than Richfield soils. They are similar to Tripp soils, but they have a slightly less clayey subsoil.

Keith, Goshen, and Kuma silt loams, 0 to 3 percent slopes (KgB).—Areas of this undifferentiated group are generally small and elongated. They are in upland depressions in intermittent drainageways. About 35 percent of each area is Keith soil, about 35 percent is Goshen soil, and about 25 percent is Kuma soil. Making up the rest of the acreage are small areas of Rago soils.

The Keith soil in this unit has a profile similar to the one described as typical of the series, but the surface layer is silt loam instead of loam. The Goshen soil in this unit has a profile similar to the one described as typical under the heading "Goshen Series." The Kuma soil in this unit has a profile similar to the one described as typical under the heading "Kuma Series."

The soils in this undifferentiated group have moderate permeability and high water-holding capacity. They receive runoff periodically from adjacent higher areas.

Nearly all the acreage is cultivated, and only a few areas are still in native grass. The crops are winter wheat, barley, and sorghum. Stubble-mulch farming helps to control erosion. (Capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Keith-Kuma silt loams, 0 to 3 percent slopes (KkB).—The soils in this complex are in slight depressions in the uplands. They are at slightly higher elevations than areas of Keith, Goshen, and Kuma silt loams, 0 to 3 percent slopes, and at slightly lower elevations than areas of Rago and Kuma silt loams. About 55 percent of each area is Keith soil, and about 45 percent is Kuma soil. Included in mapping were small areas of Rago loam.

The Keith soil in this unit has the profile described as typical of the series. The Kuma soil has the profile described as typical under the heading "Kuma Series."

The soils in this complex have moderate permeability, high water-holding capacity, and high natural fertility. Surface runoff is medium.

Nearly all the acreage is cultivated. Winter wheat and sorghum are the main crops. Wind erosion can be controlled by stubble-mulch farming. (Capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Keith and Tripp loams, 0 to 1 percent slopes (KtA).—Most areas of this unit are on terraces of the South Platte River, but some extend into the lower part of the uplands. Included in mapping were small areas of Chappell soils and a few areas of soils that are similar to Tripp soils and have sand or gravel at a depth of about 38 inches.

The Keith soil in this unit has a profile like the one described as typical of the series. The Tripp soil in this unit has a profile like the one described as typical under the heading "Tripp Series."

The soils in this unit have moderate permeability, high water-holding capacity, and high natural fertility.

These soils are well suited to intensive cultivation. All the acreage is irrigated. The main crops are sugar beets, beans, corn, and alfalfa. (Capability unit I–1, irrigated; not placed in a range site; windbreak group 1)

Keith and Tripp loams, 1 to 3 percent slopes (KtB).—The Keith soil in this unit has a profile similar to the one described as typical of the series. The Tripp soil has a profile similar to the one described as typical under the heading "Tripp Series."

The soils in this group have moderate permeability, high water-holding capacity, and high natural fertility.

Most of the acreage is cultivated; some is irrigated; and some is dryfarmed. Wind erosion can be controlled in dryfarmed areas by the use of crop residue and stubble-mulch tillage. Water erosion can be controlled in irrigated areas by land leveling and good management of irrigation water. (Capability unit IIe–1, irrigated, and capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Keith and Wages soils, 5 to 12 percent slopes (KwE).—This unit is southwest of Julesburg. The soils show more signs of erosion than other soils in the Keith and Wages series. The Keith soil has a little gravel on the surface. About 70 percent of each area is Keith soil, and about 30 percent is Wages soil. Included in mapping were a few small areas of Eckley and Chappell soils.

The Keith soil in this unit has a profile similar to the one described as typical of the Keith series. The Wages soil has a profile similar to the one described as typical under the heading "Wages Series."

The soils in this unit have moderate permeability, moderate to high water-holding capacity, and high natural fertility.

The entire acreage remains in blue grama, western wheatgrass, little bluestem, and other native grasses. (Capability unit VIe–2, nonirrigated; Loamy Plains range site; windbreak group 1)

Keota Series

The Keota series consists of moderately deep, well-drained, gently sloping to moderately sloping soils that formed in calcareous colluvium over slightly weathered siltstone bedrock. These soils are very strongly calcareous throughout. The native vegetation consisted of blue grama, western wheatgrass, buffalograss, sage, snakeweed, and annual weeds. Areas of these soils are in the northwestern part of the county, adjacent to intermittent streams and drainageways leading from the uplands to the terraces of the South Platte River.

Typically, Keota soils have a surface layer of very dark grayish-brown loam or silt loam about 4 inches thick and a transitional layer of dark grayish-brown very light silty clay loam that extends to a depth of about 9 inches. The underlying material is grayish-brown very light silty clay loam. Slightly weathered siltstone occurs at a depth of about 23 inches.

These soils have moderately slow permeability, moderate water-holding capacity, and moderate natural fertility. Surface runoff is rapid to very rapid. Water erosion is a hazard in grassland areas, and both wind erosion and water erosion are hazards in cultivated areas.

The Keota soils in Sedgwick County are mapped only in a complex with Epping soils.

Typical profile of Keota loam, in native pasture, 200 feet south and 500 feet west of the northeast corner of sec. 6, T. 11 N., R. 46 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft when dry and very friable when moist; very strongly calcareous; pH approximately 8.0; clear, smooth boundary.

AC—4 to 9 inches, light brownish-gray (10YR 6/2) very light silty clay loam; dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard when dry and very friable when moist; about 40 percent siltstone fragments; very strongly calcareous; pH approximately 8.2; gradual, wavy boundary.

C1—9 to 23 inches, light-gray (10YR 7/2) very light silty clay loam; grayish brown (10YR 5/2) when moist; massive; very hard when dry and very firm when moist; 40 percent siltstone fragments; very strongly calcareous; pH approximately 8.2; gradual, wavy boundary.

R—23 inches +, slightly weathered siltstone; white (10YR 8/2) when dry, light brownish gray (10 YR 6/2) when moist.

The A horizon ranges from silt loam to very fine sandy loam in texture and from 1 inch to 4 inches in thickness. The C horizon is silt loam, heavy loam, sandy clay loam, or silty clay loam and commonly has a few hard lime concretions in the lower part. The depth to the R horizon ranges from 20 to 40 inches.

Keota soils are similar to Epping soils but are deeper.

Keota-Epping loams, 3 to 9 percent slopes (KyD).—Keota soil makes up about 70 percent of each area of this complex, and Epping soil about 30 percent. The Keota soil in this unit has a profile similar to the one described as typical of the series. The Epping soil has a profile similar to the one described under the heading "Epping Series."

The acreage of this complex is about equally divided beween irrigated farming areas and dryfarming areas. Dryfarming results in active erosion. The use of close-growing crops and good management of irrigation water help to control erosion in irrigated areas. (Capability unit IVe-1, irrigated, and capability unit VIe-5, nonirrigated; Siltstone Plains range site; windbreak group 4)

Kuma Series

The Kuma series consists of deep, well-drained, nearly level to gently sloping soils that formed in silty eolian material. These soils are on uplands.

Typically, Kuma soils have an 8-inch surface layer of very dark grayish-brown, very friable silt loam and a 34-inch subsoil that consists of dark-brown heavy silt loam in the uppermost layer and black heavy silt loam over brown or dark-brown, calcareous silt loam in the underlying layers. Below a depth of about 18 inches is a buried soil. The underlying material is brown silt loam.

These soils have moderate permeability, high water-holding capacity, and high natural fertility. They erode readily unless protected.

If protected from erosion, these soils can be used either for irrigated farming or for dryfarming. They are also suited to grass. Nearly all the acreage is cultivated. Erosion can be controlled by stubble mulching, good management of irrigation water, and other practices.

In Sedgwick County, Kuma soils are mapped only in undifferentiated groups with Keith, Rago, and Goshen soils. The mapping units are described under the headings "Keith Series" and "Rago Series."

Typical profile of a Kuma silt loam, under native grass, 720 feet south and 20 feet east of the northwest corner of sec. 12, T. 10 N., R. 45 W.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; very dark grayish brown (10YR 3/2) when moist; strong, fine, granular structure; soft when dry and very friable when moist; noncalcareous; pH 7.0; clear, smooth boundary.

B21t—8 to 18 inches, brown (10YR 5/3) heavy silt loam; dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry and very friable when moist; thin, nearly continuous clay films; noncalcareous; pH 7.4; clear, smooth boundary.

B22tb—18 to 28 inches, dark-gray (10YR 4/1) heavy silt loam; black (10YR 2/1) when moist; moderate, medium, prismatic structure breaking to moderate to strong, medium, subangular blocky; thin, nearly continuous clay films; noncalcareous; pH 7.6; clear, smooth boundary.

B23tcab—28 to 36 inches, brown (10YR 5/3) silt loam; brown or dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry and very friable when moist; thin, patchy clay films on all faces; calcareous; gradual, smooth boundary.

B3cab—36 to 42 inches, pale-brown (10YR 6/3) silt loam; brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard when dry and very friable when moist; few, patchy clay films; calcareous; pH 8.2; moderate accumulation of visible calcium carbonate; gradual, smooth boundary.

Ccab—42 to 60 inches, pale-brown (10YR 6/3) silt loam; brown (10YR 5/3) when moist; massive; hard when dry and very friable when moist; moderate accumulation of visible calcium carbonate; calcareous; pH 8.2.

The A horizon ranges from 6 to 8 inches in thickness. In many places a 3-inch transitional A3 horizon of very dark grayish brown occurs between the A horizon and the B horizon. The depth to the buried B horizon ranges from 12 to 20 inches. The depth to calcareous material ranges from 22 to 36 inches. At a depth of 4 to more than 6 feet is gravelly material.

Kuma soils lack the layers of clay loam in the subsoil that are typical of Rago soils. They have a less clayey, generally darker colored subsoil than Tripp soils.

Lamo Series

This series consists of deep to moderately deep, somewhat poorly drained, nearly level soils that formed in alluvium. Areas of these soils are on low terraces along the South Platte River, mostly south of the towns of Ovid and Julesburg.

Typically, Lamo soils have a surface layer that consists of 2 inches of very dark grayish-brown, very friable clay loam, which overlies 11 inches of very dark grayish-brown, firm silty clay loam. Cracks form in this layer when the soil is dry. The underlying material consists of black silty clay loam over very dark brown silty clay loam, beneath which is very dark gray clay loam. The lower part of this material contains a large amount of visible lime and salts. The silty clay loam tends to contract and crack when dry.

These soils have slow surface runoff and slow internal drainage. The water-holding capacity is high, but because of the salts, not all of the water is available to plants. Natural fertility is high.

These soils are used primarily for pasture or native hay, but some small areas are irrigated and used for sugar beets, corn, and alfalfa.

Typical profile of Lamo clay loam, in native pasture, 1,010 feet east of the center of sec. 8, T. 11 N., R. 45 W.

A11—0 to 2 inches, grayish-brown (10YR 5/2) clay loam; very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure breaking to weak, fine, granular; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

A12—2 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; extremely hard when dry and firm when moist; clear, wavy boundary.

C1sa—13 to 27 inches, very dark gray (10YR 3/1) silty clay loam; black (10YR 2/1) when moist; massive, but breaks to weak, medium, subangular blocky structure; extremely hard when dry and firm when moist; weakly calcareous; 5 percent of this horizon has concretions, seams, and streaks of visible salts; clear, smooth boundary.

C2sa—27 to 42 inches, dark-gray (10YR 4/1) silty clay loam; very dark brown (10YR 2/2) when moist; massive; extremely hard when dry and firm when moist; weakly calcareous; 5 to 10 percent of this horizon has seams, streaks, and soft concretions of visible salts; clear, smooth boundary.

C3sa—42 to 60 inches, dark-gray (10YR 4/1) clay loam; very dark gray (10YR 3/1) when moist; massive; extremely hard when dry and firm when moist; weakly calcareous; 3 to 5 percent of horizon has seams, streaks, and soft concretions of visible salts; clear, smooth boundary.

The underlying material consists of stratified alluvial deposits that have textures of silty clay loam, clay loam, and sandy clay. The depth to beds of clean sand and gravel ranges from 40 to 70 inches.

These soils are associated with areas of Slickspots.

Lamo clay loam (0 to 1 percent slopes) (Lo).—The profile of this soil is the one described as typical of the series. Included in mapping were small areas of Wann soils.

This soil takes in water slowly and is somewhat poorly drained. The water-holding capacity is high.

This soil is suitable both for irrigated farming and for dryfarming. If tilled when wet, it develops a plowsole, which may have to be broken up by chiseling. Drainage is needed if alfalfa, beets, or corn is grown. Many areas need to be leveled before being irrigated. (Capability unit IIIw–2, irrigated, and capability unit IIIw–3, nonirrigated; Salt Meadow range site; windbreak group 5)

Las Series

The Las series consists of deep, somewhat poorly drained, nearly level soils that formed in stratified loamy alluvium over sand and gravel. The native vegetation consisted of western wheatgrass, alkali sacaton, saltgrass, and switchgrass. Areas of these soils are on low terraces along the South Platte River.

Typically, Las soils have a surface layer of very dark grayish-brown loam and a transitional layer of brown heavy loam. The underlying material is grayish-brown heavy loam or light clay loam over olive-gray sandy loam. These soils are strongly to very strongly calcareous.

These soils have moderate permeability and medium internal drainage. Surface runoff is medium. Salts have accumulated because of a fluctuating water table that is within 14 inches of the surface during wet years.

Most areas of Las soils are still in native grass, but some small areas are cultivated and used for sugar beets, corn, and alfalfa.

Typical profile of Las loam, in native pasture, 500 feet south and 75 feet east of the northwest corner of lot 4 in sec. 23, T. 12 N., R. 44 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; weak to moderate, very fine, granular structure; soft when dry and very friable when moist; strongly calcareous; clear, smooth boundary.

AC—3 to 14 inches, pale-brown (10YR 6/3) heavy loam; brown (10YR 5/3) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; slightly hard when dry and plastic when wet; strongly calcareous; gradual, smooth boundary.

C1—14 to 26 inches, light brownish-gray (10YR 6/2) heavy loam or light clay loam; grayish brown (10YR 5/2) when moist; massive; slightly hard when dry and plastic when wet; strongly calcareous; few, small, faint mottles of dark yellowish brown (10YR 4/4); gradual, smooth boundary.

C2cag—26 to 41 inches, light brownish-gray (2.5Y 6/2) loam; grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry and plastic when wet; strongly calcareous; common distinct mottles of dark yellowish brown (10YR 4/4); weak accumulation of calcium carbonate, mostly as concretions; gradual, smooth boundary.

C3g—41 to 60 inches, light olive-gray (5Y 6/2) sandy loam; olive gray (5Y 5/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; many, coarse, prominent mottles of strong brown (7.5YR 5/6).

The A horizon is heavy loam or clay loam in texture and ranges from 3 to 14 inches in thickness. The depth to mottling ranges from 12 to 24 inches, and the depth to an accumulation of visible calcium carbonate is generally 20 to 30 inches.

Las soils are associated with areas of Slickspots.

Las loam (0 to 1 percent slopes) (Ls).—The profile of this soil is the one described as typical of the series. Included in mapping were small areas of Wann soils.

This soil is suited to grass and to cultivated crops. Drainage is needed in most cultivated areas. Crops respond to fertilizer. (Capability unit IIs–2, irrigated, and capability unit IIIw–3, nonirrigated; Salt Meadow range site; windbreak group 5)

Manter Series

The Manter series consists of deep, well-drained, gently sloping to moderately sloping soils that formed in sandy eolian material. Dominant in the native vegetation were needle-and-thread, little bluestem, western wheatgrass, blue grama, side-oats grama, and sand dropseed.

Typically, Manter soils have a 7-inch surface layer of very dark grayish-brown sandy loam and an 18-inch subsoil that consists of very dark grayish-brown sandy loam over dark-brown fine sandy loam, below which is dark-brown loamy sand. The underlying material is brown, calcareous loamy sand.

These soils have rapid permeability and moderate water-holding capacity. There is very little surface runoff.

These soils are used entirely for native range.

The Manter soils in Sedgwick County are mapped only in a complex with Bayard and Ascalon soils. This mapping unit is described under the heading "Bayard Series."

Typical profile of a Manter sandy loam, in native pasture, 2,240 feet north of the southwest corner of sec. 29, T. 11 N., R. 46 W.

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B1—7 to 11 inches, dark grayish-brown (10YR 4/2) sandy loam; very dark grayish brown (10YR 3/2) when moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry and very friable when moist; noncalcareous; thin, patchy clay films; clear, smooth boundary.

B21t—11 to 17 inches, brown (10YR 5/3) sandy loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry and very friable when moist; noncalcareous; thin, patchy clay films; clear, smooth boundary.

B22t—17 to 23 inches, pale-brown (10YR 6/3) fine sandy loam; dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry and friable when moist; noncalcareous; thin, patchy clay films; clear, smooth boundary.

B3—23 to 25 inches, pale-brown (10YR 6/3) loamy sand; dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C1ca—25 to 32 inches, very pale brown (10YR 7/3) loamy sand; brown (10YR 5/3) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; gradual, smooth boundary.

C2—32 to 60 inches, very pale brown (10YR 7/3) loamy sand; brown (10YR 5/3) when moist; massive; soft when dry and very friable when moist; strongly calcareous.

The A horizon ranges from 7 to 11 inches in thickness and is thickest near the base of long, smooth side slopes. The depth to lime ranges from 25 to 30 inches.

Manter soils are similar to Julesburg soils, but they have calcareous instead of noncalcareous underlying material.

McCook Series

The McCook series consists of well-drained, nearly level soils that formed in alluvium. They are moderately deep to sandy material. The native vegetation consisted of western wheatgrass, blue grama, saltgrass, and alkali sacaton. Areas of these soils are on low terraces along the South Platte River.

Typically, McCook soils have a 14-inch surface layer of very dark gray loam and a transitional layer of dark grayish-brown loam. The underlying material is light yellowish-brown sandy clay loam over clay loam. At a depth of about 38 inches is light olive-brown loamy sand. The depth to visible lime is about 20 inches.

These soils have moderate permeability, medium internal drainage, and moderate to high water-holding capacity. Surface runoff is medium. The water table sometimes rises to about 38 inches below the surface. These soils are used for irrigated crops and for pasture.

Typical profile of McCook loam, in native pasture, 1,050 feet south and 215 feet west of the northeast corner of sec. 11, T. 11 N., R. 46 W.

A1—0 to 14 inches, gray (10YR 5/1) loam; very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

AC—14 to 20 inches, light brownish-gray (2.5Y 6/2) loam; dark grayish brown (2.5Y 4/2) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry and very friable when moist; strongly calcareous; clear, smooth boundary.

C1ca—20 to 32 inches, pale-yellow (2.5Y 7/3) light sandy clay loam; light yellowish brown (2.5Y 6/3) when moist; massive, but breaks to very weak, medium, subangular blocky structure; soft when dry and friable when moist; strongly calcareous; this is a weak ca horizon that has some visible calcium carbonate in thin seams and streaks and in the form of concretions; clear, smooth boundary.

C2ca—32 to 38 inches, pale-yellow (2.5Y 7/3) light clay loam; light yellowish brown (2.5Y 6/3) when moist; moderate, medium, subangular blocky structure; hard when dry and friable when moist; very strongly calcareous; this is a weak ca horizon that has some visible calcium carbonate in thin seams and streaks and in the form of concretions; abrupt, smooth boundary.

IIC3—38 to 60 inches +, light yellowish-brown (2.5Y 6/3) loamy sand; light olive brown (2.5Y 5/3) when moist; massive to single grain; soft when dry and very friable when moist; strongly calcareous; many, coarse, prominent mottles of light olive brown (2.5Y 5/6).

The A horizon ranges from 7 to 18 inches in thickness. The C horizon contains thin layers of silty and sandy material.

McCook soils are associated with Wann soils, but they have a more silty and clayey surface layer and better drained underlying material.

McCook loam (0 to 1 percent slopes) (Mc).—Areas of this soil are small, elongated, and generally parallel to the river channel. They are generally slightly higher than areas of Slickspots. The profile of this soil is the one described as typical of the series. Included were small areas of Wann soils.

This soil has moderate permeability, moderate to high water-holding capacity, and high natural fertility.

This soil is suitable for cultivation, and the entire acreage is irrigated. Corn, beans, sugar beets, alfalfa, and other crops grow well. These crops respond well to fertilizer. Proper management is needed to make sure that irrigation will not cause the water table to rise. (Capability unit IIIw-1, irrigated; not placed in a range site; windbreak group 3)

Rago Series

The Rago series consists of deep, well-drained, nearly level to gently sloping soils. The native vegetation consisted of mid and short grasses, dominantly western wheatgrass, blue grama, and, where the surface layer was thin, buffalograss. Wide areas of these soils are on uplands throughout the hardland part of the county.

Typically, Rago soils have a 5-inch surface layer of very dark gray, very friable silt loam and a 5-inch layer, transitional between the surface layer and subsoil, of dark grayish-brown, friable loam. Beneath this layer, the subsoil is dark-gray or very dark grayish-brown loam over black clay loam, below which is light olive-brown heavy loam. The underlying material is light yellowish-brown loam. It contains a large amount of calcium carbonate, much of which is visible in the form of white threads. At a depth of 40 inches is reddish-brown gravelly material.

These soils have slow permeability, high water-holding capacity, and medium internal drainage. Surface runoff is medium. Natural fertility is high.

Except for a few small areas, these soils are dryfarmed. The crops are winter wheat, winter barley, spring grain, and sorghum.

The Rago soils in Sedgwick County are mapped only in two undifferentiated groups with Kuma soils.

Typical profile of a Rago silt loam, in native pasture, 1,584 feet south and 20 feet west of the northeast corner of sec. 32, T. 11 N., R. 45 W.

A1—0 to 5 inches, gray (10YR 5/1) silt loam; very dark gray (10YR 3/1) when moist; weak, medium, platy structure breaking to weak, very fine, granular; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B1—5 to 10 inches, grayish-brown (10YR 5/2) loam; dark grayish brown (10YR 4/2) when moist; moderate, coarse, subangular blocky structure; slightly hard when dry and friable when moist; noncalcareous; clear, smooth boundary.

B21t—10 to 13 inches, dark-gray or dark grayish-brown (10YR 4/2) loam; dark gray or very dark grayish brown (10YR 3/2) when moist; moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry and friable when moist; noncalcareous; thin, nearly continuous clay films on ped surfaces; clear, smooth boundary.

