SOIL SURVEY OF

Haskell County, Oklahoma

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

Major fieldwork for this soil survey was done in the period 1962–70. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Haskell County Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

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

Farmers and those who work with farmers can learn about use and management from the soil descriptions and from the discussions of the range sites, woodland groups, and pasture and hay groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

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

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

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Engineering Uses of the Soils" and "Soils for Recreational Development."

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

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

Newcomers in Haskell County may be especially interester 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.

Cover: Area of Stigler silt loam, 1 to 3 percent slopes. Prairie hay makes up a major part of the hay baled in Haskell County.

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SOIL SURVEY OF HASKELL COUNTY, OKLAHOMA

BY R. C. BRINLEE, SOIL CONSERVATION SERVICE

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

HASKELL COUNTY is located in the east-central part of Oklahoma (fig. 1). It has an area of about 572 square miles, or 366,470 acres. Stigler, near the center of the county, is the county seat.

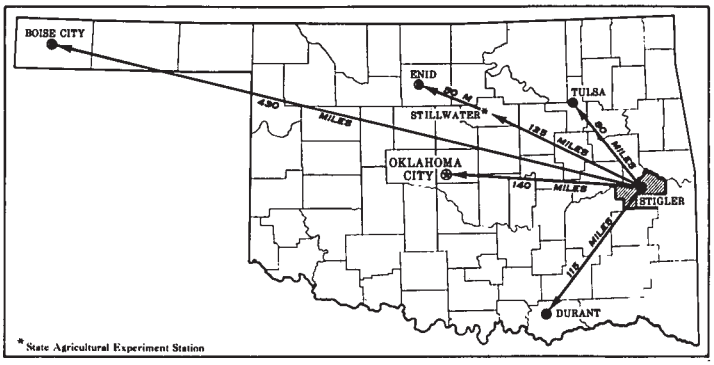

Figure 1.—**Location of Haskell County in Oklahoma.**

Livestock farming was the principal enterprise of the earliest settlers. After the coming of the railroads and the introduction of the cotton gin, corn and cotton became the main farm products. In the past 25 years the trend in farming has been away from cultivation and back to livestock farming. The areas still being cultivated are mainly on bottom lands along the Canadian and Arkansas Rivers. Much of the upland acreage that was formerly cultivated is now planted to tame pasture. Other areas are used for unimproved pasture. Many of the people now living on farms work at other jobs part of the time.

How This Survey Was Made

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

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

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

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Linker fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Linker series.

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

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

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

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they

cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Enders-Hector complex, 15 to 30 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. If two or more dominant series are represented in the group, the name of the group ordinarily consists of the names of the dominant soils joined by "and." Liberal and Collinsville stony soils, 5 to 20 percent slopes, is an example.

Another kind of unit is the variant, which is closely related to another soil series but differs from it in at least one important characteristic. Variants are really separate soil series but of too small known extent to justify a new series. Variants are named with the word "variant," plus a modifier as part of the name of each mapping unit. Mhoon soils, clayey variant, is an example.

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

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They 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 current methods of use and management.

General Soil Map

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

The soil associations in Haskell County are discussed in the following pages. The terms for texture used in the title for several of the associations apply to the surface layer. For example, in the title for association 1, the word "loamy" refers to the texture of the surface layer.

In places, the names of soils in Haskell County differ from those of adjoining soils in the survey of adjacent Pittsburg County. This difference is caused by refinements in the new system of soil classification.

1. Linker-Naldo Association

Moderately deep and deep, nearly level to sloping, well drained and moderately well drained, loamy soils on uplands

This association makes up about 17 percent of the county. It consists of soils that formed in material weathered from sandstone and in loamy sediment under a cover of trees. About 55 percent of this association is Linker soils, 20 percent is Naldo soils, and 25 percent is minor soils.

Linker soils are moderately deep, very gently sloping to sloping, well-drained soils that are loamy throughout. They are on broad crests and upper side slopes on uplands.

Naldo soils are deep, nearly level to gently sloping, moderately well drained soils that are loamy throughout. They are on lower side slopes on uplands.

Among the minor soils in this association are the Hector, Enders, Whakana, and Porum soils.

This association is used mainly as range and tame pasture. A small acreage is used for cultivated crops, such as peanuts, soybeans, small grains, grain sorghum, and cotton.

The principal concerns of management are maintaining soil fertility, controlling erosion in cultivated areas, and controlling brush in areas of range and tame pasture.

2. Enders-Hector Association

Shallow to deep, very gently sloping to steep, well-drained, loamy soils on uplands

This association makes up about 35 percent of the county. It consists of soils that formed in material weathered from shale or sandstone under a cover of trees. About 55 percent of this association is Enders soils, 30 percent is Hector soils, and 15 percent is minor soils.

Enders soils are deep, gently sloping to steep, well-drained, loamy soils that have a clayey subsoil. They are mainly on smooth side slopes on uplands.

Hector soils are shallow, very gently sloping to steep, well-drained soils that are loamy throughout. They are mainly on ridgetops and upper side slopes on uplands.

Among the minor soils in this association are the Counts, Linker, Naldo, Rexor, Sallisaw, Stigler, and Tamaha soils.

This association is used mainly as wooded range, but some areas produce hardwood and pine of marketable quality. Most of the acreage of this association is not suited to cultivated crops or tame pasture, because the soils are too stony or too steep. The less stony, less steep soils are suited to tame pasture.

The principal concerns of management are stoniness and the maintenance of soil fertility.

3. Stigler-Counts-Tamaha Association

Deep, nearly level to moderately steep, somewhat poorly drained and moderately well drained, loamy soils on uplands

This association makes up about 32 percent of the county. It consists of soils that formed in material weathered from shale or clayey sediment under an open cover of trees and an understory of grasses. About 32 percent of this association is Stigler soils, 18 percent is Counts soils, 11 percent is Tamaha soils, and 39 percent is minor soils.

Stigler soils are deep, nearly level or very gently sloping, moderately well drained, loamy soils that have a clayey or loamy subsoil. They are on broad flats on uplands.

Counts soils are deep, nearly level to moderately steep, somewhat poorly drained, loamy soils that have a clayey or loamy subsoil. They are on broad flats and side slopes on uplands.

Tamaha soils are deep, very gently sloping to sloping, moderately well drained, loamy soils that have a clayey or loamy subsoil. They are mainly on side slopes on uplands.

Among the minor soils in this association are the Collinsville, Dela, Enders, Guyton, Hector, Kanima, Liberal, Spiro, Vian, Whakana, and Wing soils.

Most of this association is used for tame pasture, range, and hay. A small acreage is used for cultivated crops. Small grain, soybeans, cotton, and grain sorghum are the main crops grown.

The principal concerns of management are maintaining soil structure, reducing surface crusting, and improving soil fertility.

4. Liberal-Collinsville Association

Deep to very shallow, very gently sloping to moderately steep, moderately well drained to somewhat excessively drained, loamy soils on uplands

This association makes up about 5 percent of the county. It consists of soils that formed in material weathered from shale and sandstone under a cover of grass. About 50 percent of this association is Liberal soils, 15 percent is Collinsville soils, and 35 percent is minor soils.

Liberal soils are deep, very gently sloping to moderately steep, moderately well drained, loamy soils that have a clayey or loamy subsoil. They are mainly on smooth side slopes on uplands.

Collinsville soils are very shallow or shallow, sloping to moderately steep, well drained or somewhat excessively drained soils that are loamy throughout. They are mainly ridge crests and upper side slopes on uplands.

Among the minor soils in this association are the Counts, Spiro, Stigler, and Tamaha soils.

This association is used mainly for range and tame pasture. A small acreage is used for cultivated crops. Small grain and grain sorghum are the main crops grown. Cotton and soybeans also are grown.

The principal concerns of management are stoniness, maintaining soil fertility, and controlling erosion.

5. Rexor-Guyton Association

Deep, nearly level or very gently sloping, well drained and poorly drained, loamy soils on flood plains

This association makes up about 8 percent of the county. It consists of soils that formed in material weathered from loamy sediment under a cover of trees. About 67 percent of this association is Rexor soils, 25 percent is Guyton soils, and 8 percent is minor soils.

Rexor soils are deep, nearly level or very gently sloping, well-drained soils that are loamy throughout. They are on higher areas of flood plains.

Guyton soils are deep, nearly level, poorly drained soils that are loamy throughout. They are on low areas of flood plains.

Among the minor soils in this association are the Dela and Sallisaw soils.

This association is used mainly for tame pasture. A small acreage is used for cultivated crops. Small grain, cotton, soybeans, and grain sorghum are the main crops grown.

The principal concerns of management are maintaining soil structure, maintaining fertility, protecting from damaging overflow, and drainage.

6. Crevasse-Oklared Association

Deep, nearly level or very gently sloping, excessively drained and well drained, loamy and sandy soils on flood plains

This association makes up about 3 percent of the county. It consists of soils that formed in material

weathered from loamy and sandy sediment under a cover of trees and an understory of grass. About 21 percent of this association is Crevasse soils, 18 percent is Oklared soils, and 61 percent is minor soils.

Crevasse soils are deep, nearly level or very gently sloping, excessively drained soils that are sandy throughout. They are mainly on the lower parts of flood plains adjacent to the stream channel.

Oklared soils are deep, nearly level or very gently sloping, well-drained soils that are loamy throughout. They are on flood plains of the major rivers.

Among the minor soils in this association are the Norwood, Caspiana, and Kiomatia soils, and the Mhoon soils, clayey variant.

This association is used mainly for cultivated crops. Grain sorghum, small grain, alfalfa, cotton, soybeans, tame pasture, and corn are the main crops grown. The sandy soils are used mainly as range.

The principal concern of management is maintaining soil structure and fertility.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in descriping the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

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

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[1]

Caspiana Series

The Caspiana series consists of nearly level soils on terraces of the Canadian and Arkansas Rivers. These