B22tb—13 to 19 inches, very dark gray (10YR 3/1) clay loam; black (10YR 2/1) when moist; strong, medium, angular blocky structure; hard when dry and friable when moist; noncalcareous; thick, continuous clay films on ped surfaces; clear, smooth boundary.

B23tb—19 to 24 inches, very dark gray or very dark grayish-brown (10YR 3/2) clay loam; black (10YR 2/1) when moist; strong, fine, angular blocky structure; hard when dry and friable when moist; noncalcareous; thick, continuous clay films on ped surfaces; clear, smooth boundary.

B3cab—24 to 28 inches, pale-yellow (2.5Y 7/3) heavy loam; light olive brown (2.5Y 5/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry and friable when moist; moderate lime accumulation; thin, patchy clay films on ped surfaces; clear, smooth boundary.

C1cab—28 to 40 inches, pale-yellow (2.5Y 8/3) loam; light yellowish brown (2.5Y 6/3) when moist; massive; slightly hard when dry and very friable when moist; very strongly calcareous; moderate lime accumulation; some visible lime in the form of concretions and in finely divided forms; gradual boundary.

IIC2ca—40 to 60 inches +, gravelly material; reddish brown (5YR 4/3 to 5/4) when moist; unconsolidated; very strongly calcareous.

The A horizon ranges from 4 to 8 inches in thickness. The B21t horizon ranges from 3 to 10 inches in thickness. The depth to the horizons of buried soil ranges from 8 to 15 inches, the depth to lime from 18 to 38 inches, and the depth to gravelly material from 40 to 72 inches. The profile is normally somewhat thinner in gently sloping areas.

Rago soils are closely associated with Kuma, Keith, and Richfield soils. They have a more clayey subsoil than Kuma and Keith soils. Rago soils are less clayey than Richfield soils. They differ from Keith and Richfield soils in having dark-colored buried layers.

Rago and Kuma silt loams, 0 to 3 percent slopes (RaB).—The soils of this undifferentiated group formed in silty eolian material. They are on uplands south of the towns of Julesburg and Ovid and north of Ovid. About 70 percent of each area is Rago soil, and about 30 percent is Kuma soil. Included in mapping were small areas of Richfield loam and Keith loam and numerous small intermittent lakes.

The Rago soil in this unit has a profile like the one described as typical of the series. The Kuma soil in this unit has a profile like the one described as typical under the heading "Kuma Series."

These soils are permeable. The hazard of erosion is slight.

Nearly all the acreage is dryfarmed. Wheat, barley, and sorghum are the main crops. Stubble-mulch farming helps to conserve moisture and control wind erosion in many fields. The lakebeds frequently cause problems in tilling and harvesting, particularly during wet weather. (Capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Rago and Kuma silt loams, 3 to 5 percent slopes (RaC).—Included with these soils in mapping were a few intermittent lakes and small areas of Keith and Goshen soils that are mainly in swales or drainageways.

The Rago soil in this unit has a profile similar to the one described as typical of the series. The Kuma soil in this unit has a profile similar to the one described as typical under the heading "Kuma Series."

Surface runoff is medium to rapid, the water-holding capacity is high, and natural fertility is high.

Nearly all the acreage is cultivated. Stubble-mulch farming, use of crop residue, and terracing help to conserve water and control erosion. (Capability unit IIIe–4, nonirrigated; Loamy Plains range site; windbreak group 1)

Richfield Series

The Richfield series consists of deep, well-drained, nearly level to gently sloping soils that formed in silty eolian material. The native vegetation consisted mainly of western wheatgrass, blue grama, and, in areas where the surface layer is less than 6 inches thick, buffalograss. Areas of these soils are on uplands, mainly in the eastern part of the county.

Typically, Richfield soils have a 6-inch surface layer of very dark grayish-brown, friable loam and a 3-inch transitional layer of very dark grayish-brown light clay loam. Beneath this layer, the subsoil is very dark grayish-brown clay loam over dark grayish-brown heavy loam. The underlying material is dark-brown loam over brown fine sandy loam. It is very strongly calcareous.

These soils have slow permeability, high water-holding capacity, medium internal drainage, and high natural fertility.

Most of the acreage is cultivated. Winter wheat, barley, sorghum, and spring grain are the principal crops.

Typical profile of a Richfield loam, in a cultivated field, 530 feet north and 50 feet west of the southeast corner of sec. 8, T. 11 N., R. 43 W.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry and friable when moist; noncalcareous; few small pebbles; clear, smooth boundary.

AB—6 to 9 inches, grayish-brown (10YR 5/2) light clay loam; very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky; slightly hard when dry and friable when moist; noncalcareous; thin, patchy clay films; few small pebbles; clear, smooth boundary.

B2t—9 to 15 inches, grayish-brown (10YR 5/2) clay loam; very dark grayish brown (10YR 3/2) when moist; strong, medium, prismatic structure breaking to strong, medium and fine, subangular blocky; soft when dry and friable when moist; noncalcareous; thick, continous clay films on all ped faces; clear, smooth boundary.

B3—15 to 19 inches, light brownish-gray (10YR 6/2) heavy loam; dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium and fine, subangular blocky; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

C1ca—19 to 36 inches, pale-brown (10YR 6/3) loam; dark brown (10YR 4/3) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; clear, smooth boundary.

IIC2ca—36 to 60 inches, very pale brown (10YR 7/3) fine sandy loam; brown (10YR 5/3) when moist; soft when dry and very friable when moist; very strongly calcareous. Soil material grades to reddish-brown (5YR 5/4) gravelly loam below a depth of 43 inches.

The A horizon ranges from 4 to 8 inches in thickness, and the B2t from 5 to 15 inches in thickness. The depth to the IIC horizon ranges from 30 to 60 inches.

Richfield soils are closely associated with Keith and Rago soils. They have a more clayey, more strongly structured subsoil than Keith soils. Richfield soils lack the dark-colored buried layers that are characteristic of Rago soils.

Richfield loam, 0 to 3 percent slopes (RcB).—Areas of this soil are irregularly shaped. They appear as rises or as elongated, southeast-trending ridges. They are on uplands and occupy a slightly higher position in the landscape than Rago and Kuma silt loams. There are many small intermittent lakes. The profile is the one described as typical of the series. Included in mapping were small areas of Rago and Kuma loams.

This soil has slow permeability, high water-holding capacity, and high natural fertility.

Nearly all the acreage is dryfarmed. Winter wheat, winter barley, and sorghum are the main crops. Stubble-mulch farming helps to control erosion and conserve moisture. Periodic chiseling when the soil is dry breaks up the plowsole that tends to form in the upper part of the subsoil if the soil is tilled when wet. (Capability unit IIc–1, nonirrigated; Loamy Plains range site; windbreak group 1)

Richfield loam, 3 to 5 percent slopes (RcC).—Areas of this soil are on rises and southeast-trending ridges and on side slopes along some intermittent streams. The profile is similar to the one described as typical of the series, but the surface layer and the upper part of the subsoil are thinner. Included in mapping were small areas of Wages soils.

This soil has slow permeability, high water-holding capacity, and high natural fertility. Surface runoff is medium.

Nearly all the acreage is cultivated. Stubble-mulch farming, use of crop residue, and terracing help to control erosion and conserve moisture. Chiseling when the soil is dry breaks up the plowsole that forms easily if the soil is tilled when wet. (Capability unit IIIe–4, nonirrigated; Loamy Plains range site; windbreak group 1)

Sandy Alluvial Land

Sandy alluvial land (Sa) consists of an unstable accumulation of gravelly and sandy alluvium washed from gravel beds that contain thin lenses and pockets of silt, clay, and sand. Areas of this land type occur in and adjacent to the beds of intermittent streams, principally tributaries of the South Platte River. Flooded during heavy rains, these areas are subject to relocation of channels and shifting of sediments. These same areas are extremely droughty during periods of dry weather (fig. 4).

Sandy alluvial land is made up of coarser textured soil material than Wet alluvial land and lacks the high water table that is characteristic of Wet alluvial land.

Areas of this land type are suitable for grass and are used mainly for grazing. (Capability unit VIIw–1, nonirrigated; not placed in a range site; windbreak group 5)

Scott Series

The Scott series consists of deep, poorly drained soils that occur in upland depressions or potholes where rainwater accumulates. Areas of these soils are south of the towns of Ovid and Julesburg.

Typically, Scott soils have a 17-inch surface layer of very dark grayish-brown, very friable silt loam over dark-gray, friable silt loam. The 25-inch subsoil is a claypan. It consists of very dark gray and dark-gray silty clay over olive-brown silty clay. The underlying material, below a depth of 42 inches, is light olive-brown silty clay loam.

These soils have slow permeability and are ponded for long periods late in May and in June.

Most areas of these soils are cultivated because they are within large areas of Rago, Kuma, Richfield, or Keith soils, and it is easier to cultivate and plant them than to farm around them.

Typical profile of Scott silt loam, 2,500 feet north and 200 feet east of the southwest corner of sec. 23, T. 10 S., R. 45 W.

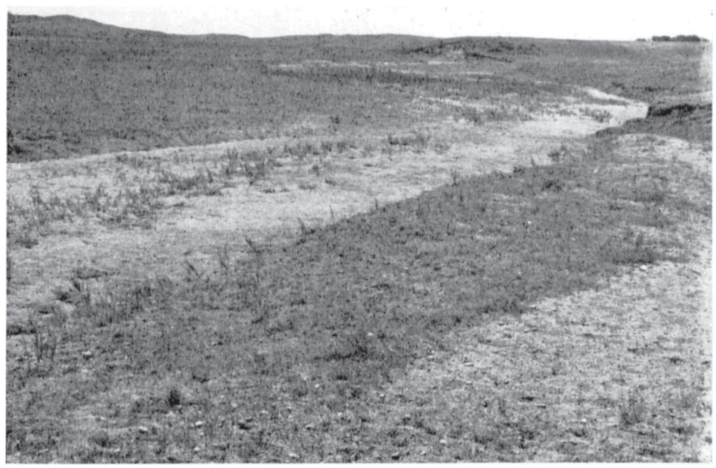

Figure 4.—**Area of Sandy alluvial land on terrace of intermittent stream during dry weather. This same area is frequently flooded.**

A1—0 to 11 inches, grayish-brown (10YR 5/2) silt loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; soft when dry and very friable when moist; pH approximately 5.7; clear, smooth boundary.

A2—11 to 17 inches, light-gray (10YR 6/1) silt loam; dark gray (10YR 4/1) when moist; thin platy structure; slightly hard when dry and friable when moist; pH approximately 6.2; abrupt, smooth boundary.

B21t—17 to 28 inches, gray (10YR 5/1) silty clay; very dark gray (10YR 3/1) when moist; weak, coarse, prismatic structure; extremely hard when dry and firm when moist; pH approximately 6.9; gradual, smooth boundary.

B22t—28 to 36 inches, gray (10YR 5/1) silty clay; dark gray (10YR 4/1) when moist; weak, coarse, prismatic structure; very hard when dry and firm when moist; noncalcareous; pH 7.2; few fine mottles of yellowish brown (10YR 5/5); gradual, smooth boundary.

B3—36 to 42 inches, light olive-brown (2.5Y 5/4) silty clay; olive brown (2.5Y 4/4) when moist; weak, coarse, subangular blocky structure; very hard when dry and firm when moist; noncalcareous; gradual, smooth boundary.

C—42 to 60 inches, light yellowish-brown (2.5Y 6/4) silty clay loam; light olive brown (2.5Y 5/4) when moist; massive; hard when dry and firm when moist; noncalcareous.

The surface layer ranges from silt loam to silty clay loam in texture and from 6 to 24 inches in thickness.

Scott silt loam (0 to 1 percent slopes) (Sc).—This soil occurs throughout the uplands, as areas 5 to 8 acres in size. It is ponded frequently, most commonly late in spring and early in summer. In many years it is damaged somewhat by wind erosion in winter and early in spring.

Because of the ponding, this soil is not suited to crops, but some areas have a vigorous growth of buffalograss and western wheatgrass. Wind erosion can be controlled by roughening the surface. (Capability unit VIIw–1, nonirrigated; not placed in a range site; windbreak group 5)

Slickspots

Slickspots (Sk) consists of deep, generally somewhat poorly drained, moderately to strongly saline-alkaline soils. One small area is poorly drained and very salty. These soils formed in alluvium. The slope range is 0 to 1 percent. The native vegetation consisted mainly of alkali sacaton, switchgrass, and saltgrass. The large continuous areas of Slickspots are on low terraces along the South Platte River and Lodgepole Creek, and the small poorly drained area extends from west of the town of Ovid to about 1 mile northwest.

Slickspots have a 2- to 4-inch surface layer of very dark grayish-brown, friable loam to fine sandy loam. This layer is gray and feels ashy when it is dry because the minerals and organic matter have been leached out. The 35-inch subsoil is very dark brown silty clay loam in the upper part and has very dark grayish-brown layers of silty clay loam, loam, and sandy clay loam in the lower part. It contains accumulations of salts. The underlying material is silty and contains visible accumulations of salts and hard concretions of lime. At a depth of 48 inches is sand and gravel.

Slickspots have a water table only 48 to 50 inches below the surface. They have slow permeability, slow internal drainage, and high water-holding capacity. Because they are salty and clayey and, consequently, release moisture slowly, these soils tend to be droughty. There is little surface runoff, and natural fertility is moderate.

Slickspots are associated with areas of Las soils. In their natural state, Slickspots are suited only to salt-tolerant and alkali-tolerant crops. Most of the acreage is still in native grass and is used for pasture early in summer. Since they are underlain by sand and gravel, however, Slickspots can be drained and leached, and many areas are now irrigated. Corn, sugar beets, barley, and alfalfa are suitable irrigated crops. In the small, poorly drained, very salty area, only the most salt-tolerant crops can survive. (Capability unit IVs–1, irrigated, and capability unit VIs–1, nonirrigated; Salt Meadow range site; windbreak group 5)

Tripp Series

The Tripp series consists of deep, well-drained, nearly level soils that formed in deposits of alluvium and colluvium. The native vegetation consisted mainly of grama, buffalograss, and western wheatgrass. Areas of these soils are on high terraces along the South Platte River, and the largest areas are north of the river.

Typically, Tripp soils have a 4-inch surface layer of very dark brown loam and a 31-inch subsoil of very dark brown clay loam over dark grayish-brown loam. The underlying material is grayish-brown, very strongly calcareous loam.

These soils have moderate permeability, high water-holding capacity, and high natural fertility. The erosion hazard is not significant.

Most of the acreage is irrigated and used for sugar beets, alfalfa, corn, and potatoes.

The Tripp soils in Sedgwick County are mapped only in two undifferentiated groups with Keith soils. These mapping units are described under the heading "Keith Series."

Typical profile of a Tripp loam, in a cultivated field, 25 feet west and 25 feet south of the northeast corner of sec. 8, T. 11 N., R. 46 W.

Ap—0 to 4 inches, grayish-brown (10YR 5/2) loam; very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B1—4 to 8 inches, grayish-brown (10YR 5/2) light clay loam; very dark brown (10YR 2/2) when moist and very dark gray (10YR 3/1) when both moist and crushed; weak to moderate, medium, subangular blocky structure; hard when dry and very friable when moist; noncalcareous; few, thin, patchy clay films on faces of aggregates; clear, smooth boundary.

B2—8 to 18 inches, grayish-brown (10YR 5/2) clay loam; very dark brown (10YR 2/2) when moist and very dark gray (10YR 3/1) when both moist and crushed; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry and very friable when moist; noncalcareous; thin, nearly continuous clay films on faces of aggregates; gradual, smooth boundary.

B3—18 to 35 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; very weak, medium, prismatic structure breaking to weak to moderate, medium, subangular blocky; slightly hard when dry and very friable when moist; noncalcareous; thin, patchy clay films, principally on vertical faces of aggregates; clear, smooth boundary.

Cca—35 to 60 inches, light-gray (10YR 7/2) loam; grayish brown (10YR 5/2) when moist; massive; slightly hard when dry and friable when moist; very strongly calcareous; this is a weak ca horizon that has some visible calcium carbonate in thin seams and streaks and in the form of concretions.

The A horizon ranges from loam to light clay loam in texture and from 4 to 8 inches in thickness. The B horizon ranges from clay loam to loam in texture and from 8 to 35 inches in thickness. In some places there is a dark-colored, moderately developed buried layer in the subsoil. At a depth of 36 to 60 inches in some areas are sand and gravel.

Tripp soils are associated with Bridgeport soils, but they have more structural development and are noncalcareous in the A and B horizons.

Ulysses Series

The Ulysses series consists of deep, well-drained, gently sloping to moderately sloping soils that formed in thick deposits of silty eolian material. These soils are on upland ridges and side slopes in the northwestern part of the county.

Typically, Ulysses soils have a 10-inch surface layer of very dark grayish-brown, very friable silt loam and an 8-inch subsoil of dark grayish-brown, strongly calcareous silt loam. The underlying material is brown silt loam over pale-brown silt loam. This material is very strongly calcareous.

If not protected, these soils are susceptible to severe water erosion. They have moderate permeability and high water-holding capacity. Surface runoff is rapid.

The Ulysses soils in Sedgwick County are mapped only in two complexes with Colby soils. These mapping units are described under the heading "Colby Series."

Typical profile of a Ulysses silt loam, under native grass, 2,240 feet east of the southwest corner of sec. 10, T. 11 N., R. 47 W.

A1—0 to 10 inches, grayish-brown (10YR 5/2) silt loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

B2—10 to 18 inches, pale-brown (10YR 6/2) silt loam; dark grayish brown (10YR 4/2) when moist; weak to moderate, fine, subangular blocky structure; soft when dry and very friable when moist; strongly calcareous; krotovinas; clear, smooth boundary.

C1ca—18 to 40 inches, very pale brown (10YR 7/3) silt loam; brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; soft when dry and very friable when moist; very strongly calcareous; clear, smooth boundary.

C2ca—40 to 60 inches, very pale brown (10YR 7/3) silt loam; pale brown (10YR 6/3) when moist; massive; soft when dry and very friable when moist; very strongly calcareous.

The A horizon ranges from 6 to 10 inches in thickness, and the B horizon from 6 to 12 inches. The depth to limy material ranges from 5 to 15 inches.

Ulysses soils have a thicker leached A1 horizon than Colby soils, and they have a B horizon, which Colby soils lack. Both Ulysses and Colby soils formed in silty eolian material.

Valentine Series

The Valentine series consists of deep, excessively drained, undulating to hilly soils that formed in sandy eolian material. Most areas of these soils are on upland sandhills in the southwestern part of the county, but a few large areas are north and west of Julesburg.

Typically, Valentine soils have a 3-inch surface layer of very dark grayish-brown, very friable fine sand and a 10-inch transitional layer of dark-brown fine sand. The underlying material is dark grayish-brown fine sand that grades to pale-brown sand at a depth of 21 inches.

These soils absorb water rapidly but have very rapid internal drainage and low water-holding capacity. There is no surface runoff.

These soils are used almost entirely for native range.

Typical profile of a Valentine fine sand, in native pasture, 520 feet west of the southeast corner of sec. 14, T. 10 N., R. 47 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) fine sand; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure breaking to single grain; soft when dry and very friable when moist; noncalcareous; clear, smooth boundary.

AC—3 to 13 inches, brown (10YR 5/3) fine sand; dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure breaking to single grain; soft when dry and very friable when moist; noncalcareous; gradual, smooth boundary.

C1—13 to 21 inches, light brownish-gray (10YR 6/2) fine sand; dark grayish brown (10YR 4/2) when moist; single grain; loose both when dry and moist; noncalcareous; gradual, smooth boundary.

C2—21 to 60 inches, sand; pale brown (10YR 6/3) when dry and when moist; single grain; loose both when dry and when moist; noncalcareous.

The A horizon ranges from loamy sand to sand in texture and from 1 inch to 5 inches in thickness.

These soils are associated with Dunday soils. They have a thinner surface layer than Dunday soils.

Valentine fine sand, rolling (VaD).—Most areas of this soil are in the southwestern part of the county, but some areas are north and west of Julesburg, along the Nebraska State line. The profile of this soil is the one described as typical of the series. The slope range is 5 to 15 percent. Included in mapping were small areas of Dunday soils.

These soils are well suited to grass. Most areas are still in native grass, but a few small areas are cultivated, mainly for convenience in making a field square or otherwise easier to farm. Eroded areas can be reseeded to grass. (Capability unit VIe-4, nonirrigated; Deep Sand range site; windbreak group 5)

Valentine fine sand, hilly (VaE).—This soil is characterized by blowouts and dune topography. The slope range is 15 to 30 percent. The profile is similar to the one described as typical of the series, but the surface layer is seldom more than 1 inch thick.

If not protected, this soil erodes quickly and severely. It has very rapid permeability and low water-holding capacity and, consequently, is droughty. Natural fertility is low.

This soil is suited only to grass and should not be cultivated. Erosion can be controlled by reseeding, deferment of grazing, proper range use, and stabilization of blowouts. Most areas are in native grass, and most blowout areas have been nearly stabilized. (Capability unit VIIe-1, nonirrigated; Choppy Sand range site; windbreak group 5)

Valentine-Dunday fine sands, undulating (VdC).—Most areas of this complex are in the southwestern part of the county, but some are west of the town of Julesburg. There are some blowout areas, which are shown on the map with a symbol. The slope range is 0 to 3 percent.

The Valentine soil in this unit has a profile similar to the one described as typical of the series. The Dunday soil has a profile similar to the one described as typical under the heading "Dunday Series." The surface layer of these soils ranges from 2 to 12 inches in thickness, and it is thickest in the lower lying areas of Dunday soils.

Overgrazed or unprotected areas of these soils erode quickly and severely. Permeability is rapid, and the water-holding capacity is low. There is no surface runoff.

The soils in this complex are well suited to grass, and most areas are in grass. Cultivated areas and seriously eroded areas should be reseeded to native or introduced grasses and then protected from overgrazing by deferment of grazing, proper distribution of livestock, and proper placement of salt and water. (Capability unit VIe–4, nonirrigated; Deep Sand range site; windbreak group 2)

Wages Series

The Wages series consists of deep, well-drained, gently sloping to moderately sloping soils on uplands. These soils formed in a mixture of silty eolian and gravelly loamy materials. The native vegetation consisted of mid and short grasses, mainly western wheatgrass, blue grama, and buffalograss.