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

Soil	Acres	Percent
Caspiana silt loam	1,563	0.4
Counts silt loam, 0 to 1 percent slopes	2,678	.7
Counts silt loam, 1 to 3 percent slopes	5,043	1.4
Counts-Dela complex, 0 to 20 percent slopes	13,600	3.7
Counts-Wing complex, 1 to 3 percent slopes	8,612	2.3
Crevasse soils	2,095	.6
Dela fine sandy loam	698	.2
Enders-Hector complex, 3 to 15 percent slopes	36,693	10.0
Enders-Hector complex, 15 to 30 percent slopes	60,307	16.5
Enders stony soils, 30 to 45 percent slopes	5,864	1.6
Guyton silt loam	8,432	2.3
Hector stony loam, 2 to 12 percent slopes	10,600	2.9
Hector-Linker complex, 2 to 5 percent slopes	28,128	7.7
Kanima soils, 1 to 30 percent slopes	5,216	1.4
Kiomatia fine sandy loam	1,270	.3
Liberal clay loam, 2 to 5 percent slopes	1,398	.4
Liberal-Spiro complex, 2 to 5 percent slopes	8,074	2.2
Liberal and Collinsville stony soils, 5 to 20 percent slopes	9,608	2.6
Linker fine sandy loam, 1 to 3 percent slopes	2,525	.8
Linker fine sandy loam, 3 to 5 percent slopes	1,565	.4
Linker fine sandy loam, 2 to 5 percent slopes, eroded	15,396	4.2
Linker-Hector complex, 2 to 8 percent slopes, severely eroded	11,761	3.3
Mhoon soils, clayey variant	598	.2
Naldo fine sandy loam, 0 to 3 percent slopes	952	.2
Naldo fine sandy loam, 3 to 5 percent slopes	4,144	1.1
Naldo fine sandy loam, 2 to 5 percent slopes, eroded	9,826	2.7
Norwood silty clay loam	1,721	.5
Oklared fine sandy loam	1,840	.5
Porum fine sandy loam, 3 to 5 percent slopes	1,050	.3
Porum fine sandy loam, 3 to 5 percent slopes, eroded	1,968	.5
Rexor silt loam	8,700	2.4
Rexor soils, channeled	13,154	3.6
Sallisaw loam, 1 to 3 percent slopes	3,101	.8
Spiro silt loam, 1 to 3 percent slopes	1,858	.5
Spiro silt loam, 3 to 5 percent slopes	3,279	.9
Spiro silt loam, 2 to 5 percent slopes, eroded	4,218	1.2
Stigler silt loam, 0 to 1 percent slopes	6,032	1.6
Stigler silt loam, 1 to 3 percent slopes	38,551	10.5
Tamaha silt loam, 1 to 3 percent slopes	5,554	1.5
Tamaha silt loam, 3 to 5 percent slopes	840	.2
Tamaha silt loam, 2 to 5 percent slopes, eroded	4,440	1.2
Tamaha soils, 3 to 8 percent slopes, severely eroded	4,355	1.2
Vian silt loam, 1 to 3 percent slopes	4,017	1.1
Whakana loamy fine sand, 3 to 8 percent slopes	2,632	.7
Whakana soils, 3 to 8 percent slopes, severely eroded	2,514	.7
Total	[1] 366,470	100.0

[1] Land area only. Does not include 30,970 acres of water area, mostly lakes.

[1] Italic numbers in parentheses refer to Literature Cited, p. 75.

soils formed under a cover of mixed hardwood trees and an understory of tall grasses in material weathered from loamy sediment.

In a representative profile the surface layer is 16 inches of very dark brown silt loam. The upper part of the subsoil, extending to a depth of 26 inches, is dark-brown silty clay loam. The lower part of the subsoil, extending to a depth of 42 inches, is dark reddish-brown silty clay loam. The underlying material is reddish-brown loam.

Caspiana soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Caspiana silt loam, 1,100 feet west and 250 feet south of the NE. corner of sec. 10, T. 9 N., R. 19 E.:

A1—0 to 16 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, granular structure; friable, slightly hard; common earthworm casts; slightly acid; gradual, smooth boundary.

B1—16 to 26 inches, dark-brown (10YR 3/3) silty clay loam; moderate, medium, subangular blocky structure; firm, hard; few clay films on faces of peds; common medium pores; slightly acid; gradual, wavy boundary.

B2t—26 to 42 inches, dark reddish-brown (5YR 3/4) silty clay loam; moderate, medium, subangular blocky structure; firm, hard; clay films on faces of peds; common medium pores; slightly acid; gradual, wavy boundary.

C—42 to 65 inches, reddish-brown (5YR 4/4) loam; massive; friable, slightly hard; slightly acid.

The A horizon is very dark grayish brown or very dark brown. It is slightly acid or neutral. The B1 horizon is very dark grayish brown, very dark brown, or dark brown. The B2t horizon is dark reddish-brown or reddish-brown silty clay loam, silt loam, or loam. It is slightly acid or neutral. The C horizon has the same color range as the B2t horizon. It is loam, silt loam, or very fine sandy loam. It is slightly acid or neutral.

Caspiana soils in Haskell County are outside the range defined for the series in that the combined thickness of the A1 and B1 horizons ranges from 26 to 38 inches. This difference does not affect the morphology, use, behavior, or management of the soils.

Caspiana soils are associated with Norwood and Oklared soils. They have a Bt horizon in the subsoil.

Caspiana silt loam (Cp).—This nearly level soil is on terraces of the Canadian and Arkansas Rivers. It is protected from flooding by the Eufaula Dam.

Included with this soil in mapping, and making up 20 percent of the acreage, are soils that are similar to this Caspiana soil, except that they have slightly less clay in the subsoil. Also included, and making up 5 percent, are similar soils that have slightly more clay in the subsoil. Also included are small areas of a similar soil that has mottles within 16 inches of the surface or that has dark-brown colors in the lower part of the subsoil.

This soil is used dominantly for alfalfa, cotton, grain sorghum, soybeans, and small grains. It is also suited to tame pasture and hay. Management is needed that maintains soil structure. Tillage should be timely and kept to a minimum. Crop residue should be returned to the soil annually to improve soil structure. Capability unit I–1, Loamy Bottomland range site; woodland group 2o4; pasture and hay group 2A.

Collinsville Series

The Collinsville series consists of sloping to moderately steep soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from sandstone.

In a representative profile the surface layer is 8 inches of dark-brown loam. The subsoil, extending to a depth of 16 inches, is brown loam. The underlying material is sandstone.

Collinsville soils are well drained to somewhat excessively drained and have moderately rapid permeability. Available water capacity is low to moderate.

Representative profile of Collinsville loam from an area of Liberal and Collinsville stony soils, 5 to 20 percent slopes, 1,700 feet west and 100 feet south of the NE. corner of sec. 19, T. 8 N., R. 20 E.:

A1—0 to 8 inches, dark-brown (10YR 3/3) loam; moderate, medium, granular structure; friable, slightly hard; few roots; common sandstone fragments; medium acid; gradual, wavy boundary.

B2—8 to 16 inches, brown (7.5YR 4/4) loam; moderate, medium, subangular blocky structure; friable, hard; few roots; few sandstone fragments; strongly acid; clear, wavy boundary.

R—16 to 20 inches, consolidated sandstone.

Stones or rock fragments make up 1 to 20 percent of the soil surface. Depth to sandstone is 4 to 20 inches.

The A horizon is dark-brown or very dark grayish-brown loam or fine sandy loam. It is strongly acid to slightly acid. A weakly developed B2 horizon is present in most places. It is brown, dark-brown, or dark yellowish-brown loam or fine sandy loam. It is strongly acid to slightly acid. The C horizon, where present, has colors similar to those of the B horizon. It is strongly acid to slightly acid.

Collinsville soils are associated with Liberal, Tamaha, and Spiro soils and are similar to Hector soils. They have a thicker surface layer than the Hector soils. They have a thinner solum than the Liberal, Tamaha, and Spiro soils.

Collinsville soils in Haskell County are mapped only with Liberal soils.

Counts Series

The Courts series consists of nearly level to moderately steep soils on uplands. These soils formed under an open stand of hardwood trees and an understory of tall and mid grasses in material weathered from shale or in clayey sediment.

In a representative profile the surface layer is 6 inches of dark grayish-brown silt loam.The subsurface layer extends to a depth of 12 inches and is grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 50 inches, is brown and dark yellowish-brown mottled clay. The lower part of the subsoil, extending to a depth of 68 inches, is coarsely mottled gray and yellowish-brown clay. The underlying material is olive shale.

Counts soils are somewhat poorly drained and have very slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 12 to 24 inches.

Representative profile of Counts silt loam, 1 to 3 percent slopes, 400 feet south and 250 feet east of the NW. corner of sec. 2, T. 7 N., R. 19 E.:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, slightly hard; few, fine, iron-manganese concretions; medium acid; gradual, smooth boundary.

A2—6 to 12 inches, grayish-brown (10YR 5/2) silt loam; weak, medium, granular structure; friable, slightly hard; few, fine, iron-manganese concretions; strongly acid; abrupt, wavy boundary.

B21t—12 to 38 inches, brown (10YR 4/3) clay; many, coarse, distinct, reddish-brown (5YR 4/4) mottles and common, medium, faint, grayish-brown mottles; weak, coarse, blocky structure; very firm, extremely hard; patchy clay films on faces of peds; few, fine, iron-manganese concretions; medium acid; gradual, wavy boundary.

B22t—38 to 50 inches, dark yellowish-brown (10YR 4/4) clay; few, fine, faint, dark-brown mottles and black specks; weak, medium, blocky structure; very firm, extremely hard; many clay films on faces of peds; few slickensides; few, fine, iron-manganese concretions; medium acid; gradual, wavy boundary.

B3t—50 to 68 inches, coarsely mottled gray (10YR 6/1) and yellowish-brown (10YR 5/6) clay; weak, coarse, blocky structure; very firm, extremely hard; common clay films on faces of peds; few, medium, iron-manganese concretions; few shale fragments; slightly acid; gradual, wavy boundary.

C—68 to 72 inches, olive (5Y 4/2) shale; neutral.

The A1 or Ap horizon is brown, dark brown, or dark grayish brown. It is strongly acid or medium acid unless limed. The A2 horizon is brown or grayish brown. The B2t horizon is brown, dark yellowish-brown, or yellowish-brown clay, clay loam, silty clay, or silty clay loam. It has brownish, grayish, and, in places, reddish mottles. It has grayish mottles within a depth of 30 inches. This horizon is medium acid or strongly acid in the upper part and medium acid to moderately alkaline in the lower part. The B3t horizon is brown, dark yellowish-brown, or yellowish-brown clay, silty clay, silty clay loam, or clay loam. In places it has coarse grayish and brownish mottles. It is medium acid to moderately alkaline.

Counts soils are associated with Tamaha and Wing soils and are similar to Stigler soils. They have a thinner surface layer and subsurface layer than the Stigler soils. They differ from the Tamaha soils in having an abrupt boundary between the subsurface layer and subsoil. They have less sodium in the subsoil than the Wing soils.

Counts silt loam, 0 to 1 percent slopes (CuA).—This soil is on uplands.

Included with this soil in mapping are areas of Stigler soils that make up 15 percent of the acreage. Also included, and making up 10 percent of the acreage, are soils that are similar to this Counts soil, except that they do not have grayish mottles in the upper part of the subsoil. Inclusions of a similar soil that has a surface layer and subsoil that extend to a depth of less than 60 inches make up 5 percent. Small areas of Wing soils are also included.