Typically, Wages soils have a 6-inch surface layer of very dark grayish-brown, friable gravelly loam. The friable, 15-inch subsoil consists of very dark grayish-brown loam over very dark grayish-brown clay loam. The color grades to dark grayish brown at a depth of 14 inches. The underlying material, below a depth of 21 inches, consists of dark grayish-brown loam over light brownish-gray loam and, below this, light brownish-gray sandy loam. In this underlying material there is much lime.

These soils have slow to moderate permeability, medium internal drainage, and moderate to high water-holding capacity. Surface runoff is medium.

Most areas are dryfarmed. Winter wheat, winter barley, spring grain, and sorghum are the main crops. A few areas along the side slopes of drainageways are still in native grass.

Typical profile of a Wages gravelly loam, in a cultivated field, 1,585 feet south and 130 feet east of the northwest corner of sec. 5, T. 10 N., R. 45 W.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) gravelly loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry and friable when moist; noncalcareous; clear, smooth boundary.

B1—6 to 9 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; soft when dry and friable when moist; noncalcareous; thin, patchy, clay films; abrupt, smooth boundary.

B2t—9 to 14 inches, grayish-brown (10YR 5/2) clay loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium and fine, angular blocky; soft when dry and very friable when moist; noncalcareous; thick, nearly continuous clay films; clear, smooth boundary.

B3ca—14 to 21 inches, light brownish-gray (10YR 6/2) clay loam; dark grayish brown (10YR 4/2) when moist; weak to moderate, medium, subangular blocky structure; soft when dry and very friable when moist; strongly calcareous; thick, nearly continuous clay films; clear, smooth boundary.

C1ca—21 to 32 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; weak prismatic structure breaking to weak, coarse, subangular blocky; soft when dry and very friable when moist; very strongly calcareous; clear, smooth boundary.

C2ca—32 to 40 inches, light-gray (10YR 7/2) loam; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous; some mixing of dark grayish-brown (10YR 4/2) material from the C1 horizon; gradual, smooth boundary.

C3ca—40 to 60 inches, light-gray (10YR 7/2) sandy loam; light brownish gray (10YR 6/2) when moist; massive; soft when dry and very friable when moist; very strongly calcareous.

The A horizon ranges from 5 to 8 inches in thickness, and the B2t horizon from 3 to 6 inches. The depth to lime ranges from 8 to 15 inches. Gravel content of the surface layer ranges from 5 to 25 percent. Gravel content of the B and C horizons is 5 to 10 percent.

Wages soils are similar to and are associated with Richfield soils. They contain more gravel than Richfield soils, and they are shallower to the horizon of lime accumulation.

Wages gravelly loam, 3 to 5 percent slopes (WaC).—This soil occurs as elongated, irregularly shaped areas, mainly on the side slopes of intermittent streams. The profile is the one described as typical of the series. Included in mapping were slightly concave areas of Richfield loam.

Some areas are irrigated and some are dryfarmed. Stubble-mulch farming, use of crop residue, terracing, and proper management of irrigation water help to control erosion and conserve moisture. Chiseling breaks up the plowpan that forms if this soil is tilled when wet. (Capability unit IIIe–1, irrigated, and capability unit IIIe–4, nonirrigated; Loamy Plains range site; windbreak group 1)

Wages gravelly loam, 5 to 9 percent slopes (WaD).—This soil occurs as long, narrow areas on ridges and on side slopes bordering intermittent streams. The profile is similar to the one described as typical of the series, but it is more gravelly and has a thinner subsoil. There are extremely gravelly areas, which are shown on the soil map with a symbol.

This soil has moderate permeability, moderate to high water-holding capacity, and high natural fertility.

If irrigated, this soil is suited to limited cultivation, but if not irrigated it is suited only to grass. Most areas now cultivated should be seeded to grass. (Capability unit IVe–1, irrigated, and capability unit VIe–2, nonirrigated; Loamy Plains range site; windbreak group 1)

Wann Series

The Wann series consists of deep, somewhat poorly drained, nearly level soils that formed in moderately sandy alluvium. The native vegetation consisted of alkali sacaton, saltgrass, western wheatgrass, needle-and-thread, and blue grama. Areas of this soil are on low terraces along the South Platte River.

Typically, Wann soils have a 14-inch surface layer of very dark gray loam over very dark grayish-brown sandy loam that has a few light olive-brown mottles. The underlying material consists of mottled very dark grayish-brown sandy loam over mottled dark-gray loamy sand, and below this olive-brown sandy loam.

In wet years, the water table is frequently within a few inches of the surface. Surface runoff is medium, permeability is moderate to rapid, and internal drainage is medium.

These soils are irrigated and used for sugar beets, corn, onions and alfalfa. They are also used for summer pasture.

Typical profile of Wann loam, in native pasture, 1,400 feet east and 225 feet north of the center of sec. 9, T. 11 N., R. 45 W.

A11—0 to 8 inches, gray (10YR 5/1) loam; very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry and very friable when moist; strongly calcareous; pH approximately 7.8; clear, smooth boundary.

A12—8 to 14 inches, grayish-brown (2.5Y 5/2) sandy loam; very dark grayish brown (2.5Y 3/2) when moist; weak prismatic structure breaking to weak, coarse, subangular blocky; hard when dry and very friable when moist; few, fine, faint mottles of light olive brown (2.5Y 5/4) when moist; very strongly calcareous; pH approximately 8.0; clear, smooth boundary.

C1g—14 to 22 inches, grayish-brown (2.5Y 5/2) sandy loam; very dark grayish brown (2.5Y 3/2) when moist; massive; hard when dry and very friable when moist; few, fine, faint mottles of olive brown (2.5Y 4/4) when moist; very strongly calcareous; pH approximately 8.2; clear, smooth boundary.

C2g—22 to 32 inches, gray (2.5Y 6/1) loamy sand; dark gray (2.5Y 4/1) when moist; massive, but breaks to single grain; slightly hard when dry and very friable when moist; 50 percent of horizon has mottles that are strong brown (7.5YR 5/6) when moist; very strongly calcareous; pH approximately 8.2; clear, smooth boundary.

C3g—32 to 60 inches, light yellowish-brown (2.5Y 6/3) sandy loam; olive brown (2.5Y 4/3) when moist; massive, but breaks to single grain; soft when dry and very friable when moist; 50 percent of horizon has mottles that are strong brown (7.5YR 5/6) when moist; very strongly calcareous; pH approximately 8.2; clear, smooth boundary.

The A horizon ranges from loam to sandy loam in texture and from 8 to 20 inches in thickness. The C horizon is stratified and has thin lenses of silty or clayey material and thin lenses of sand, but the dominant texture is sandy loam.

Wann soils are associated with areas of Slickspots.

Wann soils (0 to 1 percent slopes) (Wn).—These soils have the profile described as typical of the series. Included in mapping were old stream channels filled with clayey material.

Cultivated areas of these soils need to be leveled and drained. Crops respond to fertilizer. (Capability unit IIIw-1, irrigated, and capability unit IIIw-3, nonirrigated; Sandy Meadow range site; windbreak group 5)

Wet Alluvial Land

Wet alluvial land (Wt) consists of an accumulation of sandy and gravelly alluvium that contains thin lenses of silty and clayey materials and scattered areas of sandy soil material that is moderately deep over gravel. These materials make up sandbars and islands that are frequently flooded and are wet most of the time. Areas of this land type are adjacent to the South Platte River. The slope range is 0 to 3 percent.

Wet alluvial land is wetter than Sandy alluvial land and is made up of somewhat finer textured soil materials.

This land type is not suited to cultivated crops and is poorly suited to pasture. Some areas, however, are used for summer pasture, and because of the windbreak effect of trees, others are used as winter feedlots and bedding areas for cattle. Cottonwoods and willows are abundant. Some of the trees reach a height of 35 to 50 feet, but they have little commercial value. (Capability unit VIIw-1, nonirrigated; not placed in a range site; windbreak group 5)

Use and Management of the Soils

This section discusses the use of the soils for crops, the system of capability grouping used by the Soil Conservation Service, and the management of the soils in Sedgwick County by capability groups. Yields of the principal crops are predicted under two levels of management. Also discussed is management of the soils for range, woodland and windbreaks, recreation, wildlife, and engineering works.

Use of the Soils for Crops [1]

About 60 percent of the total acreage in Sedgwick County is used for crops. About 23,000 acres is irrigated, and about 187,000 acres is dryfarmed.

Alfalfa, sugar beets, dry beans, corn, barley, onions, and potatoes are the principal irrrigated crops. Sugar beets is the main cash crop. Beets, dry beans, onions, and potatoes are commonly grown in deep loamy soils. Keith and Tripp loams, 0 to 1 percent slopes, for example, is a mapping unit well suited to sugar beets. Corn and barley do well on all the irrigated soils but are more commonly grown in sandy or saline soils. Alfalfa is grown in rotation with other crops in nearly all irrigated areas. Not only is alfalfa a valuable hay crop, but also it helps to maintain good tilth and to increase the supply of nitrogen in the soil.

Wheat, grain sorghum, forage sorghum, barley, millet, and corn are the principal dryfarmed crops. Winter wheat is the one grown most extensively. Nearly all of it is grown in fields that were fallowed the preceding summer. Sorghum is the second most extensively grown dryfarmed crop. It is grown mostly in summer-fallowed fields where the soil is loamy. It is grown year after year in some of the sandier soils. Only a small acreage of millet, barley, and corn is grown in dryfarmed areas.

The main factor limiting crop production in this county is the shortage of available moisture. The supply of water for irrigating crops is adequate in most years, but water is sometimes in short supply when it is needed for maximum crop production. The average annual precipitation of about 16 inches is not adequate for the production of a dryfarmed crop every year. Consequently, the practice in most dryfarmed areas is to alternate a year of summer fallow with a year of crops.

Wind erosion is a constant though not a serious hazard. A growing crop or crop residue is carefully maintained in nearly all fields late in winter and early in spring, the period when wind erosion is most likely, and tillage is delayed until after this period. Stubble-mulch tillage combined with summer fallow helps to maintain the crop residue for a longer period (*9*).[2] Wind stripcropping is commonly used to protect the sandier soils from wind erosion, and in some areas it is also used to protect loamy soils.

Water erosion is active on many of the more sloping soils. In irrigated areas planting, tilling, and irrigating diagonally across the slope help to slow the rate of runoff. In dryfarmed areas terracing is used in some fields and contour farming in many. In some terraced fields, grassed waterways are used to discharge the excess water safely.

[1] ROBERT C. MORELAND, work unit conservationist, Soil Conservation Service, assisted with this section.

[2] Italic numbers in parentheses refer to Literature Cited, p. 59.

Management of irrigation water so that crops receive enough water and none is wasted requires considerable preparation of the land and close attention to irrigation methods (*16*). Most irrigated fields in the county have been leveled. The use of irrigation pipelines and lined ditches is increasing.

Capability classification system

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops or to rice and other crops that have special requirements. The soils are classified according to degree and kind of permanent limitation, without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soils, and without consideration of possible but unlikely major reclamation projects.

In the capability system, soils are grouped at three levels, the capability class, the subclass, and the unit.

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

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

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

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

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

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (There are no class V soils in Sedgwick County.)

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

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

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (There are no class VIII soils in Sedgwick County.)

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to be similar in 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 designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIw-3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral identifies the capability unit within the subclass.

Management by capability units

In the following pages each of the capability units in Sedgwick County is described, and suggestions for the use and management of the soils in each unit are given. Some soils are used to produce crops by both dryfarm and irrigation methods; others are dryfarmed only; and yet others are irrigated only. If a soil is used for both dryfarmed and irrigated crops, it needs different use and management when dryfarmed than when irrigated, and for this reason, is placed in both a dryfarmed and an irrigated capability unit.

CAPABILITY UNIT I-1, IRRIGATED

This unit consists of deep, well-drained, nearly level, loamy soils. These soils absorb water well and have high water-holding capacity. Some areas are flooded for brief periods in some years, as a result of heavy rains. There is little risk of erosion and soil deterioration if ordinary good farming practices are used.

These soils are well suited to the crops commonly grown in the area. Tilling the soils is easy, and the granular surface layer makes a good seedbed. Well-managed irrigation, preceded by leveling (fig. 5), is the single most important management need. Crops respond to nitrogen and phosphate.

CAPABILITY UNIT I-2, IRRIGATED

This unit consists of Haxtun sandy loam, 0 to 1 percent slopes, a deep, well-drained soil that has a subsoil of clay loam. This soil absorbs water well and has moderate to high water-holding capacity. Wind erosion is a moderate hazard late in winter and early in spring unless a cover crop or crop residue is maintained.

This soil is well suited to the crops commonly grown, especially corn. Tillage and seedbed preparation are easy. Leveling and floating insure even spreading of irrigation water. The use of crop residue or a winter cover crop protects the sandy surface layer from wind erosion. Most crops, and particularly corn and sorghum, respond well to

Figure 5.—**Leveling Keith and Tripp loams, 0 to 1 percent slopes, for irrigation. Capability unit I–1, irrrigated.**

Figure 6.—**A good stand of grain-sorghum stubble helps to hold the snow and to protect the soil from wind erosion in winter. The soil is Haxtun sandy loam, 0 to 3 percent slopes, which is in capability unit IIe–2, nonirrigated.**

nitrogen fertilizer, and beets and alfalfa respond well to phosphate fertilizer.

CAPABILITY UNIT IIe–1, IRRIGATED

This unit consists of well-drained nearly level to very gently sloping, moderately deep or deep, loamy soils. These soils absorb water well and release it to plants readily. The water-holding capacity is moderate to high.

These soils are suited to all crops commonly grown in irrigated areas. The most common crops are alfalfa, corn, and sugar beets.

These soils are easily worked. The main management need is to control irrigation water so that it spreads evenly and does not flow fast enough to cause erosion. Effective practices include leveling, applying water in short runs and small flows, and running crop rows diagonally across the slope. Wind erosion can be controlled by roughening the surface if the amount of crop residue is not sufficient to give adequate protection.

Generally, fertility can be maintained by applying phosphate where beets or alfalfa are grown and nitrogen where corn is grown.

CAPABILITY UNIT IIe–2, NONIRRIGATED

This unit consists of deep, nearly level to very gently sloping soils. These soils have a surface layer of sandy loam and a subsoil of sandy clay loam or clay loam. They absorb water well and release it readily to crops. They have moderate to high water-holding capacity.

These soils are well suited to grass, but only a few areas remain in grass. They are also well suited to all the crops grown in dryfarmed areas. The crops most commonly grown are wheat, corn, and sorghum.

The principal management problems are controlling wind erosion and conserving moisture. Wind erosion can be controlled by stubble mulching, stripcropping, and leaving a good stand of crop residue (fig. 6) in the fields through the winter. Generally, crops are planted only after a year of summer fallow, during which moisture can accumulate in the soil. Occasionally the year of fallow can be skipped, most commonly after a winter of above-average snowfall. Nitrogen fertilizer is beneficial to all crops in years when the moisture supply is favorable but is of little value in dry years.

CAPABILITY UNIT IIs–1, IRRIGATED

This unit consists of Chappell sandy loam, 0 to 1 percent slopes, a moderately deep to deep, well-drained soil that has sandy loam underlying material. This soil absorbs water rapidly, has moderate to low water-holding capacity, and has moderate natural fertility. Wind erosion is a moderate hazard.

This soil is suited to all the crops commonly grown in irrigated areas. The crops most commonly grown are corn, alfalfa, beets, and potatoes.

This soil is easily tilled. The chief problems are controlling irrigation water and maintaining fertility. Irrigation runs should be short, so that the upper end of the field is not overirrigated and leached before sufficient water reaches the lower end of the field. Manure and fertilizer are needed to maintain crop production. Wind erosion can be controlled by keeping crop residue on the surface in winter.

CAPABILITY UNIT IIs–2, IRRIGATED

This unit consists of Las loam, a deep, somewhat poorly drained, nearly level soil that is moderately salty. This soil absorbs water at a moderate rate. It is usually moist, but because of the salt content, not all the moisture is available to plants. This soil is moderately fertile.

Only salt-tolerant crops and grasses are suitable. Alfalfa, sugar beets, and barley are the most suitable crops.

The main management problem is controlling irrigation water so that the salt content of the soil does not increase. Frequent light applications of irrigation water give the best results. Leaching out the salts by heavy irrigation every year or two helps to keep salts from accumulating near the surface, but this must be done when the water table is low, usually early in spring.

CAPABILITY UNIT IIc–1, NONIRRIGATED

This unit consists of nearly level to very gently sloping, loamy, generally deep soils, the use of which is limited by shortage of moisture. These soils are fertile. They absorb moisture well and have moderate to high water-holding capacity.

These soils are well suited to grass, wheat, sorghum, millet, and other crops commonly grown in nonirrigated areas. Most of the acreage is cultivated. The two most important crops are wheat, which is grown on 70 percent of the acreage, and sorghum. Millet is commonly used as a catch crop.

These soils are easy to cultivate. Scarcity of moisture restricts the choice of crops and makes summer fallow a necessity. Summer fallow and stubble-mulch tillage are excellent practices for controlling erosion and conserving moisture. The stubble also helps to hold snow in winter. Controlling wind erosion is a minor problem.

CAPABILITY UNIT IIIe-1, IRRIGATED

This unit consists of deep, well-drained, gently sloping, loamy soils. These soils are relatively fertile. They absorb water well, have moderate to high water-holding capacity, and release water readily to plants. Surface runoff is medium, and erosion is a severe hazard.

Alfalfa, barley, and other close-growing crops are most suitable. Sorghum, corn, and occasionally beets grow well, but it is hard to irrigate these crops without causing erosion.

This soil is easily cultivated. The main management problem is spreading irrigation water evenly and efficiently without letting it flow rapidly enough to cause erosion. Because of the difficulty of controlling erosion in irrigated areas, it is important to use close-growing crops most of the time. Applying water in small flows and in short runs helps to increase the efficiency of irrigation.

CAPABILITY UNIT IIIe-2, IRRIGATED

This unit consists of Ascalon sandy loam, 3 to 5 percent slopes, a deep, well-drained soil that has a subsoil of sandy clay loam. This soil absorbs water well, has moderate to high water-holding capacity, and releases water to plants readily. It is moderately fertile. Wind erosion is a hazard in some years.

Alfalfa, small grain, and other close-growing crops are the most suitable. Corn and sorghum grow well, but it is hard to irrigate them without causing erosion.

This soil is easily tilled. The main management problem is spreading irrigation water evenly and efficiently without letting it flow rapidly enough to cause erosion. In some years wind erosion is a hazard. Measures that effectively keep water erosion to a minimum are leveling, running crop rows across the slope, and growing close-growing crops at least half the time. Crop residue should be kept on the surface in winter to control wind erosion.

CAPABILITY UNIT IIIe-3, IRRIGATED

This unit consists of moderately deep to deep, well-drained, nearly level to very gently sloping soils that have a surface layer of sandy loam or loamy sand. These soils absorb water rapidly, have moderate to low water-holding capacity, and release water readily to plants. Natural fertility is only moderate. Wind erosion and water erosion are hazards.

Alfalfa, corn, sorghum, potatoes, and barley are suitable crops. Corn and alfalfa are the ones most extensively grown.

These soils are easily tilled. The main management problems are maintaining fertility and spreading irrigation water evenly and efficiently without letting it flow rapidly enough to cause erosion. Manure and fertilizer are needed to maintain fertility. For control of irrigation water, it is necessary to level before irrigating and then to apply water frequently in small amounts and using short runs, so that the upper end of the field is not overirrigated and leached before enough water reaches the lower end. Careful management of crop residue is needed for control of wind erosion.

CAPABILITY UNIT IIIe-4, NONIRRIGATED

This unit consists of deep, well-drained, gently sloping, loamy soils. These are fertile soils. They take in water well and have moderate to high water-holding capacity. Most cultivated areas have been slightly to moderately eroded.

These soils are suited to grass and to the crops commonly grown in dryfarmed areas. Wheat grows well and is the main crop.

The main management problem is control of runoff and erosion. Contour farming, terraces, and grassed waterways are effective means of control. A season of summer fallow is needed between crops. Fields that are to be fallowed should be stubble mulched, so that plant residue will be left to provide protection through the fallow season.

CAPABILITY UNIT IIIe-5, NONIRRIGATED

This unit consists of Ascalon sandy loam, 3 to 5 percent slopes, a deep, well-drained soil that has a subsoil of sandy clay loam. This soil absorbs water well, has moderate water-holding capacity, and is moderately fertile. If not protected, it is easily eroded by wind and water, and some cultivated areas already have been moderately eroded. Surface runoff is rapid.

This soil is suited to grass and to all the crops commonly grown in dryfarmed areas, but it is used mostly for wheat and sorghum. A few small areas are still in native grass.

The main management problem is controlling erosion in cultivated areas. Among the practices needed are contour farming and stripcropping. A season of summer fallow is needed between crops. Fields to be fallowed should be stubble mulched, so that plant residue will be left to provide protection through the fallow season.

CAPABILITY UNIT IIIe-6, NONIRRIGATED

This unit consists of Chappell sandy loam, 1 to 3 percent slopes, a moderately deep to deep, well-drained soil. This soil absorbs water rapidly, has moderate to low water-holding capacity, and is moderately fertile. If not protected, it is subject to wind erosion.

This soil is suited to grass and to sorghum, corn, and wheat. About half the acreage is cultivated. Sorghum and wheat are the main crops.

This soil is easily cultivated. The main management need is the control of wind erosion. Among the effective practices are stubble-mulch tillage, stripcropping, and careful management of crop residue. Crops respond well to nitrogen fertilizer in most years.

CAPABILITY UNIT IIIe-7, NONIRRIGATED

This unit consists of deep, well-drained, nearly level to very gently sloping, loamy sands. Most of these soils have a subsoil or underlying material of sandy loam, but some are more clayey. If not protected, these soils are subject to severe wind erosion. They absorb water rapidly, have low to moderate water-holding capacity, and are moderately fertile. There is seldom any runoff.

The soils in this unit are well suited to grass and to crops that leave a large amount of residue. They can be used for any of the dryfarmed crops.

Control of wind erosion is the main management problem. Among the effective practices are careful management of crop residue, stripcropping (fig. 7), and stubble-mulch tillage in preparation for summer fallow. Crops do fairly well without summer fallow if small amounts of nitrogen fertilizer are applied.