This soil is used dominantly for range or hay and tame pasture. It is also suitable for soybeans, cotton, grain sorghum, and small grains. Management is needed that improves soil structure and reduces surface crusting. Returning large amounts of crop residue to the soil improves soil structure, increases water intake, and reduces crusting. Capability unit IIw–2; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Counts silt loam, 1 to 3 percent slopes (CuB).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Stigler soils that make up 15 percent of the acreage. Also included, and making up 10 percent of the acreage, are soils that are similar to this Counts soil, except that they do not have grayish mottles in the upper part of the subsoil. Also included are small areas of a similar soil that is less than 60 inches deep over shale or that contains more than 15 percent sodium in the subsoil.

This soil is used dominantly for range, hay, and tame pasture. It is also suited to soybeans, cotton, grain sorghum, and small grains. Management is needed that improves soil structure and fertility and reduces surface crusting and erosion. The cropping system needs to include crops that produce large amounts of residue, which is returned to the soil to improve soil structure, increase water intake, and reduce surface crusting and erosion. Use of terracing and contour tillage is also needed to reduce erosion. Sown crops can be grown without terraces if fertilizer is added and crop residue is returned to the soil. Capability unit IIIe–1; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Counts-Dela complex, 0 to 20 percent slopes (CvE).—This complex is on drainageways. The Counts soil is sloping to moderately steep and is on upland side slopes, and the Dela soil is nearly level or very gently sloping and is on flood plains. The uplands part of this complex is about 20 percent this Counts soil, 15 percent Tamaha soils, 10 percent Spiro soils, and 20 percent Stigler, Wing, Collinsville, Liberal, Naldo, and Linker soils. The flood plains part is about 15 percent this Dela soil, 10 percent a similar soil that is more clayey at a depth of 10 to 40 inches, 5 percent Guyton soils, and 5 percent Rexor soils. The percentage of soils varies from place to place.

These soils are used for tame pasture and range. Suitable grazing practices, protection from fire, control of brush, and improvement to soil fertility are needed to maintain or improve the quality of the grass. Both soils in capability unit VIe–1, Counts part in Loamy Savannah range site, and Dela part not in a range site; both soils in woodland group 4o1; Counts part in pasture and hay group 8C, and Dela part in pasture and hay group 2A.

Counts-Wing complex, 1 to 3 percent slopes (CwB).—This complex is 40 percent Counts soil and 25 percent Wing soil. These soils are between mounds on uplands. Each has a profile similar to the one described as representative of its respective series, except that the Wing soil has a surface layer of loam or fine sandy loam.

Included with these soils in mapping are areas of Stigler soils on mounds that make up 20 percent of the acreage. Also included are soils similar to Wing soils, except that the upper part of the subsoil is gray. These areas make up 15 percent of the acreage. The extent of the inclusions varies from areas to area.

These soils are used dominantly for range and tame pasture. They are also suitable for soybeans, grain

sorghum, and small grains. Management is needed that maintains fertility, reduces surface crusting and erosion, improves soil structure, and conserves moisture. Use of contour farming, fertilizer, and crop residue is needed to reduce erosion, to conserve moisture and to maintain soil fertility and structure. Both soils in capability unit IVs–1; Counts part in Loamy Savannah range site and Wing part in Slickspot range site; both soils in woodland group 5oO; Counts part in pasture and hay group 8C, and Wing part in pasture and hay group 8D.

Crevasse Series

The Crevasse series consists of nearly level or very gently sloping soils on flood plains of the Canadian and Arkansas Rivers. These soils formed under a cover of hardwood trees and tall grasses in material weathered from sandy sediment. They are protected from flooding by the Eufaula Dam.

In a representative profile the surface layer is 7 inches of brown loamy fine sand. The underlying material extends to a depth of 65 inches and is stratified light yellowish-brown fine sand, pale-brown fine sand, and light yellowish-brown sand.

Crevasse soils are excessively drained and have rapid permeability. Available water capacity is moderate. A seasonal ground water table is at a depth of 48 to 72 inches.

Representative profile of Crevasse soils, 1,200 feet south and 1,100 feet west of the NE. corner of sec. 11, T. 9 N., R. 19 E.:

A1—0 to 7 inches, brown (7.5CR 4/4) loamy fine sand; weak, fine, granular structure; very friable, soft; few fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 42 inches, light yellowish-brown (10YR 6/4) fine sand; single grained; loose; few fine roots; calcareous; moderately alkaline; gradual, smooth boundary.

C2—42 to 55 inches, pale-brown (10YR 6/3) fine sand; single grained; loose; calcareous; moderately alkaline; clear, smooth boundary.

C3—55 to 65 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; calcareous; moderately alkaline.

The A1 horizon is loamy fine sand, fine sandy loam, or sand. It is neutral to moderately alkaline. The C horizon is light yellowish-brown, light-brown, or pale-brown sand or fine sand. It is neutral to moderately alkaline. This horizon has common bedding planes and stratifications of sand.

Crevasse soils differ from the associated Kiomatia soils in being fine sand or sand between depths of 10 and 40 inches.

Crevasse soils (Cz).—These soils are nearly level or very gently sloping and are on flood plains. The surface layer is loamy fine sand, sand, or fine sandy loam. Native vegetation is cottonwood, willow, and tamarisk and an understory of tall grasses (fig. 2).

Included with these soils in mapping are areas of Kiomatia soils that make up 12 percent of the acreage, areas of Oklared soils that make up 5 percent, and areas of Mhoon soils, clayey variant that make up 3 percent. Also included are similar soils that are slightly redder than Crevasse soils.