CAPABILITY UNIT IIIw-1, IRRIGATED

This unit consists of moderately deep to deep loams and sandy loams. These soils are moderate to high in fertility. They are either poorly drained or have a fluctuating water table that is in the root zone part of the time. In some areas they are salty.

If drained, these soils are suited to all crops commonly grown in irrigated areas. Corn, barley, and alfalfa are the main crops.

These soils are easily cultivated. The main management problem is keeping the water table low enough that salts do not accumulate near the surface. Tile drainage or open-ditch drainage is important to continued successful irrigation. Unless a drainage system has been constructed, applications of irrigation water must be light, so as to keep the water table from rising into the root zone.

CAPABILITY UNIT IIIw-2, IRRIGATED

This unit consists of Lamo clay loam, a deep, somewhat poorly drained, nearly level soil that is moderately saline. This soil is on low terraces. It absorbs water slowly and has high water-holding capacity, but not all the water is available to plants, because of the salts in the subsoil.

This soil is well suited to salt-tolerant crops. Sugar beets and barley do well, and in better drained fields, alfalfa and corn grow satisfactorily.

The main management problems are the management of irrigation water and the maintenance of drainage. The installation of drainage ditches or tile lines is important to crop production. Leaching out salts each year improves newly drained areas and helps to prevent the accumulation of salts in other areas. Special care is required in cultivating because a plowsole or hardpan forms quickly if this soil is tilled when it is too moist. Barnyard manure and green manure help to improve the tilth and to increase the water-intake rate.

CAPABILITY UNIT IIIw-3, NONIRRIGATED

This unit consists of somewhat poorly drained, nearly level soils that are moderately salty, especially in the underlying material. These soils are on bottom lands and low terraces, and most areas are flooded occasionally. These soils have a surface layer of clay loam, loam, or sandy loam, and a subsoil of clay loam or sandy loam. They are moderate to high in natural fertility. They have moderate to high water-holding capacity, but because of the salt content, they are sometimes droughty late in summer when the water table is low. The roots of crops frequently extend into the layer immediately above the water table.

***Figure 7.*—Stripcropping for protection against wind erosion. The soil is Haxtun loamy sand, 0 to 3 percent slopes, which is in capability unit IIIe-7, nonirrigated.**

These soils are suited to grass and to wheat, barley, corn, and, in some areas, alfalfa. Many areas are still used for grass.

Control of wind erosion is a problem. Stubble-mulch tillage and stripcropping help to control wind erosion in tilled fields. The last cutting of alfalfa should be made early enough to allow time in fall for the growth of a good stand that will protect the soil in winter.

CAPABILITY UNIT IIIs-1, NONIRRIGATED

This unit consists of Campus-Richfield loams, 0 to 3 percent slopes, which are moderately deep to deep, well-drained soils. These soils are relatively fertile. The water-holding capacity generally is moderate to high, but there are small areas of shallow soils that have low water-holding capacity.

These soils are suited to grass and to any of the dry-farmed crops. Wheat and sorghum are the main crops, except in the small areas of shallow soils. These soils are easy to till.

The main management problem is controlling wind erosion. This problem is severe in the areas of shallow soils where crops grow poorly. Stubble-mulch tillage is needed in summer-fallowed fields to keep crop residue on the surface. Roughening the surface by tillage protects the small areas where the amount of crop residue is not sufficient to give adequate protection.

CAPABILITY UNIT IVe-1, IRRIGATED

This unit consists of moderately deep to deep, well-drained, gently sloping to moderately sloping, loamy soils. There are also small areas of shallow, loamy soils in some fields. These soils are moderately fertile. They absorb water well, but because of the slope, runoff is rapid and the hazard of erosion is high.

These soils are well suited to grass and to alfalfa and small grain. Most of the acreage is used for alfalfa.

The main management problem is controlling erosion. Careful management of irrigation water is needed at all times, to make sure that water does not collect into streams and cause erosion. Short runs are necessary. Growing grass with alfalfa reduces the erosion hazard.

CAPABILITY UNIT IVe-2, IRRIGATED

This unit consists of Ascalon sandy loam, 5 to 9 percent slopes, a deep, well-drained soil that has a subsoil of sandy clay loam. This soil absorbs water well and has moderate water-holding capacity. Surface runoff is rapid.

This soil is well suited to grass and to alfalfa and small grain, but it is used mostly for alfalfa.

The main management problem is the control of erosion. Growing grass with the alfalfa and applying irrigation water in short runs help to control erosion. Phosphate fertilizer is beneficial to alfalfa.

CAPABILITY UNIT IVe-3, IRRIGATED

This unit consists of Julesburg loamy sand, 3 to 5 percent slopes, a deep, well-drained soil that has a subsoil of sandy loam. This soil absorbs water rapidly and has low water-holding capacity. It is subject to wind and water erosion. Natural fertility is moderate.

This soil is suited to alfalfa, barley, wheat, sudangrass, drilled forage sorghum, and other close-growing crops. Most of the acreage is used for alfalfa. The areas where row crops have been grown are badly eroded.

The main management problem is the control of wind erosion and water erosion in cultivated areas. The maintenance of fertility is also a problem. Among the practices needed are frequent applications of irrigation water, in short runs and small flows, and maintenance of crop residue or a cover crop on the surface. Phosphate fertilizer is needed for alfalfa, and nitrogen fertilizer is beneficial to sudangrass and sorghum.

CAPABILITY UNIT IVe-4, NONIRRIGATED

This unit consists of moderately deep to deep, gently sloping, loamy soils. These soils absorb water well but nevertheless lose a large amount of water as runoff unless protected by an adequate plant cover. Some spots are moderately eroded. In the grassed areas there is less runoff and almost no erosion. Most areas are limy at or near the surface.

These soils are suited to grass and to small grain and sorghum. They are fair for wheat, even though much moisture is lost through runoff. About a third of the acreage is in grass.

The chief management problems are conserving moisture and controlling water erosion and wind erosion. Among the measures needed are the use of crop residue or a cover crop at all times, stubble-mulch tillage, terracing, and contour farming.

CAPABILITY UNIT IVe-5, NONIRRIGATED

This unit consists of deep, well-drained, gently sloping soils that have a surface layer of loamy sand and a subsoil of sandy loam or light clay loam. These soils are moderate to low in fertility. They absorb water rapidly and lose very little through runoff. The surface layer has low water-holding capacity.

This soil is well suited to grass, and about a third of the acreage is still in native grass. Small grain and forage sorghum are the most suitable cultivated crops. Wheat, sorghum, and corn are the crops most commonly grown.

The main problems in managing these soils for cultivated crops are the control of wind erosion, the maintenance of the organic-matter content, and the maintenance of fertility. Crop residue should be left on the surface as protection against wind erosion. Stripcropping of wheat and corn or wheat and sorghum provides good protection in most years. Summer fallow is of little benefit, because of the sandy texture, and it is not a common practice. Crops respond to nitrogen in most years.

CAPABILITY UNIT IVe-6, NONIRRIGATED

This unit consists of Ascalon sandy loam, 5 to 9 percent slopes, a deep, well-drained soil that has a subsoil of sandy clay loam. This soil takes in water well and has moderate water-holding capacity. Nevertheless, cultivated areas lose considerable moisture through runoff and are moderately eroded. Natural fertility is moderate.

This soil is well suited to grass. Small grain and sorghum are the most suitable cultivated crops. Most of the acreage is used for wheat, barley, and sorghum.

The main management problem in using this soil for crops is the control of erosion. Careful management of crop residue is essential. Terraces and diversions slow runoff in cultivated areas.

CAPABILITY UNIT IVs-1, IRRIGATED

This unit consists of Slickspots, a nearly level, somewhat poorly drained, strongly saline-alkali land type. Most areas have a thin layer of loamy material at the surface and clayey and loamy material underneath. This land type takes in water slowly. The water-holding capacity is high, but the water is not available to plants, because of the salt content.

Slickspots are suitable only for salt-tolerant crops and grass. Sugar beets, barley, corn, and alfalfa grow fairly well in drained areas. Beans almost always fail.

Installing drainage and leaching out salts by periodic heavy irrigation are good practices. Phosphate fertilizer is beneficial to sugar beets and alfalfa.

CAPABILITY UNIT VIe-1, NONIRRIGATED

This unit consists of gently sloping to moderately sloping soils that have a surface layer of sandy loam and a subsoil or underlying material of sandy loam or sandy clay loam. A few areas of shallow soil are included.

These soils absorb water well. If not protected, they are subject to erosion.

Areas where the plant cover has been destroyed can be seeded to little bluestem, blue grama, side-oats grama, sand bluestem, prairie sandreed, and other native grasses, as well as to crested wheatgrass, an introduced species that has been used successfully.

These soils are used as range. They are not suitable for cultivation. Their use as range is discussed under the headings "Sandy Plains Range Site" and "Limestone Breaks Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIe-2, NONIRRIGATED

This unit consists of deep, gently sloping to moderately sloping, loamy soils. These soils absorb water well and have good water-holding capacity. Runoff is rapid where the plant cover is inadequate.

Areas that do not have a plant cover can be reseeded successfully to blue grama, side-oats grama, western wheatgrass, and other native grasses. Crested wheatgrass, intermediate wheatgrass, and Russian wildrye are introduced plants that can be used for reseeding.

These soils are used as range. They cannot be used for crops, because the risk of erosion is too severe. Their use as range is discussed under the heading "Loamy Plains Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIe-3, NONIRRIGATED

This unit consists of Elsmere loamy fine sand, a deep, nearly level soil. This soil is highly susceptible to wind erosion if the permanent vegetation is removed. The water table is high, and some plant roots extend into ground water.

This soil is used for grazing and for hay. It is well suited to sedges, sandreed, sand bluestem, switchgrass, and other grasses.

The main management need is protection from overgrazing. The use of this soil for range is discussed under the heading "Sandy Meadow Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIe-4, NONIRRIGATED

This unit consists of deep, undulating to rolling soils that have a surface layer of loamy sand or sand underlain by loose sand. These soils absorb water rapidly and have low water-holding capacity. The moisture penetrates deeply. There is almost no runoff. Wind erosion is a hazard.

These soils cannot be used for crops, but they are well suited to grass. In areas where the plant cover has been destroyed, a temporary plant cover should be established first, and then these areas can be reseeded to sandreed, big bluestem, sand bluestem, switchgrass, and other native grasses. Sudangrass and forage sorghum provide good temporary cover.

The use of these soils for range is discussed under the heading "Deep Sand Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIe-5, NONIRRIGATED

This unit consists of shallow to moderately deep, gently sloping to strongly sloping, strongly calcareous, loamy soils. If not protected, these soils are easily eroded by both wind and water. Much water is lost through runoff.

These soils are not suitable for cultivation, but if managed properly, they are productive of native grasses. Reseeding with blue grama, western wheatgrass, and other native grasses is needed in areas where the grass cover has been destroyed.

The use of these soils for range is discussed under the heading "Siltstone Plains Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIs-1, NONIRRIGATED

This unit consists of Slickspots, which is a nearly level, somewhat poorly drained, strongly to very strongly saline-alkali land type. This land type is on low terraces. It is droughty because of the salt content.

This land type is not suitable for cultivated crops, because of the salt content, but it is suitable for grazing or for hay. Permanent grasses that have roots extending nearly to the water table grow well.

The use of this land type for range is discussed under the heading "Salt Meadow Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIs-2, NONIRRIGATED

This unit consists of Eckley-Chappell complex, 9 to 20 percent slopes. These soils are dominantly shallow over sand and gravel. Intermingled are some areas of deep sandy loams. These soils absorb water rapidly, have low to moderate water-holding capacity, and are low to moderate in fertility. There is little surface runoff.

These soils are not suitable for cultivated crops, but they are well suited to grass.

The main management problem is the prevention of overgrazing in the swales and draws. The use of these soils for range is discussed under the headings "Gravel Breaks Range Site" and "Sandy Plains Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIIe-1, NONIRRIGATED

This unit consists of Valentine fine sand, hilly, a deep soil. This soil is subject to severe wind erosion, and there are many blowouts.

This soil is not suitable for cultivated crops, but it is suited to native grasses. Some areas where the plant cover has been destroyed can be successfully reseeded by broadcasting seed or by allowing the present grasses to go to seed. Results are best if the soil is moist and has a cover of mulch, annual weeds, or litter.

This soil is suitable for grazing, but because the plant cover is difficult to reestablish if it is once destroyed, careful management of the grazing is needed. The use of this soil for range is discussed under the heading "Choppy Sand Range Site," in the section on "Use of the Soils for Range."

CAPABILITY UNIT VIIw-1, NONIRRIGATED

This unit consists of soils that are severely limited by frequent flooding or ponding. The plant cover is sparse because it is periodically drowned or washed away. The soils in this unit should remain in native vegetation. They can be used for pasture and for wildlife habitat.

CAPABILITY UNIT VIIs-1, NONIRRIGATED

This unit consists of Canyon complex, 3 to 9 percent slopes, and numerous outcrops of limestone or caliche. These soils are shallow. They absorb water well, but they hold little water because they are shallow, and they lose much of the water received in heavy rainfall through runoff. There is very little hazard of erosion.

These soils are not suitable for cultivation, because of shallowness and outcrops, but they are well suited to grass.

Careful management of range is required because the plant cover is difficult to reestablish if it is once destroyed. The use of these soils for range is discussed under the heading "Limestone Breaks Range Site," in the section on "Use of the Soils for Range."

Predicted Yields

Predicted yields of the principal irrigated crops grown in Sedgwick County are given in table 2, and predicted yields of the principal nonirrigated crops in table 3. The figures in the tables represent averages for a period long enough to include years when crops are damaged or destroyed by hail or drought and years when no damage has occurred. Nonirrigated soils, as a rule, are cropped only

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every second year and are left fallow in the alternate years. Only the years when crops were seeded were considered in arriving at the figures given in table 3.

For both irrigated and nonirrigated crops, two levels of management are represented: common management in the A columns of the two tables, and improved management in the B columns. Improved management is assumed to include the following: (1) Controlling erosion and conserving water; (2) using a suitable cropping system; (3) proper tilling at the right time; (4) managing crop residue; (5) consistently controlling weeds, insects, and plant diseases; (6) choosing suitable crop varieties; (7) applying lime and fertilizer as indicated by soil tests. For irrigated crops, it is assumed that water is applied carefully. If some of these practices are omitted or are poorly performed or applied at the wrong time, the yield level is about as shown in the A columns.

Use of the Soils for Range [3]

In Sedgwick County, approximately 99,500 acres, or 28 percent of the acreage, is native range. About 20,000 cattle and calves are grazed each year. The range is used mostly during the growing season, after which the cattle are moved to cropland fields and feedlots. Nearly all the ranches in the county also have some irrigated or nonirrigated cropland.

[3] W. W. HAMMOND and T. K. EAMAN, range conservationists, Soil Conservation Service, assisted with this section.

The native range vegetation is a mixture of mid and short grasses in most areas. Tall grasses are common on the more sandy and gravelly soils, which have a porous root zone that allows percolation of water to a greater depth. Short grasses are dominant on the finer textured soils. The grasses are distributed in this way because of the lack of sufficient moisture in this semiarid climate.

Many areas of cultivated soils in this county are eroded and depleted of natural fertility. Such areas can be reseeded to native grasses. Protective measures are needed until the grasses become established. A dead-litter cover provides protection against both wind and water erosion.

On sandy soils, control of brush is beneficial. Sand sagebrush has been controlled successfully by aerial spraying with a chemical hormone.

Range sites and condition classes

Soils are grouped into range sites on the basis of similarity in the characteristics that affect their capacity for producing native forage plants. Nine range sites are recognized in Sedgwick County. Each site has a distinctive potential plant community, the composition of which depends upon a combination of environmental conditions, mainly the combined effects of soil and climate. The potential plant community reproduces itself so long as the environmental conditions remain the same.

The plants on any given range site are grouped, according to their response to grazing, as decreasers, increasers, and invaders. Decreasers are plants in the potential plant community that tend to die out if heavily grazed. Gen-

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

[The only soils listed are those on which significant yields of one or more of the principal crops are obtained. The figures in columns A indicate average yields under common management; those in columns B indicate average yields under improved management. Dashed lines indicate that the crop is not commonly grown on or is not suited to the particular soil]

Soil	Sugar beets		Corn		Alfalfa		Beans		Wheat		Potatoes	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cwt.*	*Cwt.*	*Bu.*	*Bu.*	*Cwt.*	*Cwt.*
Ascalon sandy loam, 3 to 5 percent slopes	12	16	65	85	2. 8	3. 7	15	18	33	46	------	------
Ascalon sandy loam, 5 to 9 percent slopes	------	------	------	------	2. 5	3. 5	------	------	------	------	------	------
Bridgeport loam, 0 to 1 percent slopes	17	21	80	120	3. 5	5. 5	20	23	40	56	215	320
Bridgeport loam, 1 to 3 percent slopes	15	18	65	90	3. 2	5. 2	18	21	38	53	170	255
Chappell loamy sand, 1 to 3 percent slopes	10	14	55	95	2. 5	4. 0	15	19	30	41	120	240
Chappell sandy loam, 0 to 1 percent slopes	13	17	60	100	2. 7	4. 2	19	22	35	48	170	255
Chappell sandy loam, 1 to 3 percent slopes	11	16	58	78	2. 4	3. 8	18	21	32	45	165	250
Cheyenne loam, 1 to 3 percent slopes	13	17	72	110	3. 0	4. 5	15	19	40	56	215	320
Colby-Ulysses silt loams, 3 to 5 percent slopes	15	17	60	80	3. 0	3. 5	16	19	------	------	------	------
Colby-Ulysses silt loams, 5 to 9 percent slopes	------	------	------	------	2. 0	2. 5	------	------	------	------	------	------
Haverson loam, 0 to 1 percent slopes	16	19	73	110	3. 5	5. 0	18	21	33	46	215	330
Haverson loam, 1 to 3 percent slopes	15	18	67	98	3. 1	4. 6	17	20	31	43	165	275
Haxtun loamy sand, 0 to 1 percent slopes	13	17	65	110	2. 5	5. 0	17	20	32	45	150	260
Haxtun sandy loam, 0 to 1 percent slopes	16	20	79	115	3. 0	5. 3	19	22	34	48	170	280
Julesburg loamy sand, 3 to 5 percent slopes	------	13	------	------	3. 5	4. 8	------	------	33	45	------	------
Keith and Tripp loams, 0 to 1 percent slopes	18	23	79	125	4. 0	5. 5	20	24	42	58	220	330
Keith and Tripp loams, 1 to 3 percent slopes	16	19	75	115	3. 8	5. 2	18	22	38	53	200	300
Keota-Epping loams, 3 to 9 percent slopes	10	13	40	65	2. 0	2. 5	------	------	------	------	------	------
Lamo clay loam	13	18	50	80	2. 5	4. 5	------	------	28	38	------	------
Las loam	12	16	40	70	2. 2	3. 5	------	------	29	35	180	250
McCook loam	12	16	50	80	2. 6	3. 8	------	------	------	------	------	------
Slickspots	12	17	50	80	2. 5	4. 0	------	------	25	35	------	------
Wages gravelly loam, 3 to 5 percent slopes	------	------	50	80	2. 5	3. 5	12	14	35	50	------	------
Wages gravelly loam, 5 to 9 percent slopes	------	------	------	------	2. 0	3. 5	------	------	30	43	------	------
Wann soils	10	15	45	77	2. 5	3. 7	12	14	24	30	150	270

TABLE 3.—*Predicted average acre yields of principal nonirrigated crops under two levels of management*

[The only soils listed are those on which significant yields of one or more of the principal crops are obtained. The figures in columns A indicate average yields under common management; those in columns B indicate average yields under improved management. Dashed lines indicate that the crop is not commonly grown on or is not suited to the particular soil]

Soil	Wheat		Sorghum				Barley		Corn	
			Grain		Forage					
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Ascalon sandy loam, 0 to 3 percent slopes	18	23	19	24	1.7	2.3	17	23	20	28
Ascalon sandy loam, 3 to 5 percent slopes	15	20	16	19	1.6	2.2	14	20	18	26
Ascalon sandy loam, 5 to 9 percent slopes	13	19	12	18	1.1	1.9	12	18	------	------
Bridgeport loam, 0 to 3 percent slopes	30	36	29	34	1.7	2.3	29	35	15	20
Campus-Richfield loams, 0 to 3 percent slopes	12	21	11	19	1.1	1.8	11	20	------	------
Campus-Richfield loams, 3 to 5 percent slopes	11	20	9	18	1.0	1.5	9	18	------	------
Chappell loamy sand, 1 to 3 percent slopes	16	22	14	20	1.6	2.2	14	21	15	23
Chappell sandy loam, 1 to 3 percent slopes	14	19	13	17	1.4	2.1	12	17	13	27
Cheyenne loam, 1 to 3 percent slopes	23	30	21	29	1.8	2.5	22	30	21	37
Colby-Ulysses silt loams, 3 to 5 percent slopes	11	14	9	12	.7	1.1	9	12	------	------
Haxtun loamy sand, 0 to 3 percent slopes	16	25	23	39	1.6	2.2	17	22	22	42
Haxtun loamy sand, 3 to 5 percent slopes	14	20	19	32	1.4	2.0	13	20	21	41
Haxtun sandy loam, 0 to 3 percent slopes	20	28	28	43	1.8	2.4	23	31	25	45
Julesburg loamy sand, 0 to 3 percent slopes	16	22	18	30	1.4	1.9	15	21	------	------
Julesburg loamy sand, 3 to 5 percent slopes	12	19	15	25	1.3	1.7	11	17	------	------
Keith, Goshen, and Kuma silt loams, 0 to 3 percent slopes	25	31	31	38	1.9	2.5	30	36	------	------
Keith-Kuma silt loams, 0 to 3 percent slopes	26	34	33	39	1.9	2.7	33	39	------	------
Keith and Tripp loams, 1 to 3 percent slopes	26	31	29	38	2.0	2.5	30	36	16	21
Lamo clay loam	------	------	------	------	1.4	1.8	10	12	12	16
Rago and Kuma silt loams, 0 to 3 percent slopes	25	31	29	37	2.0	2.5	30	36	------	------
Rago and Kuma silt loams, 3 to 5 percent slopes	23	28	26	34	1.7	2.4	27	34	------	------
Richfield loam, 0 to 3 percent slopes	21	28	23	31	1.9	2.3	23	30	------	------
Richfield loam, 3 to 5 percent slopes	18	25	21	28	1.7	2.1	20	27	------	------
Wages gravelly loam, 3 to 5 percent slopes	12	21	9	19	1.0	1.5	11	20	------	------
Wann soils	17	20	19	23	1.4	1.9	12	16	10	14

erally they are the tallest, most productive, and most palatable perennials. Increasers are plants in the potential community that normally become more abundant as the decreasers decline. Generally they are shorter, less productive, and less palatable than the increasers. Invaders are not part of the original vegetation but become established if both the decreasers and increasers decline. They may be woody plants or herbaceous annuals or perennials.

Four condition classes represent the degree to which the composition of the existing plant community is different from that of the potential plant community, or climax vegetation. The range is in excellent condition if 75 percent to 100 percent of the existing vegetation is of the same kind as the climax vegetation; it is in good condition if the percentage is between 50 and 75 percent; it is in fair condition if the percentage is between 25 and 50; and it is in poor condition if the percentage is 25 or less.

Descriptions of range sites

The range site classification of each individual soil in Sedgwick County is shown in the "Guide to Mapping Units." Twelve mapping units have not been placed in any range site, because, as the result of irrigation or other factors, the soils in these units do not produce vegetation characteristic of any range site. Unassigned are one or more soils of the Bridgeport, Chappell, Haverson, Haxtun, Keith, McCook, Scott, and Tripp series, and two land types, Sandy alluvial land and Wet alluvial land.

The nine range sites in Sedgwick County are described in the following pages. Included in each description is an estimate of potential yield. The estimate is based on clipping data from a limited number of plots but is extended to cover years of both favorable and unfavorable moisture supply. About 90 percent of the estimated total is palatable to livestock.

LOAMY PLAINS RANGE SITE

This range site consists of deep to moderately deep, well-drained, loamy soils. These soils absorb water well and have high water-holding capacity. The surface layer holds most of the moisture received and permits little deep percolation; consequently, conditions are favorable for shallow-rooted plants.

Except in depressions and swales, where western wheatgrass and other mid grasses are abundant, the vegetation is made up of short grasses, dominantly blue grama and buffalograss. When the range is in good condition, about 60 percent of the vegetation is blue grama, but as the condition of the range declines, the percentage of buffalograss increases. If the range is continuously overgrazed or if a period of drought is prolonged, the control of cactus, yucca, fringed sage, snakeweed, and other invaders becomes a serious problem.

The potential yield varies between 2,500 pounds in years of favorable moisture supply and 800 pounds in years of unfavorable supply.

SANDY PLAINS RANGE SITE

This range site consists of deep to moderately deep, well-drained, moderately sandy soils. These soils have a surface layer of sandy loam or loamy sand and a subsoil of sandy loam or of finer texture. They have moderate to high water-holding capacity. The surface layer absorbs water rapidly, but holds little water and allows most of the water to percolate into the subsoil. The subsoil holds most of the moisture received and permits little deeper percolation. Consequently, conditions are favorable for a mixture of shallow-rooted and deep-rooted plants.

At least 40 percent of the cover on this site is made up of little bluestem, switchgrass, side-oats grama, sand bluestem, prairie sandreed, and other tall and mid grasses. The rest consists of a vigorous growth of blue grama, small amounts of sand dropseed, widely scattered perennial forbs, sand sagebrush and other shrubs, and small spots of snakeweed, fringed sage, and wormwood. Control of sand sagebrush is a problem on this site.

The potential yield varies between 3,500 pounds in years of favorable moisture supply and 1,200 pounds in years of unfavorable supply.

DEEP SAND RANGE SITE

This range site consists of deep, extremely sandy soils. The texture of these soils is fine sand or loamy fine sand. Moisture is absorbed rapidly, penetrates deeply, and is readily available to plants. Consequently, conditions are favorable for deep-rooted plants.

The vegetation is dominated by tall grasses, mainly sand reedgrass and sand bluestem, which are the main forage plants. A fair proportion of the plant cover consists of little bluestem, side-oats grama, needle-and-thread, and other mid grasses. There are also short grasses, which are of minor importance, pockets of switchgrass, and, where the condition of the range has deteriorated, sand sagebrush. The control of sand sagebrush is a problem on this site. Because of the bunchy growth of tall grasses, this range has a healthy green appearance in summer and a tawny aspect in winter.

The potential yield varies between 4,000 pounds in years of favorable moisture supply and 1,500 pounds in years of unfavorable supply.

GRAVEL BREAKS RANGE SITE

The dominant soil in this range site is the Eckley soil in Eckley-Chappell complex, 9 to 20 percent slopes. This is a shallow gravelly loam that absorbs water rapidly and has moderate water-holding capacity in the surface layer and low water-holding capacity in the subsoil. In small draws, on concave slopes fingering into the draws, and in outwash areas at the base of slopes there is a deeper soil, of sandy loam texture, that has a better supply of moisture.

The dominant range plants are blue grama, hairy grama, and side-oats grama. Others are fringed sage, sedges, hairy goldaster, wormwood, leadplant, sand bluestem, and sand reedgrass. The best stands are in the areas of sandy loam.

The potential yield varies between 1,400 pounds in years of favorable moisture supply and 500 pounds in years of unfavorable supply.

CHOPPY SAND RANGE SITE

This range site consists of Valentine fine sand, hilly, which is a deep, loose, unstable soil that is very susceptible to wind erosion. The topography is dunelike.

The vegetation is made up of sand reedgrass, which is generally dominant, hairy grama, sand dropseed, beadgrass, sandhill muhly, blowoutgrass, sand bluestem, and blue grama.

The potential yield varies between 1,500 pounds in years of favorable moisture supply and 600 pounds in years of unfavorable supply.

SALT MEADOW RANGE SITE

This range site consists of somewhat poorly drained, salty soils. The slope range is 0 to 1 percent. Some areas are subject to seasonal flooding. Because of a strong concentration of salts, the amount of moisture available to plants is limited.

The vegetation is made up mostly of switchgrass, alkali sacaton, western wheatgrass, alkali bluegrass, sedges, and rushes. It includes small amounts of saltgrass, foxtail barley, and wildlicorice.

The potential yield varies between 4,500 pounds in years of favorable moisture supply and 3,000 pounds in years of unfavorable supply.

SANDY MEADOW RANGE SITE

This range site consists of sandy soils that contain salts in places and that have a high water table. The salts affect the vegetation less than does the high water table.

The vegetation is dominated by tall, deep-rooted grasses, mainly sand bluestem, switchgrass, and indiangrass (fig. 8). Prairie cordgrass, a decreaser, grows abundantly in wet spots. The increasers are western wheatgrass, alkali sacaton, saltgrass, Canada wildrye, sedges, and blue grasses. When the range is in fair to poor condition, the proportion of foxtail barley and wildlicorice increase. Included in some areas are very wet soils that would be placed in a separate range site if extensive enough. Cattails and bulrushes grow in these areas.

The potential yield varies between 4,500 pounds in years of favorable moisture supply and 3,000 pounds in years of unfavorable supply.

***Figure 8.*—Sandy Meadow range site in good condition. The dominant grasses are sand bluestem, switchgrass, and indiangrass. The soil is Wann loam.**

SILTSTONE PLAINS RANGE SITE

This range site consists of shallow to moderately deep soils that contain a large amount of lime. These soils have a surface layer that absorbs water slowly. The rate of runoff increases rapidly if the grass cover is thinned or destroyed, and thus the hazard of erosion is greater.

Blue grama is the dominant grass. A scattering of western wheatgrass and buffalograss is present. Fourwing saltbush and winterfat are decreasers that distinguish this site. Fringed sage and snakeweed increase where the range is not well managed.

The potential yield varies between 1,000 pounds in years of favorable moisture supply and 500 pounds in years of unfavorable supply.

LIMESTONE BREAKS RANGE SITE

This range site consists mainly of gently sloping to strongly sloping, shallow gravelly loams. These soils are strongly calcareous, and in some places they have a surface layer that consists almost entirely of fragments of soft limestone. Outcrops of caliche or limestone are common.

The vegetation is dominated by mid grasses, mainly little bluestem and side-oats grama. Blue grama and hairy grama are abundant on the smoother slopes. Also in the vegetation are big bluestem, needle-and-thread, perennial forbs, and yucca. Buckwheat, mat milkvetch, nailwort, actinea, fringed sage, and other mat-forming plants and half-shrubs increase rapidly where the range is overgrazed.

The potential yield varies between 1,800 pounds in years of favorable moisture supply and 600 pounds in years of unfavorable supply.

Woodland and Windbreaks [4]

The natural vegetation in Sedgwick County is grass, but since the early 1900's, cottonwoods and willows have spread extensively on Wet alluvial land along the South Platte River and now form dense stands in some places. These trees are also gradually spreading along Cottonwood Creek, Lodgepole Creek, and other streams in the northern part of the county and along Sand Creek in the southeastern part. Russian-olive and Siberian elm and a few other trees that were introduced by planting are now becoming naturalized along the streams and in other favorable places. Sand cherry is native to the sandhills.

Windbreaks have been planted in the county, both for protection and for beautification, from the time it was first settled. A few of the plantings that were established in the 1880's under the Timber Culture Act still exist.

Windbreaks and shelterbelts produce many benefits. They hold snow in fields and prevent it from blowing into the farmyard; they provide protection for the livestock and thus reduce the cost of feeding them; they protect gardens from winds strong enough to damage crops; they minimize evaporation of moisture from the soil; they control wind erosion; they provide habitat for insect-eating birds and other wildlife; and they help to reduce the cost of heating houses.

Establishing trees is not easy, but it can be done if the site is well prepared, and if the trees are of suitable species, come from good stock, and are properly planted, cultivated, and protected. Evergreens, which are the most desirable trees for windbreaks, should be potted and should be protected with shingles or shade on the south and west sides.

In loam and clay loam soils, trees should be planted only where the moisture supply is good to a depth of 30 inches or more or where irrigation water is available. If the moisture supply is not adequate or if there is a cover of sod, the site should be fallowed for a year before any trees are planted, to increase the amount of moisture in the soil and reduce competition from other vegetation. If irrigation water is available, the soils should be well soaked before trees are planted.

If the soils are sandy a cover of crops, grass, or stubble ought to be maintained and a narrow strip prepared for each row of trees. If the cover is not adequate, a band of sorghum, sudangrass, or millet should be seeded between rows. These plants can be removed when the trees are established and large enough to protect the soil.

A farmstead windbreak should be at least 5 rows wide, or wide enough to trap most of the blowing snow within it, and should be on the north and west sides of the farmstead. The first row should be at least 100 feet but not more than 300 feet away from the main farm buildings. At least a third of the rows should be juniper (redcedar), pine, or other adapted evergreens (fig. 9), which live longer than deciduous trees. Junipers are dense close to the ground, and pines add height as they grow older.

Field windbreaks or shelterbelts should be spaced at regular intervals across the field, but they need be only 1 row or 2 rows wide. Juniper and pine are better choices than Siberian elm and other trees that have shallow, spreading root systems. The trees provide protection for a distance equal to about 20 times their height. For example, 25-foot trees provide protection for a distance of about 500 feet.

Windbreak groups

The soils of this county have been placed in five windbreak groups. The soils in each group are suitable for similar species, and the trees make similar response to good management. The names of soil series represented are mentioned in the description of each windbreak group, but this does not mean that all the soils of a given series are in the group. The "Guide to Mapping Units" at the back of this publication shows which group each individual soil is in. The groups are described in the following paragraphs. Table 4 shows the height and survival rate of selected species for windbreak plantings.

WINDBREAK GROUP 1

This group consists mainly of deep to moderately deep, well-drained loams and sandy loams. These soils are members of the Ascalon, Bayard, Bridgeport, Campus, Chappell, Cheyenne, Colby, Goshen, Haverson, Haxtun, Keith, Kuma, Manter, Rago, Richfield, Tripp, Ulysses, and Wages series. Some of these soils have a clayey subsoil.

Trees generally grow well on these soils. Suitable species for windbreak plantings are squawbush, lilac, Caragana, chokecherry, Rocky Mountain juniper, eastern redcedar, ponderosa pine, Austrian pine, Siberian elm, Russian-olive, and hackberry.

Wind, drought, and wind erosion are the chief hazards to newly planted trees. To overcome these hazards, the

[4] By WILFRED S. SWENSON, woodland conservationist, Soil Conservation Service.

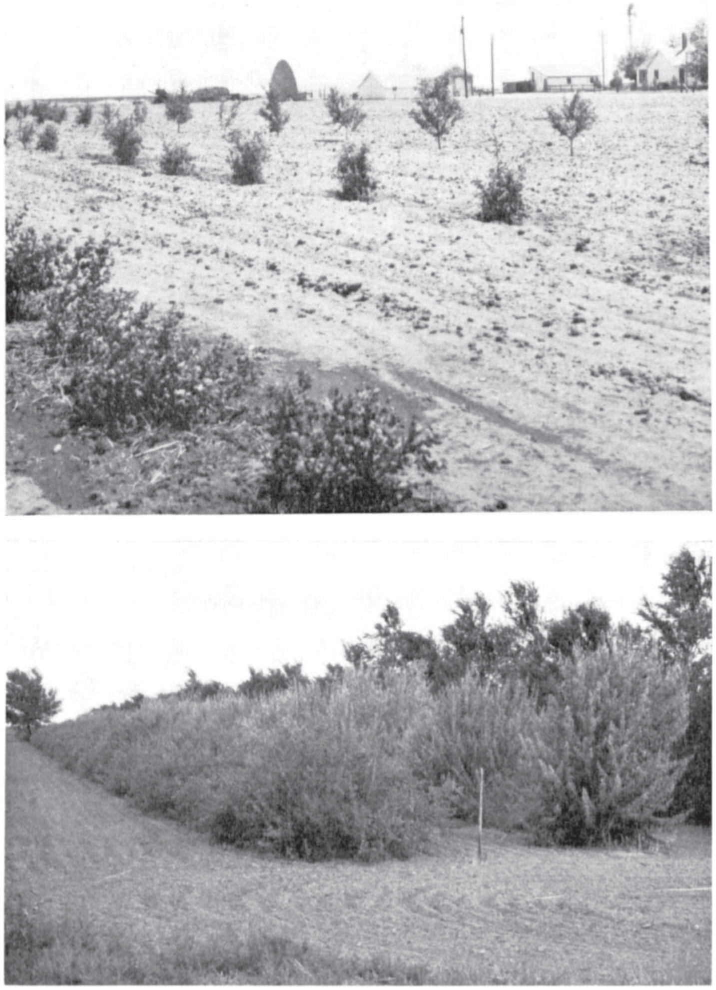

Figure 9.—**A farmstead windbreak consisting of squawbush, Russian-olive, Siberian elm, Rocky Mountain juniper, and ponderosa pine on Richfield loam and Rago and Kuma silt loams. In the top picture the planting is 1 year old; in the bottom picture, it is 5 years old and in excellent condition.**

soils should be left fallow for a summer before planting. After trees have been planted, clean cultivation for as many years as possible is important. Cover crops between the rows of trees for the first 2 or 3 years may be desirable. If practical, water should be diverted from other areas to the planting site.

WINDBREAK GROUP 2

This group consists of deep, well-drained loamy sands or fine sands. These soils are members of the Bayard, Chappell, Dunday, Haxtun, Julesburg, and Valentine series. They are well suited to trees.

Suitable species for windbreak plantings on these soils are squawbush, American plum, Caragana, sand cherry, lilac, Rocky Mountain juniper, eastern redcedar, ponderosa pine, Austrian pine, Siberian elm, Russian-olive, hackberry, and green ash.

Wind erosion is a hazard. Strips of stubble or growing vegetation should be maintained between the rows of trees. Plantings on Valentine soils should not be cultivated.

WINDBREAK GROUP 3

This group consists of soils on bottom lands that are flooded occasionally or that have a high water table. These soils are members of the Elsmere and McCook series. In some of these soils the water table is more than 36 inches below the surface but is within reach of tree roots.

Suitable species for windbreak plantings are purple willow, basket willow, buffaloberry, western chokecherry, Colorado blue spruce, Rocky Mountain juniper, eastern redcedar, Siberian elm, Russian-olive, white willow, golden willow, cottonless cottonwood, green ash, hackberry, and lilac.

Establishing trees may be difficult, but once established, they grow well. Cultivation and irrigation for the first 2 or 3 years may be essential. After the first 2 or 3 years the trees are usually able to compete with the other vegetation.

WINDBREAK GROUP 4

This group consists of well-drained soils that have less than 24 inches of root zone over limestone, gravel, or silt-

TABLE 4.—*Height and survival rate of selected species for windbreak plantings*

[Dashed line indicates that the soil is not suitable for windbreak plantings]

Suitable species	Windbreak group 1		Windbreak group 2		Windbreak group 3		Windbreak group 4 [1]		Windbreak group 5	
	Height at 20 to 25 years	Survival rate	Height at 20 to 25 years	Survival rate	Height at 20 to 25 years	Survival rate	Height at 20 to 25 years	Survival rate	Height at 20 to 25 years	Survival rate
	Ft.	*Pct.*	*Ft.*	*Pct.*	*Ft.*	*Pct.*	*Ft.*	*Pct.*	*Ft.*	*Pct.*
Siberian (Chinese) elm on—										
Irrigated soils	50+	90	50+	90	35–50	85	35–50	85	--------	--------
Non irrigated soils	35+	90	35+	90	25–35	80	(2)	70	--------	--------
Ponderosa pine on—										
Irrigated soils	25+	90	25+	90	20–25	80	20–25	80	--------	--------
Nonirrigated soils	20+	90	20+	90	15–20	80	15–20	80	--------	--------
Rocky Mountain juniper on—							18+			
Irrigated soils	18+	90	18+	90	12–15	70	13–15	90	--------	--------
Nonirrigated soils	15+	85	15+	85	10–13	60		75	--------	--------

[1] Onsite investigation is needed before these poorly suited soils are used for windbreak plantings.
[2] Less than 25.

stone. These soils are members of the Canyon, Eckley, Epping, and Keota series.

The species most suitable for windbreak plantings on these soils are Siberian elm, ponderosa pine, and Rocky Mountain juniper.

Trees are difficult to plant in these soils and can be expected to have poor survival and growth rates. A careful onsite examination should be made to find the places where the soil is deepest before any trees are planted.

WINDBREAK GROUP 5

This group consists of soils of the Lamo, Las, Scott, Valentine, and Wann series and of Sandy alluvial land, Slickspots, and Wet alluvial land. These soils are not suited to windbreak plantings because of one or more of the following characteristics: excessive salinity, strong slopes, erodibility, frequent ponding, or frequent flooding.

Use of the Soils for Recreation [5]

The relative severity of the limitations of the soils for recreational development is shown in table 5, by soil associations. The broad classification by soil associations should be noted. Certain locations within an association that generally have severe limitations might readily be adapted to a given recreational use. Other locations within an association that generally have only slight limitations might be severely limited for a given use. The general soil map at the back of this survey shows the location of the six soil associations in the county.

Limiting factors other than soil characteristics were also considered in evaluating the soil associations for recreational enterprises. Among these were the long distance from population centers, the lack of spectacular scenery, and the hot summer weather.

Improving the waterfowl habitat in areas under irrigation, such as those in association 3, and then leasing the rights for hunting ducks probably offers the best potential for the development of recreational facilities. Areas to be used for duck hunting must have a gradient of no more than 1 percent, and water must be available for irrigating and flooding. Diking and planting such areas in spring and then flooding them with not more than 15 inches of water in fall provides excellent facilities for duck shooting.

Good sites for campgrounds and trailer courts can be found in associations 2, 3, and 5.

[5] By ELDIE W. MUSTARD, biologist, Soil Conservation Service.

Use of the Soils for Wildlife [6]

The native vegetation of Sedgwick County was grass. It once supported large herds of bison, large herds of pronghorn antelope, flocks of prairie chickens, and other animals. Since then, changes in land use have altered the wildlife habitat. Changes unfavorable to some kinds of wildlife have been favorable to other kinds and have made possible the introduction of new species. For example, the large herds of bison are gone, and only a small number of prairie chickens remain but the number of antelope is increasing, and pheasants have been successfully introduced.

Table 6 shows the suitability of each of the six soil associations for the elements of habitat for specified kinds of wildlife. For descriptions of the soil associations, see the section "General Soil Map."

The ring-necked pheasant, an introduced species, is the most important gamebird in Sedgwick County. The large fields of grain in soil associations 1, 2, and 6 provide an ample supply of food, but cover is scarce in these areas, except in association 6, which is extensively stripcropped. Soil association 3 provides winter cover and is near food-producing areas. The pheasant population would increase if more permanent nesting cover and winter cover were established.

All of the soil associations provide some food and cover for mourning doves, but associations 1, 3, and 6 provide more than the others. These birds eat waste grain and seeds of grasses and weeds.

Colorado is at the western edge of bobwhite territory, so a large population of bobwhite cannot be expected. Some are found along the South Platte River in association 3, where the grainfields provide food and the adjacent brushland provides cover. Bobwhite would benefit if the scarce woody and brushy cover were protected from grazing.

[6] By ELDIE W. MUSTARD, biologist, Soil Conservation Service.

TABLE 5.—*Relative limitations of the soil associations for selected recreational uses*

Recreation	Degree of limitation					
	Soil association 1	Soil association 2	Soil association 3	Soil association 4	Soil association 5	Soil association 6
Hunting areas:						
Big game	Severe	Severe	Moderate	Moderate	Moderate	Severe.
Upland game	Slight	Slight	Moderate	Moderate	Severe	Slight.
Waterfowl	Severe	Severe	Moderate	Very severe	Severe	Moderate.
Vacation farms or dude ranches	Moderate	Moderate	Moderate	Severe	Severe	Severe.
Picnic and sports areas	Severe	Moderate	Moderate	Severe	Severe	Severe.
Fishing	Severe	Severe	Moderate	Very severe	Very severe	Very severe.
Seasonal campsites	Severe	Moderate	Moderate	Severe	Severe	Severe.
Rural cottage, camp, and home sites	Severe	Moderate	Moderate	Very severe	Severe	Severe.