Figure 2.—**Area of Crevasse soils. The native vegetation of grasses and scattered tamarisk, willow, and cottonwood trees is typical.**

These soils are used dominantly for range and woodland. They are also suited to tame pasture, cotton, and grain sorghum. Suitable grazing practices, protection from fire, and control of brush are needed to maintain or improve the quality of the grass. Capability unit IVs–2; Sandy Bottomland range site; woodland group 3s6; pasture and hay group 3A.

Dela Series

The Dela series consists of nearly level or very gently sloping soils on flood plains. These soils formed under a cover of hardwood trees in material weathered from loamy and sandy sediment. They are subject to flooding.

In a representative profile the surface layer is 12 inches of brown fine sandy loam. The underlying material extends to a depth of 64 inches and is yellowish-brown fine sandy loam and brown fine sandy loam stratified with thin layers of loamy fine sand.

Dela soils are moderately well drained and have moderately rapid permeability. Available water capacity is high. A seasonal ground water table is at a depth of 36 to 48 inches.

Representative profile of Dela fine sandy loam, 1,700 feet west and 2,200 feet north of the SE. corner of sec. 36, T. 9 N., R. 19 E.:

A1—0 to 12 inches, brown (10YR 4/3) fine sandy loam; moderate, medium, granular structure; very friable, soft; many fine roots; few iron-manganese concretions or small pebbles; medium acid; gradual, smooth boundary.

C1—12 to 34 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, medium, granular structure; friable, slightly hard; few iron-manganese concretions or fine gravel; medium acid; gradual, smooth boundary.

C2—34 to 64 inches, brown (10YR 4/3) fine sandy loam stratified with thin layers of loamy fine sand; few, fine, faint, gray, yellowish-brown and dark-brown mottles; structureless; friable, slightly hard; few iron-manganese concretions; medium acid.

In some areas the A horizon is less than 5 percent gravel or rocks. The A1 horizon is brown or dark grayish brown. It is medium acid or strongly acid. The C horizon is yellowish brown, dark yellowish brown, or brown and has grayish mottles below a depth of 30 inches. It is medium acid or strongly acid. This horizon has thin layers of coarser textured or finer textured material. In some areas a buried A horizon is below a depth of 20 inches.

Dela soils are associated with Rexor and Guyton soils and are similar to Oklared soils. They do not have the Bt horizon that is typical of the Rexor and Guyton soils. They are more acid than the Oklared soils.

Dela fine sandy loam (Da).—This nearly level or very gently sloping soil is on food plains. It is subject to occasional damaging floods.

Included with this soil in mapping, and making up about 20 percent of the acreage, are soils similar to this Dela soil except that the upper 20 inches has grayish mottles. Small areas of Rexor soils and Guyton soils are also included.

This soil is used dominantely for tame pasture (fig. 3) and trees. It is also suited to alfalfa, cotton, soybeans, grain sorghum, peanuts, and small grains. Management is needed that maintains soil structure and fertility and protects the soil from damaging overflow from streams. Use of crop residue, minimum tillage, and fertilizer is needed to maintain production and to improve soil structure. Capability unit IIw–1; not in a range site; woodland group 2o7; pasture and hay group 2A.

Enders Series

The Enders series consists of gently sloping to steep soils on uplands. These soils formed under a cover of hardwood trees and pine trees in material weathered from shale.

In a representative profile the surface and subsurface layers are 8 inches of dark-brown and brown loam. The upper part of the subsoil, extending to a depth of 36 inches, is yellowish-red clay. The lower part of the subsoil, extending to a depth of 42 inches, is mottled brownish, grayish, and yellowish clay. The underlying material is shale.

Enders soils are well drained and have very slow permeability. Available water capacity is high.

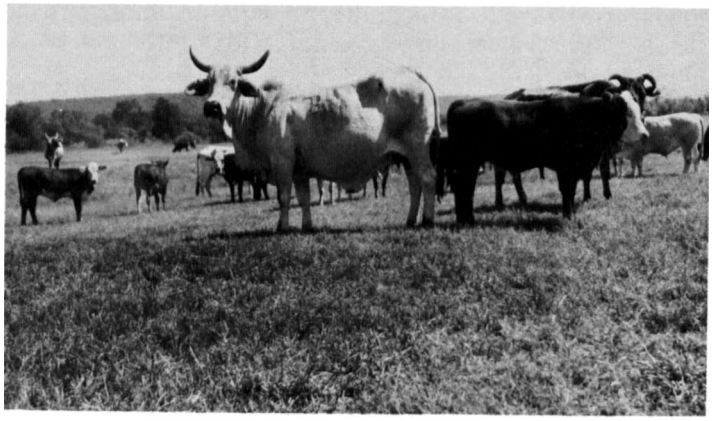

Figure 3.—**Brahma cows and crossbred calves on a pasture of clover, lespedeza, and bermudagrass. The soil is Dela fine sandy loam.**

Representative profile of Enders loam from an area of Enders-Hector complex, 15 to 30 percent slopes, 2,500 feet west and 400 feet north of the SE. corner of sec. 16, T. 7 N., R. 20 E.:

A1—0 to 3 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable, slightly hard; surface covered with about 5 percent sandstone rock fragments 3 to 18 inches in diameter; 12 percent, by volume, sandstone rock fragments less than 3 inches in diameter; strongly acid; clear, wavy boundary.

A2—3 to 8 inches, brown (7.5YR 5/4) loam; weak, fine, granular structure; friable, slightly hard; about 10 percent sandstone rock fragments less than 3 inches in diameter; very strongly acid; gradual, wavy boundary.

B21t—8 to 24 inches, yellowish-red (5YR 4/6) clay; moderate, fine, blocky structure; very firm, very hard; distinct clay films on faces of peds; very strongly acid; diffuse, wavy boundary.

B22t—24 to 36 inches, yellowish-red (5YR 4/6) clay; common, fine and medium, distinct, light yellowish-brown (10YR 6/4) and light brownish-gray (2.5YR 6/2) mottles; moderate, medium, blocky structure; very firm, very hard; distinct clay films on faces of peds; few shale and siltstone fragments; very strongly acid; gradual, wavy boundary.

B3—36 to 42 inches, coarsely mottled brownish-yellow (10YR 6/6), light-gray (10YR 6/1), and light yellowish-brown (10YR 6/4) clay; weak, coarse, blocky structure; very firm, very hard; patchy clay films on faces of peds; many black stains or spots; common shale fragments that increase with increasing depth; strongly acid; diffuse, wavy boundary.

C—42 to 46 inches, fractured shale that is about 10 percent light-gray (10YR 6/1) soil material between cracks; strongly acid.

Sandstone fragments more than 10 inches in diameter and rock fragments 3 to 10 inches in diameter cover 0 to 20 percent of the soil surface. Depth to shale is 40 to 60 inches.

The A1 horizon is very dark grayish-brown, dark grayish-brown, dark-brown, or brown loam, fine sandy loam, or silt loam. The A2 horizon is brown, pale-brown, grayish-brown, and yellowish-brown fine sandy loam, silt loam, or loam. It is very strongly acid or strongly acid. The A horizon is 0 to 20 percent, by volume, rock fragments less than 10 inches in diameter. In some places a B1 horizon of loam or silty clay loam as much as 6 inches thick is present in these soils. The B2t horizon is red or yellowish-red silty clay or clay that is generally mottled with brownish and grayish colors. It is very strongly acid or strongly acid. The B3 horizon is coarsely mottled with reddish, brownish, or grayish colors; the grayish colors increase with increasing depth. The B3 horizon is silty clay or clay. It is very strongly acid or strongly acid.

Enders soils are associated with Linker and Hector soils. They have a more clayey subsoil than the Linker soils. They have a thicker solum than Hector soils.

Enders-Hector complex, 3 to 15 percent slopes (EhD).—This complex is about 35 percent Enders soil and 25 percent Hector soil. These soils are on uplands. Each has a profile similar to the one described as representative of its respective series, except that the Enders soil has a surface layer of silt loam or fine sandy loam that is 0 to 20 percent rock fragments and stones, and the Hector soil has a surface layer of fine sandy loam that is 0 to 20 percent rock fragments on stones. The Enders soil is mainly on smooth side slopes, and the Hector soil is mainly on ridgetops and upper parts of side slopes.

Included with these soils in mapping are areas of soils similar to the Enders soil, except that the combined thickness of the surface layer and subsoil is less than 32 inches, the subsoil is more yellow, or the subsoil is more than 35 percent rock fragments, by volume. These areas make up about 35 percent of the acreage. Also included are areas of Linder soils that make up 5 percent. The extent of the inclusions varies from area to area.

These soils are suitable for tame pasture, range, and trees. Suitable grazing practices, control of brush, and protection from fire are needed to maintain or improve the quality of the native grass. Both soils in capability unit VIs–2; Enders part in Sandy Savannah range site and Hector part in Shallow Savannah range site; both soils in woodland group 4x2; less stony areas of Enders part in pasture and hay group 8B, and less stony areas of Hector part in pasture and hay group 14A.

Enders-Hector complex, 15 to 30 percent slopes (EhE).—This complex is about 42 percent Enders soil and 20 percent Hector soil. These soils are on uplands. The Hector soil has the profile described as representative of its series, but in some areas the surface layer is fine sandy loam or silt loam that is 0 to 20 percent stones and rock fragments. The Hector soil has a profile similar to that described as representative of the series, except that the surface layer is fine sandy loam that is 0 to 10 percent sandstone fragments more than 10 inches in diameter and 0 to 20 percent rock fragments less than 10 inches in diameter. The Enders soil is mainly on smooth side slopes, and the Hector soil is mainly on ridgetops and upper parts of side slopes.

Included with these soils in mapping are areas of soils similar to Enders soils, except that they are 30 to 40 inches deep over shale or the subsoil is more yellow. These areas make up 28 percent of the acreage. Also included are areas of Linder soils and areas of a deep, stony, colluvial soil on foot slopes, each of which makes up 5 percent of the acreage. The extent of the inclusions varies from area to area.

These soils are better suited to range and trees than to tame pasture. Suitable grazing practives, control of brush, and protection from fire are needed to maintain or improve the quality of the grass. Both soils in capability unit VIIs–1; Enders part in Sandy Savannah range site and Hector part in Shallow Savannah range site; both in woodland group 4x2; not in a pasture and hay group.

Enders stony soils, 30 to 45 percent slopes (EkF).—These soils are on uplands. They have a profile similar to that described as representative of the Enders series, except that the surface layer is silt loam or fine sandy loam that is 2 to 10 percent stones more than 10 inches in diameter and 10 to 20 percent rock fragments less than 10 inches in diameter. Enders stony soils make up 55 percent of this complex.

Included with these soils in mapping are areas of soils similar to Enders soils, except that the combined thickness of the surface layer and subsoil is less than 32 inches, the subsoil is more yellow, or the subsoil contains more than 35 percent rock fragments, by volume. These areas make up 30 percent of the acreage. Also included are areas of a deep, stony, colluvial soil on foot slopes. These areas make up 10 percent of the acreage. Rock outcrops make up 5 percent of the total acreage.