TABLE 6.—*Suitability of soil associations for elements of wildlife habitat*

Soil associations and elements of wildlife habitat	Pheasant	Mourning dove	Bobwhite	Waterfowl	Deer	Antelope	Cottontail	Jack-rabbit	Fish
Association 1:									
Woody plant cover	Fair	Fair	Not applicable.	Not applicable.	Poor	Not applicable.	Fair	Not applicable.	Not applicable.
Herbaceous plant cover	Good	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Poor	Not applicable.	Not applicable.
Food	Good	Good	Not applicable.	Fair	Poor	Not applicable.	Good	Good	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Poor	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Poor.
Association 2:									
Woody plant cover	Fair	Fair	Not applicable.	Not applicable.	Poor	Not applicable.	Fair	Not applicable.	Not applicable.
Herbaceous plant cover	Poor	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Poor	Not applicable.	Not applicable.
Food	Good	Fair	Not applicable.	Fair	Good	Not applicable.	Good	Not applicable.	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Fair	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Fair.
Association 3:									
Woody plant cover	Fair	Fair	Fair	Not applicable.	Fair	Not applicable.	Fair	Not applicable.	Not applicable.
Herbaceous plant cover	Fair	Not applicable.	Fair	Not applicable.	Not applicable.	Not applicable.	Fair	Not applicable.	Not applicable.
Food	Good	Good	Good	Good	Fair	Not applicable.	Good	Poor	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Fair	Nor applicable.	Not applicable.	Not applicable.	Not applicable.	Good.
Association 4:									
Woody plant cover	Not applicable.	Poor	Not applicable.	Not applicable.	Poor	Not applicable.	Fair	Not applicable.	Not applicable.
Herbaceous plant cover	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Fair	Fair	Not applicable.
Food	Not applicable.	Fair	Not applicable.	Not applicable.	Poor	Good	Good	Good	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.
Association 5:									
Woody plant cover	Fair	Poor	Not applicable	Not applicable.	Poor	Not applicable.	Poor	Not applicable.	Not applicable.
Herbaceous plant cover	Poor	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Fair	Not applicable.	Not applicable.
Food	Poor	Poor	Not applicable.	Not applicable.	Poor	Fair	Fair	Fair	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.

TABLE 6.—*Suitability of soil associations for elements of wildlife habitat*—Continued

Soil associations and elements of wildlife habitat	Pheasant	Mourning dove	Bobwhite	Waterfowl	Deer	Antelope	Cottontail	Jack-rabbit	Fish
Association 6:									
Woody plant cover	Fair	Fair	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Fair	Not applicable.	Not applicable.
Herbaceous plant cover	Good	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Fair	Not applicable.	Not applicable.
Food	Good	Good	Not applicable.	Good	Not applicable.	Not applicable.	Good	Good	Not applicable.
Aquatic environment	Not applicable.	Not applicable.	Not applicable.	Poor	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.

Waste grain from the extensive grainfields would provide food for a larger population of waterfowl than now exists in the county, but there is only one body of water, the 1,570-acre Julesburg Reservoir, large enough to provide a resting place for migrating waterfowl. Waterfowl hunting is good along the South Platte River.

Deer, generally mule deer, are found on soils of association 3, where some woody growth along the South Platte River provides food and cover. The soils on these bottom lands are commonly used as pasture for cattle. Such use destroys the brushy cover necessary for the survival of deer.

Pronghorn antelope should eventually be found on soils of all of the associations that have extensive rangeland, but they are found presently only in soil associations 4 and 5, and only in the western part of the county. They eat many plants that are considered poisonous to cattle (*7*). On well-managed range, there is little competition between cattle and antelope for food. If the range is overgrazed, cattle are forced to eat certain weeds and other less palatable plants that antelope ordinarily would eat.

Cottontails need patches of brush or weeds to protect them from numerous enemies. There are areas favorable to cottontails in all of the associations.

Jackrabbits live in areas of open range. They do not need cover of brush or weeds, because they run fast enough to outdistance their enemies. There are areas favorable to jackrabbits in all of the associations.

Fishing waters are relatively scarce. Farm ponds furnish some fishing. In soil associations 4, 5, and 6 the soils are very porous, and it is not generally practical to build farm ponds. At times Julesburg Reservoir furnishes excellent fishing for warm-water fish.

Engineering Uses of the Soils [7]

Some soil properties are of interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, and sewage disposal systems. The soil properties most important to engineers are permeability, shear strength, compaction characteristics, drainage, shrink-swell characteristics, dispersion, grain size, plasticity, and reaction. Depth to water table, depth to bedrock, water-holding capacity, and topography are also important. Estimates of the soil properties significant in engineering are given in table 7, page 40, and interpretations relating to engineering uses of the soils in table 8, page 44.

The information in this section can be used to—

1. Make preliminary estimates of soil properties that are significant in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
2. Make preliminary evaluations that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations of the selected locations.
3. Locate probable sources of sand, gravel, or other construction materials.
4. Make studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing and maintaining engineering structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used in soil science—for example, soil, clay, silt, and sand—differ in meaning from the same terms used in engineering. These terms and others are defined in the Glossary.

[7] RONALD I. BLEWITT, conservation engineer, Soil Conservation Service, helped prepare this section.

324-526—69——4

TABLE 7.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA	Unified	AASHO
	In.			
Ascalon (AsB, AsC, AsD).	0–6	Sandy loam	A–2	SM
	6–11	Sandy clay loam	A–6	SC
	11–25	Light sandy clay loam	A–2	SM or SC
	25–37	Very fine sandy loam	A–4	ML
	37–60	Fine sand	A–2–4	SM
Bayard (BaE, BcE). (For properties of Ascalon and Manter components of BaE, see Ascalon and Manter series; for properties of Canyon component of BcE, see Canyon series.)	0–60	Sandy loam	A–2	SM
Bridgeport (BrA, BrB, BrAB).	0–60	Loam	A–4	ML
Campus (CaB, CaC). (For properties of Richfield component, see Richfield series.)	0–15	Loam	A–4	ML
	15–24	Light clay loam	A–4	ML
	24	Marl or soft limestone		
Canyon (CcD).	0–10	Gravelly loam	A–2	SM
	10	Bedrock (cemented gravelly material of Ogallala formation).		
Chappell (ChB, CpA, CpB).	0–9	Sandy loam	A–2	SM
	9–60	Sandy loam	A–2	SM
Cheyenne (CrB).	0–10	Loam	A–4	ML
	10–36	Loam and sandy loam	A–4 or A–2	SM
	36–60	Sand and gravel	A–1	SP or SP–SM
Colby (CuC, CuD). (For properties of Ulysses component, see Ulysses series.)	0–60	Silt loam	A–4	ML
Dunday.	0–18	Loamy sand	A–2	SM
	18–60	Sand	A–3	SP–SM
Eckley (EcE). (For properties of Chappell component, see Chappell series.)	0–8	Gravelly loam	A–2	SM
	8–60	Sand and gravel	A–1	SW
Elsmere (El).	0–13	Loamy fine sand	A–2	SM
	13–60	Fine sand	A–2	SP–SM and SP
Epping (EpE).	0–12	Gravelly loam	A–4	ML, SM
	12	Indurated, calcareous material		
Goshen.	0–6	Loam	A–4	ML
	6–23	Clay loam	A–6	CL
	23–60	Loam	A–4	ML
Haverson (HaA, HaB).	0–40	Loam	A–4	ML
Haxtun (HtA, HtB, HtC, HxA, HxB).	0–19	Sandy loam or loamy sand	A–2	SM
	19–33	Clay loam	A–4	ML, SM
	33–60	Loam	A–4, A–2	ML, SM
Julesburg (JuB, JuC).	0–7	Loamy sand	A–2	SM
	7–33	Sandy loam	A–2	SM
	33–60	Loamy sand and sand	A–2 or A–3	SM or SP–SM
Keith (KgB, KkB, KtA, KtB, KwE). (For properties of Goshen component of KgB, see Goshen series; for properties of Kuma component of KgB and KkB, see Kuma series; for properties of Tripp component of KtA and KtB, see Tripp series; and for properties of Wages component of KwE, see Wages series.)	0–7	Loam	A–4	ML
	7–26	Loam	A–4	ML
	26–60	Silt loam	A–4	ML

properties of the soils

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200						
				In./hr.	*In./in. of soil*	*pH*			
95–100	95–100	70–90	20–35	>6. 3	0. 1	6. 6–7. 3	None	Low	Low.
95–100	95–100	75–95	35–50	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Moderate.
95–100	95–100	75–90	20–35	0. 63– 6. 3	. 16	7. 4–7. 8	None	Low	Low.
95–100	95–100	90–100	50–65	0. 63– 6. 3	. 1	7. 9–8. 4	None	Low	Low.
95–100	90–100	70–85	20–35	>6. 3	. 04	7. 9–8. 4	None	Low	Low.
95–100	90–100	75–90	20–35	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
100	95–100	85–95	65–95	0. 63– 6. 3	. 16	7. 4–8. 4	None	Low	Low.
85–95	65–85	60–80	40–60	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
85–95	85–95	75–90	50–70	0. 63– 6. 3	. 16	7. 4–8. 4	None	Low	Low.
50–90	50–85	30–50	20–35	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
90–100	85–95	55–70	20–35	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
90–100	85–95	30–50	15–30	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
95–100	95–100	75–95	50–70	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
85–95	85–95	60–80	30–50	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
70–90	40–60	30–50	5–12	>6. 3	. 04	7. 4–7. 8	None	Low	Low.
100	100	80–95	75–90	0. 63– 6. 3	. 16	7. 4–8. 4	None	Low	Low.
100	100	90–100	15–35	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
100	100	90–100	5–12	>6. 3	. 04	6. 6–7. 3	None	Low	Low.
70–90	50–75	20–35	20–30	0. 63–>6. 3	. 16	6. 6–7. 3	None	Low	Low.
70–90	40–60	25–45	0–5	>6. 3	. 04	7. 4–7. 8	None	Low	Low.
100	100	90–100	15–35	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
100	100	90–100	0–10	>6. 3	. 04	7. 9–8. 4	None	Low	Low.
90–100	70–85	65–75	40–70	0. 63– 6. 3	. 16	7. 4–8. 4	None	Low	Low.
100	95–100	90–100	75–95	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
100	95–100	90–100	80–95	<0. 63	. 16	7. 4–7. 8	None	Low	Moderate.
100	95–100	90–100	75–95	0. 63– 6. 3	. 16	7. 9–8. 4	None	Low	Low.
100	100	90–100	50–70	0. 63– 6. 3	. 16	7. 4–7. 8	None	Low	Low.
95–100	95–100	80–95	12–25	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
95–100	95–100	75–95	40–70	<0. 63	. 16	6. 6–7. 3	None	Moderately high	Moderate.
95–100	90–95	75–90	20–70	0. 63– 6. 3	. 16	7. 4–8. 4	None	Low	Low.
100	95–100	70–90	12–20	>6. 3	. 08	6. 6–7. 3	None	Low	Low.
100	100	70–95	20–30	>6. 3	. 1	6. 6–7. 3	None	Low	Low.
100	95–100	65–95	5–15	>6. 3	. 04	6. 6–7. 3	None	Low	Low.
100	95–100	90–100	75–95	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
100	95–100	90–100	80–95	0. 63– 6. 3	. 16	6. 6–7. 3	None	Low	Low.
100	95–100	90–100	80–95	0. 63– 6. 3	. 16	7. 4–7. 8	None	Low	Low.

TABLE 7.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification: USDA	Unified	AASHO
	In.			
Keota (KyD). (For properties of Epping component, see Epping series.)	0–4	Silt loam	A–4	ML
	4–23	Light silty clay loam	A–6	CL
	23	Bedrock (Brule formation)		
Kuma.	0–8	Silt loam	A–4	ML
	8–28	Silt loam (heavy)	A–6	CL
	28–60	Silt loam	A–4	ML
Lamo (La).	0–2	Clay loam	A–6	CL
	2–42	Silty clay loam	A–7	CL
	42–62	Clay loam	A–6	CL
Las (Ls).	0–3	Silt loam or loam	A–4	ML
	3–41	Loam	A–4	ML
	41–60	Sandy loam	A–2	SM
Manter.	0–23	Sandy loam	A–2	SM
	23–60	Loamy sand	A–2 or A–3	SM or SP–SM
McCook (Mc).	0–20	Loam	A–4	ML
	20–38	Light sandy clay loam	A–6	SC
	38–60	Loamy sand	A–2 or A–3	SM or SP–SM
Rago (RaB, RaC). (For properties of Kuma component, see Kuma series.)	0–13	Silt loam	A–4	ML
	13–28	Clay loam	A–6	CL
	28–40	Loam	A–4	ML
	40–60	Loam to gravel		
Richfield (RcB, RcC).	0–6	Loam	A–4	ML
	6–15	Clay loam	A–7	CL
	15–36	Loam	A–4	ML
	36–60	Fine sandy loam	A–4	ML
Sandy alluvial land (Sa).	0–4	Gravelly sandy loam	A–2	SM
	4–26	Sand and gravel	A–1	SP and SP–SM
Scott (Sc).	0–17	Silt loam	A–4	ML
	17–42	Silty clay	A–7	CH
	42–60	Silty clay loam	A–4	ML
Slickspots (Sk).	0–3	Loam	A–4	ML
	3–15	Silty clay loam	A–6	CL
Tripp.	0–4	Loam	A–4	ML
	4–18	Clay loam	A–6	CL
	18–60	Loam	A–4	ML
Ulysses.	0–10	Silt loam	A–4 or A–6	ML
	10–60	Silt loam	A–4	ML
Valentine (VaD, VaE, VdC). (For properties of Dunday component of VdC, see Dunday series.)	0–60	Fine sand and loamy sand	A–3	SP
Wages (WaC, WaD).	0–9	Gravelly loam	A–4, A–2	ML, SM
	9–21	Clay loam	A–4	ML
	21–40	Loam	A–4	ML
	40–60	Sandy loam	A–2	SM
Wann (Wn).	0–8	Loam	A–4	ML
	8–22	Sandy loam	A–2	SM
	22–32	Loamy sand	A–1	SP
	32–60	Sandy loam	A–2	SM
Wet alluvial land (Wt).	0–60	Sand and gravel	A–1	GP, SP, or SP–SM

properties of the soils—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200						
				In./hr.	*In./in. of soil*	*pH*			
85–100	85–100	75–90	60–80	0.63–6.3	.16	6.6–7.3	None	Low	Low.
95–100	95–100	75–90	60–80	0.63–6.3	.16	7.9–8.4	None	Low	Low.
100	95–100	90–100	75–95	0.63–6.3	.16	6.6–7.3	None	Low	Low.
100	95–100	90–100	80–95	<0.63	.16	7.4–7.8	None	Low	Low.
100	95–100	90–100	75–95	0.63–6.3	.16	7.9–8.4	None	Low	Low.
95–100	95–100	80–95	75–95	<0.63	.16	7.9–8.4	Moderate	Moderately high	High.
100	95–100	80–95	75–95	<0.63	.16	7.9–8.4	Moderate	High	High.
100	85–95	80–90	70–80	<0.63	.16	7.9–8.4	Moderate	High	High.
95–100	95–100	80–95	75–95	0.63–6.3	.16	7.9–8.4	Moderate	Low	Low.
95–100	95–100	80–95	60–80	0.63–6.3	.16	7.9–8.4	Moderate	Low	Low.
95–100	95–100	70–85	20–40	0.63–6.3	.1	7.9–8.4	Moderate	Low	Low.
100	100	70–95	20–30	0.63–6.3	.1	6.6–7.3	None	Low	Low.
100	95–100	65–95	5–15	>6.3	.08	7.3–7.8	None	Low	Low.
100	95–100	85–95	65–95	0.63–6.3	.16	7.9–8.4	Moderate	Low	Low.
95–100	95–100	75–95	35–50	0.63–6.3	.16	7.9–8.4	Moderate	Low	Low.
95–100	95–100	65–95	5–15	>6.3	.08	7.9–8.4	Moderate	Low	Low.
100	95–100	90–100	75–95	0.63–6.3	.16	6.6–7.3	None	Low	Low.
100	95–100	90–100	75–95	<0.63	.16	7.4–7.8	None	Moderately high	Moderate.
95–100	95–100	90–100	75–95	0.63–6.3	.16	7.9–8.4	None	Low	Low.
100	95–100	80–95	60–85	0.63–6.3	.16	6.6–7.3	None	Low	Low.
100	95–100	85–95	75–95	<0.63	.16	6.6–7.3	None	High	High.
100	95–100	90–100	60–85	0.63–6.3	.16	6.6–7.3	None	Low	Low.
95–100	90–100	80–95	60–80	0.63–6.3	.16	7.4–7.8	None	Low	Low.
75–90	50–80	50–70	15–35	>6.3	.1	6.6–8.4	None	Low	Low.
60–90	40–60	20–60	0–10	>6.3	.04	6.6–8.4	None	Low	Low.
100	95–100	90–100	75–95	0.63–6.3	.16	5.6–6.0	None	Low	Low.
100	95–100	90–100	80–95	<0.63	.16	6.6–7.3	None	High	High.
100	95–100	90–100	75–95	0.63–6.3	.16	7.9–8.4	None	Low	Low.
100	100	90–100	75–95	0.63–6.3	.16	7.9–8.4	Moderate	Low	Low.
100	100	90–100	80–95	<0.63	.16	8.5–9.0	Moderate	High	High.
100	95–100	90–100	75–95	0.63–6.3	.16	6.6–7.3	None	Low	Low.
100	95–100	90–100	80–95	<0.63	.16	6.6–7.3	None	Moderately high	Moderate.
100	95–100	90–100	70–95	0.63–6.3	.16	7.9–8.4	None	Low	Low.
100	100	80–100	70–90	0.63–6.3	.16	6.6–7.3	None	Low	Low.
100	100	80–95	75–90	0.63–6.3	.16	7.9–8.4	None	Low	Low.
100	100	95–100	0–4	>6.3	.04	6.6–7.3	None	Low	Low.
95–100	60–85	60–80	30–60	0.63–6.3	.16	6.6–7.3	None	Low	Low.
95–100	90–100	65–80	55–75	<0.63	.16	6.6–7.3	None	Moderately high	Low.
95–100	85–100	80–95	60–85	0.63–6.3	.16	7.9–8.4	None	Low	Low.
90–100	85–95	65–80	20–50	>6.3	.1	7.9–8.4	None	Low	Low.
95–100	85–100	80–95	60–75	0.63–6.3	.16	7.4–7.8	Moderate	Low	Low.
90–100	85–95	30–50	15–30	>6.3	.1	7.9–8.4	Moderate	Low	Low.
90–100	85–100	30–50	0–5	>6.3	.08	7.9–8.4	Moderate	Low	Low.
90–100	85–95	30–50	15–30	>6.3	.1	7.9–8.4	Moderate	Low	Low.
50–85	15–50	10–40	0–10	>6.3	.04	7.9–8.4	Moderate	Low	Low.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability of soil as a source of—			Degree of limitation for—		Soil features adversely affecting use for—
	Topsoil	Road fill	Sand and gravel	Septic tank filter fields	Sewage lagoons	Foundation support [1]
Ascalon (AsB, AsC, AsD)	Fair	Good	Not suitable	Slight on slopes of 0 to 5 percent; moderate on slopes of 5 to 9 percent.	Moderate to severe: rapid permeability in substratum.	No unfavorable features.
Bayard (BaE, BcE) (For interpretations of Ascalon and Manter components of BaE, see Ascalon and Manter series; for interpretations of Canyon component of BcE, see Canyon series.)	Fair	Good	Poor	Severe on slopes of 5 to 12 percent.	Severe: slopes of 5 to 12 percent.	Slopes of 5 to 12 percent.
Bridgeport (BrA, BrB, BrAB).	Good	Fair	Not suitable	Slight	Moderate	Fair to poor bearing capacity.
Campus (CaB, CaC) (For interpretations of Richfield component, see Richfield series.)	Fair	Fair to good.	Not suitable	Severe: limestone or marl within a depth of 5 feet.	Moderate	No unfavorable features.
Canyon (CcD)	Poor	Fair to good.	Not suitable	Severe: limestone bedrock within a depth of 20 inches.	Severe: bedrock within a depth of 20 inches.	Limestone bedrock within a depth of 20 inches.
Chappell (ChB, CpA, CpB)	Fair	Good	Fair for sand; good for gravel below a depth of 3 feet.	Slight	Severe: rapid permeability.	No unfavorable features.
Cheyenne (CrB)	Good	Fair to good.	Good below a depth of 2 feet.	Slight	Severe: rapid permeability.	No unfavorable features.
Colby (CuC, CuD) (For interpretations of Ulysses component, see Ulysses series.)	Fair	Fair	Not suitable	Slight on slopes of 3 to 5 percent; moderate on slopes of 5 to 9 percent.	Moderate: moderate permeability.	Fair to poor bearing capacity.
Dunday	Poor	Good if binder is added.	Fair for fine sand; not suitable for gravel.	Slight	Severe: rapid permeability.	No unfavorable features.
Eckley (EcE) (For interpretations of Chappell component, see Chappell series.)	Fair	Good	Good below a depth of 1 foot.	Severe: slopes of 9 to 20 percent.	Severe: slopes of 9 to 20 percent; rapid permeability.	Slopes of 9 to 20 percent.

See footnote at end of table.

interpretations of soils

Soil features adversely affecting use for—Con.					
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
	Reservoir area	Embankment			
No unfavorable features.	Rapid seepage rate.	Moderate permeability when compacted.	No unfavorable features.	Moderate water-holding capacity; slopes of 3 to 9 percent in some areas.	Hazard of wind erosion.
Erodibility	Rapid seepage rate.	Moderate permeability when compacted.	No unfavorable features.	Rapid intake rate; low water-holding capacity.	Soil is too sandy; slopes of 5 to 12 percent.
Erodibility; flooding in some places.	Moderate seepage rate.	Fair stability; fair compaction characteristics.	No unfavorable features.	No unfavorable features.	Nearly level.
Limestone or marl within a depth of 5 feet.	Moderate seepage rate.	No unfavorable features.	No unfavorable features.	Gentle slope in some areas; limestone or marl within a depth of 5 feet.	Scattered outcrops of limestone.
Limestone bedrock within a depth of 20 inches.	Rapid seepage rate.	Bedrock within a depth of 20 inches which is too shallow for borrow.	No unfavorable features.	Bedrock within a depth of 20 inches; gentle to moderate slope.	Bedrock within a depth of 20 inches.
Erodibility	Rapid seepage rate.	Moderate permeability when compacted.	No unfavorable features.	Moderate to low water-holding capacity.	Highly susceptible to wind erosion.
Occasional flooding	Rapid seepage rate.	Strongly stratified soil materials.	No unfavorable features.	Moderate water-holding capacity.	Nearly level.
Erodibility	Moderate seepage rate.	No unfavorable features.	No unfavorable features.	Slopes of 3 to 9 percent.	No unfavorable features.
Erodibility	Rapid seepage rate.	Soil is too sandy and needs binder.	No unfavorable features.	Low water-holding capacity.	Soil is too sandy.
Slopes of 9 to 20 percent.	Rapid seepage rate.	Moderate permeability when compacted.	No unfavorable features.	Low water-holding capacity; slopes of 9 to 20 percent.	Rapid intake rate.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability of soil as a source of—			Degree of limitation for—		Soil features adversely affecting use for—
	Topsoil	Road fill	Sand and gravel	Septic tank filter fields	Sewage lagoons	Foundation support [1]
Elsmere (El)	Poor	Good	Fair for fine sand; no gravel.	Severe: high water table.	Severe: rapid permeability.	High water table.
Epping (EpE)	Poor	Good	Not suitable	Severe: bedrock within a depth of 20 inches.	Severe: slopes of 3 to 9 percent; bedrock within a depth of 20 inches.	Bedrock within a depth of 20 inches.
Goshen	Good	Fair	Not suitable	Moderate: frequent flooding.	Moderate: frequent flooding.	Frequent flooding.
Haverson (HaA, HaB)	Good	Fair	Not suitable	Moderate: occasional flooding.	Moderate: occasional flooding.	Occasional flooding.
Haxtun (HtA, HtB, HtC, HxA, HxB).	Fair	Fair to good.	Poor for sand; no gravel.	Slight	Moderate: moderate permeability.	No unfavorable features.
Julesburg (JuB, JuC)	Poor	Good if binder is added.	Fair for sand below a depth of 3 feet; no gravel.	Slight	Severe: rapid permeability.	No unfavorable features.
Keith (KgB, KkB, KtA, KtB, KwE). (For interpretations of Goshen component of KgB, see Goshen series; for interpretations of Kuma component of KgB and KkB, see Kuma series; for interpretations of Tripp component of KtA and KtB, see Tripp series; and for interpretations of Wages component of KwE, see Wages series.)	Good	Fair	Not suitable	Slight	Moderate: moderate permeability.	Fair bearing capacity.
Keota (KyD) (For interpretations of Epping component, see Epping series.)	Poor	Fair	Not suitable	Severe: bedrock at a depth of 20 to 36 inches.	Severe: slopes of 3 to 9 percent; bedrock at a depth of 20 to 36 inches.	Fair to poor bearing capacity.
Kuma	Good	Fair	Not suitable	Slight	Moderate: moderate permeability.	Fair bearing capacity.
Lamo (La)	Poor	Poor	Not suitable	Severe: slow permeability.	Moderate: occasional flooding.	High shrink-swell potential.
Las (Ls)	Poor	Poor	Not suitable	Severe: high water table.	Severe: high water table.	High water table.
Manter	Fair	Good if binder is added.	Not suitable	Severe: slopes of 5 to 12 percent.	Severe: slopes of 5 to 12 percent.	Slopes of 5 to 12 percent.

interpretations of soils—Continued

Soil features adversely affecting use for—Con.					
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
	Reservoir area	Embankment			
High water table	Rapid seepage rate	Soil is too sandy and needs binder.	Sandy soil drains rapidly when water table is lowered.	High water table; sandy soil.	Nearly level; sandy soil.
Erodibility of moderate to strong slopes.	Bedrock within a depth of 20 inches; seepage rate is unpredictable.	Bedrock within a depth of 20 inches, which is too shallow for borrow.	No unfavorable features.	Bedrock within a depth of 20 inches; slopes of 3 to 9 percent.	Bedrock within a depth of 20 inches.
Frequent flooding	Moderately slow seepage rate.	No unfavorable features.	Frequent flooding	Frequent flooding	Nearly level.
Occasional flooding	Moderate seepage rate.	No unfavorable features.	No unfavorable features.	Occasional flooding	Nearly level.
No unfavorable features.	Rapid seepage rate.	No unfavorable features.	No unfavorable features.	Moderate water-holding capacity.	Rapid intake rate.
Erodibility	Rapid seepage rate.	Moderate to rapid permeability when compacted.	No unfavorable features.	Low water-holding capacity.	Rapid intake rate; hazard of wind erosion.
No unfavorable features.	Slow to moderate seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level.
Erodibility	Slow to moderate seepage rate.	Erodibility	No unfavorable features.	Bedrock at a depth of 20 to 36 inches.	Erodibility.
No unfavorable features.	Slow to moderate seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level.
High shrink-swell potential.	Slow seepage rate.	Fair stability; high shrink-swell potential.	Slow permeability	Poor tilth; slow permeability.	Nearly level.
High water table	Moderate seepage rate.	Fair stability	Drainage outlets scarce.	Salinity; high water table.	Nearly level.
Erodibility	Rapid seepage rate.	Moderate to rapid permeability when compacted.	No unfavorable features.	Low water-holding capacity; slopes of 5 to 12 percent.	Rapid intake rate.

See footnote at end of table.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability of soil as a source of—			Degree of limitation for—		Soil features adversely affecting use for—
	Topsoil	Road fill	Sand and gravel	Septic tank filter fields	Sewage lagoons	Foundation support [1]
McCook (Mc)	Good	Fair	Fair for sand below a depth of 3 feet; no gravel.	Severe: slow permeability.	Slight	No unfavorable features.
Rago (RaB, RaC) (For interpretations of Kuma component, see Kuma series.)	Good	Fair	Not suitable	Slight to moderate.	Slight	Fair to poor bearing capacity.
Richfield (RcB, RcC)	Good	Fair	Not suitable	Slight to moderate.	Slight	Fair to poor bearing capacity.
Sandy alluvial land (Sa)	Poor	Fair to good if binder is added.	Good	Severe: frequent flooding.	Severe: frequent flooding.	Frequent flooding
Scott (Sc)	Fair	Poor	Not suitable	Severe: slow permeability.	Severe: frequent ponding.	Frequent ponding
Slickspots (Sk)	Poor	Poor	Not suitable	Severe: slow permeability.	Slight	High shrink-swell potential.
Tripp	Good	Fair	Not suitable	Slight	Moderate: moderate permeability.	Fair bearing capacity.
Ulysses	Fair	Fair	Not suitable	Slight on slopes of 3 to 5 percent; moderate on slopes of 5 to 9 percent.	Moderate: moderate permeability.	Fair to poor bearing capacity.
Valentine (VaD, VaE, VdC) (For interpretations of Dunday component of VdC, see Dunday series.)	Poor	Good if binder is added.	Fair for fine sand: no gravel.	Slight to severe: undulating to hilly relief.	Severe: rapid permeability.	Erodibility
Wages (WaC, WaD)	Fair to good.	Good	Poor	Slight to moderate: slopes of 3 to 9 percent.	Severe: slopes of 3 to 9 percent.	No unfavorable features.
Wann (Wn)	Fair to poor.	Fair	Fair for sand below a depth of 2 feet; gravel below a depth of 4 feet in some areas.	Severe: high water table.	Severe: rapid permeability.	High water table
Wet alluvial land (Wt)	Poor	Good if binder is added.	Good	Severe: high water table.	Severe: rapid permeability.	High water table

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity.

interpretations of soils—Continued

Soil features adversely affecting use for—Con.					
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
	Reservoir area	Embankment			
No unfavorable features.	Moderate seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level.
No unfavorable features.	Slow seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level.
No unfavorable features.	Slow seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level in some areas.
Frequent flooding	Rapid seepage rate.	Soil is too sandy	No unfavorable features.	Not applicable	Sandy soil; frequent flooding.
Frequent ponding	Slow seepage rate.	Clayey material very difficult to compact.	Slow permeability	Slow permeability; frequent ponding.	Level to concave.
High shrink-swell potential.	Slow seepage rate	High shrink-swell potential; soil material is difficult to compact.	Slow permeability	Salinity and alkalinity; slow permeability.	Nearly level.
No unfavorable features.	Slow to moderate seepage rate.	No unfavorable features.	No unfavorable features.	No unfavorable features.	Nearly level.
Erodibility	Moderate seepage rate.	No unfavorable features.	No unfavorable features.	Slopes of 3 to 9 percent.	No unfavorable features.
Erodibility	Rapid seepage rate.	Soil is too sandy and needs binder.	No unfavorable features.	Low water-holding capacity; undulating to hilly relief.	Soil is too sandy.
No unfavorable features.	Slow seepage rate	No unfavorable features.	No unfavorable features.	No unfavorable features.	No unfavorable features.
High water table	Moderate seepage rate.	Fair stability	Good drainage outlets scarce.	Salinity; high water table.	Nearly level.
High water table; flooding.	Rapid seepage rate.	Soil is too sandy	Drainage outlets scarce.	Not applicable	Rapid intake rate; nearly level.

Engineering classification systems

The system of classifying soils used by the American Association of State Highway Officials (AASHO) (*1, 11*) is based on field performance of the soils in highways. It groups soils that have about the same general load-carrying capacity. In this system the soils are placed in seven principal groups. The groups range from A–1, which consists of gravelly soils of high bearing capacity, the best soils for road subgrade, to A–7, which consists of clayey soils that have low strength when wet, the poorest soils for subgrades.

The Unified soil classification system (*11, 18*), developed by the U.S. Army Corps of Engineers, is based on texture, the plastic and liquid limits, and performance as engineering construction material. The symbols SW and SP identify clean sand; SM and SC, sand that contains fines; GM and GC, gravel that contains fines; ML and CL, fine-grained material that has a low liquid limit; and MH and CH, fine-grained material that has a high liquid limit. Soils on the borderline between two classifications are given a joint classification, for example, SP–SM.

The system of textural classification used by the U.S. Department of Agriculture (USDA) (*15*) is primarily for agricultural use but is also important in engineering. In this system the texture of the soil depends on the proportions of the different sized mineral particles. The sizes are designated as cobblestones, gravel, sand, silt, and clay. The textural classes range from fine-textured clay, silty clay, and sandy clay to coarse-textured loamy fine sand, loamy sand, sand, and coarse sand.

Estimated engineering properties

Table 7 shows estimates of soil properties that affect engineering significantly. Estimates are given for the major horizons of the typical profiles. The column headings in table 7 are discussed briefly in the following paragraphs.

Permeability indicates the rate at which water moves through undisturbed soil material. The estimates are based largely on texture, structure, and porosity and on the results of permeability tests on undisturbed cores of similar soil material.

The available water capacity is the amount of capillary water held in a soil in a form that plants can use readily. This amount of water will wet soil material that is at the wilting point of common crops to a depth of 1 inch without further percolation.

Reaction (pH) refers to the degree of acidity or alkalinity of a soil. It indicates the need for protection for pipelines and other structures that are placed in the soil. The degrees of acidity or alkalinity are defined under "Reaction" in the Glossary.

Salinity is indicated by the electrical conductivity of saturated soil extract, which is expressed in millimhos per centimeter at 25° C.

Salinity:	*Millimhos per centimeter*
None	Less than 2.0
Slight	2.0 to 4.0
Moderate	4.0 to 8.0
Severe	8.0 to 16.0
Very severe	More than 16.0

Dispersion, as used in this publication, refers to the degree to which particles smaller than 0.005 millimeter are separate or dispersed. It should be distinguished from the single-grain or unaggregated condition of clean sand. Dispersed soils often become slick when wet, and a crust of clay forms as the surface dries. If the content of exchangeable sodium is more than 15 percent, the soil is likely to be dispersed.

The column headed "Shrink-swell potential" indicates the volume change to be expected with a change in moisture content. In general, soils classed as CH and A–7 have a high shrink-swell potential, and structureless sand and other nonplastic soil materials have a low shrink-swell potential.

Engineering interpretations

Table 8 shows the suitability of each soil as a source of topsoil, road fill, and sand and gravel; the degree of limitation for use in septic tank filter fields and sewage lagoons; and the soil features that adversely affect use of the soils for specific engineering structures. These ratings are based on information in table 7 and on field experience.

In table 8, topsoil refers to soil material used to grow vegetation. Usually only the surface layer of a soil is rated; however, in some areas the subsoil is rated because it may be the best material that is readily available.

Suitability ratings for road fill are based on the performance of the soil material when excavated and used as borrow for highway subgrade. In general, a sandy material containing adequate binder is the best. It is least affected by adverse weather conditions and can be worked during a greater number of months of the year. The poorest materials are plastic clays or organic material.

Some factors important in determining the degree of limitation for septic tank filter fields are permeability of the subsoil and substratum, depth to consolidated rock or other impervious layers, flooding hazard, depth to the water table, and soil slope.

Some factors considered in determining the degree of limitation for sewage lagoons are permeability, depth to hard rock, and soil slope.

In determining the soil features that affect highway location, the entire profile of an undisturbed soil is evaluated. Some of the features considered are depth to bedrock, depth to water table, stability, erodibility, and flooding hazard.

Formation and Classification of the Soils

This section discusses the factors of soil formation, the processes of soil formation, and the classification of the soils in Sedgwick County by higher categories.

Factors of Soil Formation

The factors that determine the kind of soil that forms at any given point are the composition of the parent material, the climate under which the soil material accumulated and weathered, the plant and animal life, the relief, or lay of the land, and time (*8*). Each of these factors modifies the effects of the other four.

Climate and vegetation are the active factors of soil formation. They act on the accumulated soil material and slowly change it into a soil that has genetically related horizons. Relief, mainly by its influence on temperature and runoff, modifies the effect of climate and vegetation.

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. Usually a long time is required for the development of distinct horizons.

Parent material

The parent materials of the soils in Sedgwick County include material weathered from the siltstone of the Brule Formation and from the alternating beds of limestone and cemented sandy and gravelly sediments of the Ogallala Formation; sand, gravel, and loess of Pleistocene age; and eolian sand and alluvium of Recent age (*5*, *6*).

The siltstone (fig. 10) is hard, but it is strongly calcareous and consequently weathers rapidly when it is exposed to air and water. It crops out on the south bank of the Julesburg Reservoir. Epping and Keota soils formed in material weathered from this siltstone.

The alternating beds of limestone (fig. 11) and cemented sandy and gravelly sediments are extremely hard and are resistant to weathering. The limestone crops out along U.S. Highway 385 about 1 mile south of Julesburg. Canyon soils formed in material weathered from this formation.

The deposits of sand and gravel are thick, and the material is loosely consolidated. The gravelly material is free of lime, and in some small areas is capped with a thin mantle of calcareous loess. Throughout these deposits are many cobblestones as much as 10 inches in diameter. Most appear to be on or near the surface. Eckley and Chappell soils formed in this material.

The loess, deposited at two different times, averages about 3½ feet in thickness. It contains a large amount of lime. The first deposit weathered for a considerable period of time before it was buried under the second deposit. Richfield soils formed in the earlier deposits, and Rago and Kuma soils in the later deposits.

In the western and southwestern parts of the county are thick deposits of loose eolian fine sand that is free of lime. Valentine soils formed in this material. Haxtun soils formed in material blown from these sand deposits and redeposited over older loess.

More recent are the deep deposits of silty alluvium on the terraces of the South Platte River. Haverson, Las, Wann, Cheyenne, Lamo, and Bridgeport soils formed in this material.

Climate

Sedgwick County has a semiarid continental climate characterized by warm summer temperatures, strong winds, and an average annual rainfall of 16.3 inches. Moisture

***Figure 10.*—Siltstone of the Brule Formation crops out on the south bank of Julesburg Reservoir.**

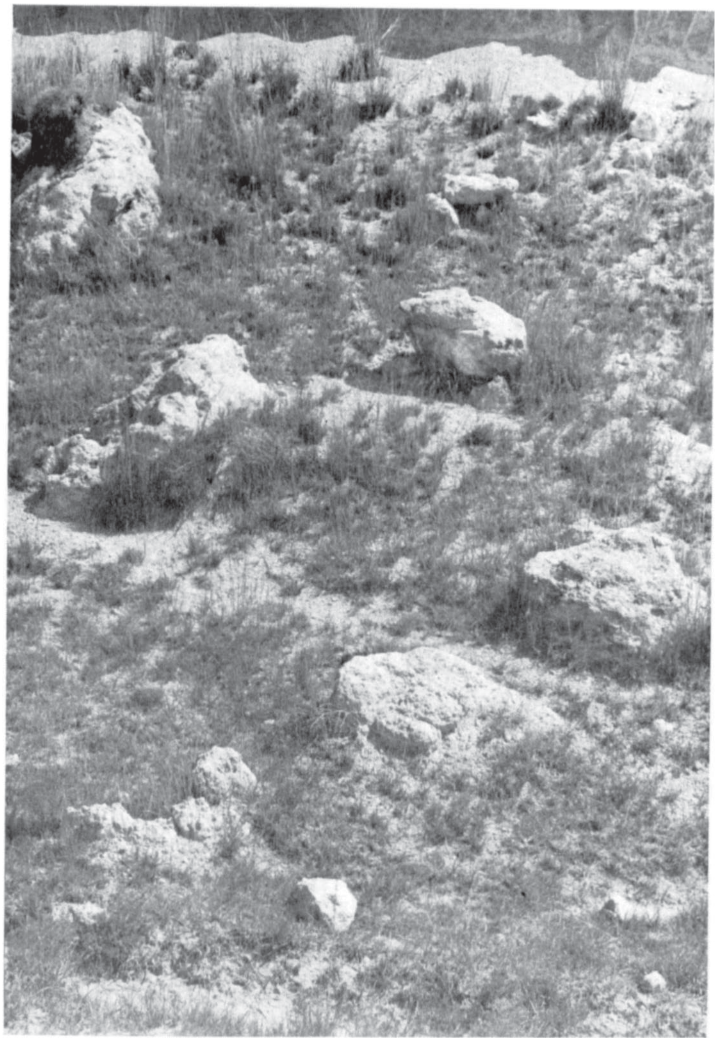

Figure 11.—**Limestone of the Ogallala Formation crops out south of Julesburg.**

generally penetrates the soils to a depth of about 3 feet, and small differences in the amount of soil moisture are significant in soil formation.

Rainfall has not been sufficient to leach out all the lime from any of the soils. The most strongly developed ones have a horizon of accumulated calcium carbonate. Many of the younger ones, the Colby soils, for example, have lime throughout the profile.

The warm temperatures hasten the decomposition of organic material, which turns into humus fairly rapidly.

The surface layer of many of the soils was deposited or has been altered by wind action. A thin film of windblown material may be deposited on the surface in any year and then removed the next year.

Plant and animal life

Grass, trees, micro-organisms, earthworms, rodents, and other forms of life are active in the soil-forming process.

The original vegetation in Sedgwick County was generally mid and short grasses, but it included some tall grasses in the sandhill area and sedges and alkali-tolerant grasses along the river. As is typical of soils that form under grass, nearly all the soils have a very dark grayish-brown surface layer and organic-matter stains. Within the past 60 years, the number of cottonwoods and willows growing along the perennial streams has greatly increased.

Although not studied in detail, the activity of earthworms, rodents, and other animals is known to be important in soil formation. Many worm casts are visible in the B3 and C horizons of loessal soils. These generally are about 1/4 to 1/2 inch in diameter and have been filled with dark-colored soil material from the horizons above.

Relief

Soil genesis is affected both by major differences in elevation and landform and by relatively small differences in landform within a given landscape. In either case, the effect is indirect.

Distinct differences in soil morphology are associated with relatively minor differences in slope and landform within a given landscape. In such circumstances, relief influences soil formation by virtue of its control of runoff. Where the total amount of rainfall is small, slight differences in the supply of moisture may account for relatively great differences in soil morphology. In the drier sections of the county, soils in concave spots, where runoff water concentrates, show more evidence of horizonation than other soils of the immediate landscape. The evidence may be only a thicker and darker colored surface layer, or it may be as significant as a distinct B2 horizon. Some soils that occur in such concave spots are soils of the Goshen and the Scott series.

Nearly level, low-lying soils on the recent alluvial fans and stream deposits are commonly influenced by a high water table and periodic flooding. Position and topography are such that this excess water is discharged very slowly. Vegetation is more dense and furnishes far more organic matter to the soil than the adjacent drier soils receive. Soils of the Lamo series and Wet alluvial land are examples of such low-lying soils.

Runoff from steeply sloping and convex areas results in the soils of these areas being much drier than other soils of the county. These soils have a thin surface soil and, for the most part, are shallow. There is little movement of salts or minerals within their profiles. Typical of such soils are soils of the Epping series.

Time

Time refers to the length of time the other soil-forming factors have been active. Normally, a long period of time is required for development of soils having well-defined horizons. These soils generally have a textural B horizon and horizons where calcium carbonate has accumulated. The soils of the Richfield series are examples. Soils on which the soil-forming factors have not been active for a long time generally lack a B horizon. Examples are the Bridgeport, Lamo, and Las soils on terraces.

The depth to which parent material has weathered is a clue to the age of a soil, but thick profiles do not have a chance to develop where geologic erosion is active. Here, soil material is carried away almost as fast as it forms. Soils of the Eckley and Wages series are examples. Soils in alluvium on bottom lands, as for example, soils of the Haverson series in this county, are considered young. Such soils receive new material each time they are flooded.

Processes of Soil Formation

The soils in Sedgwick County developed through one or more of the following processes: (1) the accumulation of organic matter, (2) the leaching of calcium carbonate and bases, (3) the reduction and transfer of iron, and (4) the formation and translocation of silicate clay minerals. In most of the soils, more than one of these processes was involved.

Accumulation of organic matter in the uppermost part of the profile has been an important process in horizon development. The content of organic matter ranges from low to high.

Most of the soils of the county are moderately leached to strongly leached. Generally, the leaching of bases precedes translocation of silicate clay minerals.

Reduction and transfer of iron, or gleying, are evident in the poorly drained and very poorly drained soils. Gray colors in the subsoil indicate reduction and loss of iron. Mottles and concretions of reddish brown indicate segregation of iron.

The translocation of clay minerals has contributed to horizon development in some of the soils. An example is Scott silt loam, which has an eluviated A2 horizon that has platy structure and contains less clay and generally is lighter colored than the B horizon. Generally, the clay has accumulated in the B horizon in the form of clay films in pores and on ped surfaces. The Richfield soils are examples of soils in which translocation has occurred.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another, and understand their behavior and their response to the whole environment. Through classification and the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Two systems of classifying soils above the series level have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*14*). The system currently used by the National Cooperative Soil Survey was adopted in 1965 and is under continual study. Readers interested in the development of the system should refer to the latest literature available (*13*, *17*).

The current system consists of six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are measurable or observable, but the properties are selected so that soils of similar genesis are grouped together. Placement of some series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of the soil series in Sedgwick County according to the current system (*17*) and the great soil group according to the 1938 system. The categories of the current system are defined briefly in the following paragraphs.

TABLE 9.—*Soil series in Sedgwick County classified into higher categories*

Series	Current classification system				Great soil group, 1938 classification
	Family	Subgroup	Suborder	Order	
Ascalon	Fine-loamy, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Bayard	Coarse-loamy, mixed, mesic	Entic Haplustolls	Ustolls	Mollisols	Chestnut soils intergrading to Regosols.
Bridgeport	Fine-silty, mixed, mesic	Entic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Chestnut soils.
Campus	Fine-loamy, mixed, mesic	Typic Calciustolls	Ustolls	Mollisols	Calcisols.
Canyon	Loamy, mixed, calcareous, mesic, thin.	Typic Ustorthents	Orthents	Entisols	Lithosols.
Chappell	Coarse-loamy, mixed, mesic	Typic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Chestnut soils.
Cheyenne	Fine-loamy over sandy skeletal, mixed, mesic.	Typic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Chestnut soils.
Colby	Coarse-silty, mixed calcareous, mesic.	Typic Ustorthents	Orthents	Entisols	Regosols.
Dunday	Sandy, siliceous, mesic	Entic Haplustolls	Ustolls	Mollisols	Regosols.
Eckley	Fine-loamy, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Elsmere	Sandy, siliceous, mesic	Aquic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Humic Gley soils.
Epping	Coarse-loamy, mixed, calcareous, mesic.	Andic Ustorthents	Orthents	Entisols	Lithosols.
Goshen	Fine-silty, mixed, mesic	Cumulic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Haverson	Fine-loamy, mixed, calcareous, mesic.	Typic Ustifluvents	Fluvents	Entisols	Alluvial soils.
Haxtun	Fine-loamy, mixed, mesic	Cumulic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Julesburg	Coarse-loamy, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Keith	Fine-silty, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Keota	Coarse-silty, mixed, calcareous, mesic.	Andic Ustorthents	Orthents	Entisols	Regosols.

TABLE 9.—*Soil series in Sedgwick County classified into higher categories*—Continued

Series	Current classification system				Great soil group, 1938 classification
	Family	Subgroup	Suborder	Order	
Kuma	Fine-silty, mixed, mesic	Cumulic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Lamo	Fine-silty, mixed, calcareous, mesic.	Cumulic Haplaquolls	Aquolls	Mollisols	Alluvial soils intergrading to Humic Gley soils.
Las	Fine-loamy, mixed, calcareous, mesic.	Typic Ustifluvents	Fluvents	Entisols	Alluvial soils.
Manter	Coarse-loamy, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
McCook	Fine-loamy, mixed, mesic	Fluventic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Chestnut soils.
Rago	Fine, montmorillonitic, mesic	Cumulic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Richfield	Fine, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Albolls	Mollisols	Planosols.
Tripp	Coarse-silty, mixed, mesic	Typic Haplustolls	Ustolls	Mollisols	Alluvial soils intergrading to Chestnut soils.
Ulysses	Fine-silty, mixed, mesic	Typic Haplustolls	Ustolls	Mollisols	Chestnut soils intergrading to Regosols.
Valentine	Sandy, siliceous, mesic	Typic Ustipsamments	Psamments	Entisols	Regosols.
Wages	Fine-loamy, mixed, mesic	Typic Argiustolls	Ustolls	Mollisols	Chestnut soils.
Wann	Fine-loamy, mixed, mesic	Typic Haplaquolls	Aquolls	Mollisols	Alluvial soils intergrading to Humic Gley soils.

ORDER.—Soils are grouped into orders according to properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Utisols, Oxisols, and Histosols. The Entisols and Mollisols are represented in Sedgwick County.

Entisols are recent soils in which there has been little, if any, horizon development.

Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 50 percent.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. The suborders have a narrower climatic range than the order. The criteria for suborders reflect either the presence or absence of waterlogging or soil differences resulting from climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups, on the basis of uniformity in kind and sequence of genetic horizons. The great group is not shown in table 9 because the name of the great group is the same as the last word in the name of the subgroup.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) concept of the group, and the other subgroups, called intergrades, made up of soils that have mostly the properties of one great group but also one or more properties of another great group.

FAMILIES.—Families are established within subgroups, primarily on the basis of properties important to plant growth. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

Mechanical and Chemical Analysis

Table 10 gives the results of mechanical and chemical analysis of samples taken from representative profiles of Eckley, Julesburg, Keith, Manter, Rago, Scott, and Wages soils. Data of this kind are useful in classifying soils and in understanding their genesis. Data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in determining whether saline-alkali soils can be reclaimed.

Field and Laboratory Methods

Samples were collected from carefully selected pits. If necessary, a sample was sieved after it had been dried, and the rock fragments larger than three-fourths of an inch in diameter were discarded. All the material less than three-fourths of an inch in diameter was rolled, crushed, and sieved by hand; the rock fragments larger than 2 millimeters in diameter were discarded. Only ovendry material that passed the 2-millimeter sieve was analyzed.

The data in table 10 were obtained by the following standard methods of the Soil Survey Laboratory. Percentage of clay was determined by the hydrometer method. Percentage of salts was estimated by the Bureau cup method. Reaction was measured with a glass electrode. Percentage of organic matter was determined by a modification of the Walkley-Black wet-combustion method (*10*). Calcium carbonate equivalent was obtained by measuring the volume of carbon dioxide emitted from soil samples that had been treated with concentrated hydrochloric acid. Extractable sodium and potassium were determined with a flame spectrophotometer on original saturation extracts obtained by the methods used in the U.S. Salinity Laboratory (*12*). Exchangeable sodium was extracted by the ammonium acetate method. Cation-exchange capacity was determined by direct distillation of adsorbed ammonia (*10*).

General Nature of the County

In the 1860's, when homesteaders first settled in Sedgwick County, ranching and cattle raising were the main farming enterprises, but in the 1890's wheat farming began to supplant them. Then irrigation ditches were built on the bottom lands along the river, and consequently more crops could be grown. Good yields of wheat, corn, alfalfa, and sugar beets encouraged agricultural development.

According to data published by the Colorado Department of Agriculture (*3*) the number of farms in the county in 1959 was 376. One third of the farms were partly or entirely irrigated, but the irrigated acreage was only about 6½ percent of the county. Data also showed that the acreage of hay and cultivated crops in 1966 (*4*) were as follows:

Crops:	Acres
Winter wheat	74,000
Oats	8,100
Barley	2,050
Sorghum—	
Grain	5,670
Forage	2,650
Corn—	
Grain	11,700
Silage	2,400
Hay—	
Alfalfa	4,800
Wild	2,400
Sugar beets	4,700
Beans (dry)	4,650

The livestock industry in the county centers around beef cattle, and there are several herds of purebred stock. Most ranches are cow-calf enterprises. Fat-cattle feeding is done on a moderate scale, and most of the finished stock is sold outside the county. In 1960 there were 10,920 cattle and calves, 1,025 sheep, 1,200 swine, and about 13,000 chickens in the county.

The population of Sedgwick County is about 4,250. Julesburg, population 1,840, is the largest town, the county seat, and a trading center for a wide area. Sedgwick and Ovid are the only other towns in the county.

Among the industries in the county are sugar refining, the manufacture of ready-mix concrete, and the processing, drying, and storing of grain.

Furnishing transportation are trucking firms and a railroad that has adequate passenger service. U.S. Highway 138 and most of the numbered county roads are hard surfaced.

Physiography, Relief, and Drainage

Sedgwick County is in the central part of the High Plains, within the physiographic province of the Great Plains. The elevation ranges from 3,435 feet northeast of Julesburg to 4,100 feet in the southwestern part of the county.

Along the South Platte River are bottom lands that extend outward a mile on either side. Also along the river are alluvial terraces, nearly all of which are level to gently sloping. These terraces slope toward the river, generally at about 7 feet to the mile. The terrace along Lodgepole Creek overlies the river terrace in the area north and east of Ovid. Parallel to the river terraces are gently sloping to moderately steep gravel hills and sand hills. The rest, and the largest part, of the county is a nearly level to gently sloping upland.

The northern part of the county is drained by the South Platte River and two of its tributaries, Cottonwood Creek and Lodgepole Creek, both of which flow in from the north. The river flows generally northeast through the northern part of the county, entering at the western edge and leaving at the northern edge, a few miles short of the eastern boundary. The bottom lands have poor drainage and a fluctuating water table. The low terraces along the river have somewhat poor drainage, but the higher terraces have good drainage. The water that runs off the gravel hills and sand hills generally travels only a short distance and then spreads out on the terrace. If rainfall is heavy, several intermittent streams are likely to overflow.

In the southern part of the county are numerous shallow drainageways, many of which terminate in small lakebeds or spread out over level to nearly level areas. The most significant drainageway is Sand Creek, an intermittent stream that rises in the south-central part of the county, flows toward the southeast, and leaves the county at the southeastern corner. There is no runoff from the sand hills in the southwestern part of the county.

Climate[8]

Sedgwick County has a semiarid, continental climate. Wide variations in precipitation, temperature, and humidity are characteristic. Except during a short period of hot weather in July, summer days are warm and the nights are cool. Winter temperatures are mild, but strong winds makes the weather seem colder than the thermometer indicates. Chinook winds are common, and heavy snow is infrequent. Damaging winds and hailstorms are fairly common, and several tornadoes have occurred.

Temperature and precipitation data based on records kept at Sedgwick and Julesburg are given in table 11. The probability of and the dates when specified freezing temperatures can be expected at Julesburg are shown in table 12. These data are representative of Sedgwick County.

Precipitation in Sedgwick County averages 16.3 inches a year, but not all the water that falls infiltrates and becomes effective for plant growth. A hard, heavy rain may produce only runoff, or, if rain is followed by hot temperatures and strong winds, the moisture may evaporate rapidly. Thus, precipitation data may be misleading in that they do not show the amount of effective moisture.

[8] Data compiled by J. W. BERRY, State climatologist, Denver.

TABLE 10.—*Analytical data on*

[Analysis by Soil Survey Laboratory, Fort Collins, Colo.

Soil and sample number	Horizon	Depth from surface	Particle-size distribution			Textural class	Reaction
			Sand	Silt	Clay		Paste
		In.	*Pct.*	*Pct.*	*Pct.*		*pH*
Eckley gravelly loam: S58 Colo-58-42(1-3).	A1	0–4	56	33	11	Sandy loam	7. 8
	B2t	4–8	81	10	9	Loamy sand	7. 4
	C	8–60	91	5	4	Sand	7. 6
Julesburg loamy sand: S58 Colo-58-40(1-5).	A1	0–7	91	5	4	Sand	----------
	B21t	7–13	80	12	8	Loamy sand	----------
	B22t	13–19	75	15	10	Sandy loam	----------
	B3	19–33	92	4	4	Sand	----------
	C	33–47	94	3	3	Sand	----------
Keith loam: S56 Colo-58-7(1-5).	Ap	0–7	42	42	16	Loam	6. 6
	B1	7–11	39	39	22	Loam	7. 1
	B2t	11–21	33	40	27	Loam	7. 1
	B3	21–26	26	49	25	Loam	7. 4
	Cca	26–60	29	53	18	Silt loam	8. 0
Manter sandy loam: S62 Colo-58-73(1-7).	A1	0–7	72. 1	16. 6	11. 3	Sandy loam	7. 5
	B1	7–11	72. 4	14. 1	13. 5	Sandy loam	7. 4
	B21	11–17	67. 1	18. 5	14. 4	Sandy loam	7. 4
	B22	17–23	59. 8	25. 1	15. 1	Sandy loam	7. 5
	B3	23–25	77. 7	13. 4	8. 9	Loamy sand	7. 6
	C1ca	25–32	80. 6	12. 3	7. 1	Loamy sand	7. 7
	C2	32–60	86. 8	8. 9	4. 3	Loamy sand	8. 0
Rago loam: S56 Colo-58-1(1-7).	A1	0–5	30	50	20	Loam	6. 7
	B1	5–10	33	44	23	Loam	6. 9
	B21t	10–13	34	43	23	Loam	6. 9
	B22tb	13–19	38	36	26	Loam	7. 0
	B23tb	19–24	36	36	28	Clay loam	7. 5
	B3cab	24–28	34	43	23	Loam	7. 7
	C1cab	28–40	34	50	16	Loam	7. 9
Scott silt loam: S58 Colo-58-46(1-7).	A1	1–7	16	61	23	Silt loam	5. 3
	A2	7–11	14	73	13	Silt loam	5. 8
	B21t	11–18	5	51	44	Silty clay	6. 2
	B22t	18–27	6	54	40	Silty clay	6. 8
	B23t	27–32	6	55	39	Silty clay	7. 2
	B3	32–40	7	65	28	Silty clay loam	7. 5
	C	40–60	12	78	20	Silt loam	7. 7
Wages gravelly loam: S59 Colo-58-53(1-5).	Ap	0–6	39. 2	43. 0	17. 8	Loam	7. 5
	B1	6–9	49. 0	28. 6	22. 4	Loam	7. 2
	B2t	9–14	43. 4	27. 3	29. 3	Clay loam	7. 6
	B3ca	14–21	40. 2	33. 9	25. 9	Loam	7. 8
	C1ca	21–32	38. 0	35. 8	26. 2	Loam	8. 1

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Dashes indicate that determination was not made]

Reaction—Continued	Estimated salts (Bureau cup)	Organic matter	Calcium carbonate equivalent	Electrical conductivity EC×10³ millimhos per centimeter at 25° C.	Extractable cations (milli-equivalent per 100 grams of soil)		Exchangeable sodium	Cation-exchange capacity
Water 1:5					Na	K		
pH	*Pct.*	*Pct.*	*Pct.*				*Pct.*	
8.1	<0.2	3.3	0.2	1.0	0.8	1.0	6.4	12.0
7.7	<.02	2.9	0	.4	.8	.3	4.9	16.0
8.0	<.02	.9	0	.4	.7	.3	16.3	4.0
7.6	<.02	.3	0	----	----	----	----	----
6.7	<.02	.6	0	----	----	----	----	----
6.7	<.02	.4	0	----	----	----	----	----
7.3	<.02	.1	0	----	----	----	----	----
7.2	<.02	.1	0	----	----	----	----	----
7.0	.10	2.4	0	.7	0	1.8	8.0	16.3
7.3	.07	1.9	.2	.4	.1	1.0	.5	19.0
7.5	.10	1.2	0	.5	.1	----	.4	20.5
7.9	.12	----	.4	.6	.1	----	.5	24.0
8.4	.10	----	10.5	.4	.3	----	2.2	19.3
8.0	----	1.3	.4	.5	.2	.8	1.8	10.8
7.9	----	1.1	.4	.4	.2	1.0	1.6	11.6
7.9	----	.8	.4	.4	.2	.8	1.6	12.0
7.8	----	.7	.5	.4	.2	.8	1.3	13.4
8.3	----	.3	.2	.4	.2	.4	2.4	8.0
8.5	----	.3	3.7	.5	.2	.4	2.5	7.6
8.9	----	.1	3.6	.5	.2	.4	3.2	5.6
6.8	<.02	4.1	.4	.7	.3	.3	1.3	20.0
6.9	<.02	2.3	.4	.4	.3	.3	1.8	15.8
7.1	<.02	1.6	.5	.5	.2	.3	1.1	17.5
7.4	.07	1.2	.3	.4	.2	2.0	.9	19.5
7.6	.08	----	1.5	.3	.2	1.8	1.3	21.8
7.7	.09	----	.5	.4	.3	1.8	1.3	22.3
8.2	.09	----	5.9	.4	.5	----	2.5	19.5
5.7	.07	3.1	.2	.9	.9	1.4	4.2	21.5
6.2	<.02	.9	0	.6	.4	.9	3.3	12.0
6.9	.14	1.0	0	----	----	----	----	----
7.4	.14	1.0	0	.6	.4	2.8	1.1	36.5
7.2	.14	.9	.3	----	----	----	----	----
7.5	.14	1.0	.2	----	----	----	----	----
8.0	.12	.6	.5	----	----	----	----	----
7.6	<.02	3.6	.5	----	----	----	----	----
7.5	<.02	2.5	.5	----	----	----	----	----
7.6	.10	1.7	4.8	----	----	----	----	----
7.6	.09	1.5	18.7	----	----	----	----	----
8.0	.05	1.0	29.5	----	----	----	----	----

TABLE 11.—*Temperature and precipitation data*

[Data for temperature and snow cover from Sedgwick, elevation 3,583 feet, and based on records for the period 1938 to 1957; data for precipitation from Julesburg, elevation 3,469 feet, and based on records for the period 1931 to 1960]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Days with snow cover	Average depth of snow on days with snow cover
	°F.	°F.	°F.	°F.	In.	In.	In.		In.
January	40	11	60	−8	0.41	0.1	0.6	8	3
February	45	15	64	−3	.44	.1	.8	7	3
March	52	22	73	5	1.00	.3	1.2	6	3
April	64	34	81	19	1.74	.5	2.5	1	4
May	74	44	89	33	2.94	1.5	4.2	(1)	1
June	84	53	100	41	2.78	1.6	3.6	0	
July	93	59	103	51	2.20	1.1	3.5	0	
August	91	57	102	49	1.93	.9	2.8	0	
September	82	46	97	34	1.23	.2	2.1	0	
October	70	34	86	24	.73	.2	1.4	(1)	1
November	53	21	70	6	.50	.1	.8	5	4
December	42	15	62	1	.42	.2	.6	9	3
Year	66	34	(2) 105	(3) −16	16.32	11.6	19.3	36	3

1 Less than one-half day.
2 Average annual highest temperature.
3 Average annual lowest temperature.

TABLE 12.—*Probabilities of freezing temperatures in spring and in fall*

[All data from Julesburg, elevation 3,469 feet, based on records for the period 1921–50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 14	April 23	May 1	May 16	May 27
2 years in 10 later than	April 9	April 17	April 25	May 11	May 21
5 years in 10 later than	March 30	April 7	April 15	May 1	May 11
Fall:					
1 year in 10 earlier than	October 21	October 14	October 5	September 24	September 15
2 years in 10 earlier than	October 26	October 19	October 11	September 30	September 20
5 years in 10 earlier than	November 6	October 30	October 21	October 10	October 1

Total precipitation varies widely from year to year. During the period 1953 to 1963, the low was about 10 inches, in 1954, and the high about 23 inches, in 1958. Most of the rain in the period April through August falls during thunderstorms. As much as 4 inches of rain in one thunderstorm has been recorded. Ordinarily there is enough rain through fall, winter, and spring to replace the moisture used during the growing season.

The average yearly temperature in the county is 49.6° F. The highest temperature recorded at Julesburg was 108°, and at Sedgwick 113°; the lowest temperature recorded at Julesburg was −38°, and at Sedgwick −40°. High temperatures combined with strong winds during the growing season often burn plant leaves and cause crop damage. The average length of the growing season is 143 days.

Water Supply

Water for irrigation and domestic use in Sedgwick County comes from the South Platte River and its tributaries and from water-bearing strata underground.

Julesburg Reservoir stores about 27,200 acre-feet of surface water that runs off in spring and winter. Water from this reservoir serves the entire valley area of the South

Platte River. The water is moderately alkaline but not detrimental to soils or crops. The cost is low compared with costs in areas farther west and nearer the mountains. Some water is diverted directly from the South Platte River through irrigation ditches.

Approximately 174 irrigation wells have been developed in the county. On some farms, wells are the only source of irrigation water. The wells in the valley of the South Platte River are about 60 feet in depth and 4 to 10 inches in diameter. The output is 350 to 2,000 gallons a minute. Wells in the uplands are much deeper; they range from a depth of 165 feet in the southern part of the county to a depth of 250 feet in the northern part. Water for urban use also comes from deep wells. Other sources of water include shallow wells for farmstead use and rainwater impounded for the use of livestock and wildlife.

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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.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

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.

Catch crop. A quick-growing crop, planted and harvested between two regular crops in consecutive seasons, or between two patches of regular crops in the same season.

Chiseling. Breaking or loosening subsoil with a chisel cultivator or chisel plow.

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.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors, consisting either 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.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are either at right angles to the natural direction of the slope or parallel to the terrace grade.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. A layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. The A and B horizons combined are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leached soil. A soil from which most of the soluble materials have been removed or in which these have been moved from one part of the profile to another part.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mapping unit. Areas of soil of the same kind, outlined on the soil map and identified by a symbol.

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.

Munsell notation. A system for designating color by degrees of the three simple variables: hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural drainage. Drainage 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.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A horizon and upper part of the B horizon and have mottling in the lower part of the B horizon and in the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time. If podzolic, they commonly have mottling below a depth of 6 to 16 inches in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods; they are light gray and generally mottled from the surface downward, but some have few or no mottles.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements are nutrients obtained from the soil. Carbon, hydrogen, and oxygen are nutrients obtained largely from air and water.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables a soil horizon to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system, made because of differences that affect management but do not affect classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Plowsole. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	PH		*PH*
Extremely acid	Below 4.5	Mildly alkaline	7.4–7.8
Very strongly acid	4.5–5.0	Moderately alkaline	7.9–8.4
Strongly acid	5.1–5.5	Strongly alkaline	8.5–9.0
Medium acid	5.6–6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1–6.5		
Neutral	6.6–7.3		

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

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 arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil; the C or R horizon.

Summer fallow. Tillage of uncropped land during the summer, to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in regions where annual precipitation is not enough to produce a crop every year. Summer fallow frequently precedes planting of winter grains.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

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."

Type, soil. A subdivision of the soil series, made on the basis of differences in the texture of the surface layer.

Water-holding capacity. The difference between the amount of water in a soil at field capacity and the amount in the same soil at the permanent wilting point. Commonly expressed as inches of water per inch of soil depth.

E R R A T A

Soil Survey of Sedgwick County, Colorado

In table 7, pages 40 through 43, the headings for AASHO and Unified engineering classifications are reversed. Where "AASHO" is shown, read "Unified," and where "Unified" is shown, read "AASHO." Explanation of the two systems, page 50, is correct.

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