These soils are better suited to range and trees than to tame pasture. Suitable grazing practices, protection from fire, and control of brush are needed to maintain or improve the quality of the native grass. Capability unit VIIs–2; Savannah Breaks range site; woodland group 5r3; not in a pasture and hay group.

Guyton Series

The Guyton series consists of nearly level soils on flood plains. These soils formed under a cover of hardwood trees in material weathered from loamy sediment. They are subject to flooding.

In a representative profile the surface layer is 7 inches of dark grayish-brown silt loam. The subsurface layer extends to a depth of 28 inches and is gray and light brownish-gray silt loam. The upper part of the subsoil, extending to a depth of 60 inches, is dark-gray silty clay loam that has tongues and interfingerings of lighter textured material from the subsurface layer. The lower part of the subsoil, extending to a depth of 80 inches, is coarsely mottled grayish- and brownish-colored silty clay loam.

Guyton soils are poorly drained and have very slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 0 to 12 inches.

Representative profile of Guyton silt loam, 2,300 feet south and 1,100 feet west of the NE. corner of sec. 1, T. 8 N., R. 21 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, yellowish-brown mottles; moderate, medium, granular structure; friable, hard; many roots; medium acid; clear, smooth boundary.

A21g—7 to 16 inches, gray (10YR 5/1) silt loam; many, medium, faint, dark grayish-brown mottles and common, fine, faint, brown mottles; weak, medium, subangular blocky structure and weak, fine, granular; friable, very hard; common fine pores; common iron-manganese concretions; strongly acid; gradual, wavy boundary.

A22g—16 to 28 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, distinct, yellowish-brown mottles; weak, medium, subangular blocky structure; firm, very hard; 15 to 20 percent ½-inch B horizon bodies that are grayish-brown (10YR 5/2) silty clay loam; common, fine and medium, iron-manganese concretions; very strongly acid; diffuse, wavy boundary.

B21tg—28 to 44 inches, dark-gray (10YR 4/1) silty clay loam: many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable, very hard; 15 to 20 percent tongues of light brownish-gray (10YR 6/2) silt loam; very dark grayish-brown (10YR 3/2) clay films on faces of peds; few iron-manganese concretions; few clean sand grains; strongly acid; gradual, wavy boundary.

B22tg—44 to 60 inches, dark-gray (10YR 4/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable, very hard; 15 to 20 percent tongues of light brownish-gray (10YR 6/2) silt loam; very dark grayish-brown (10YR 3/2) clay films on faces of peds; few iron-manganese

concretions; few clean sand grains; about 5 percent interfingerings of material from A2 horizon; medium acid; diffuse, wavy boundary.

B3tg—60 to 80 inches, coarsely mottled dark-gray (10YR 4/1) and yellowish-brown (10YR 5/4) silty clay loam; weak, medium, subangular blocky structure; firm, very hard; patchy clay films and thin silt coatings on faces of peds; neutral.

The A1 horizon is dark grayish brown or grayish brown. It is very strongly acid to medium acid. The A2g horizon is gray or light brownish gray and has grayish or brownish mottles. It is very strongly acid or strongly acid. The lower part of the A2g horizon is 5 to 20 percent B horizon bodies. The B2tg horizon is gray, dark-gray, light brownish-gray, or grayish-brown silt loam or silty clay loam that has brownish or grayish mottles. It is very strongly acid to medium acid. Tongues of the A2g horizon make up 15 percent or more, by volume, of the upper part of the B2tg horizon. The B3tg horizon is mottled grayish- and brownish-colored silt loam or silty clay loam. It is strongly acid to neutral.

Guyton soils are associated with Rexor and Dela soils. They have poorer drainage than the Rexor soils. They have a Bt horizon, which does not occur in the Dela soils.

Guyton silt loam (Gu).—This nearly level soil is on flood plains. It is subject to damaging floods and is wet during spring.

Included with this soil in mapping, and making up 8 percent of the acreage, are areas of Rexor soils. Also included are soils that are similar to this Gutyon soil but that have a brown subsoil. These areas make up 12 percent of the acreage.

This soil is used dominantly for tame pasture. It is also suited to cotton, grain sorghum, soybeans, small grains, and trees. Management is needed that controls wetness, maintains soil structure, and protects the soil from damaging overflow from streams. Tillage should be timely and kept to a minimum. Crop residue should be returned to the soil annually to improve the soil structure. Use of surface drains is needed to control wetness. Capability unit IIIw–1; not in a range site; woodland group 2w9; pasture and hay group 2B.

Hector Series

The Hector series consists of very gently sloping to steep soils on uplands. These soils formed under a cover of hardwood trees in material weathered from sandstone (fig. 4).

In a representative profile the surface and subsurface layers are 6 inches of dark-brown and brown loam. The subsoil extends to a depth of 14 inches and is yellowish-red loam. The underlying material is sandstone.

Hector soils are well drained and have rapid permeability. Available water capacity is low or moderate.

Representative profile of Hector stony loam, 2 to 12 percent slopes, 900 feet east and 700 feet north of the SW. corner of sec. 13, T. 10 N., R. 22 E.:

A1—0 to 3 inches, dark-brown (10YR 3/3) loam; weak, medium, granular structure; very friable, soft; 5 percent sandstone rock fragments more than 10 inches in diameter on surface; few, angular, sandstone fragments as much as 3 inches in diameter; many roots; medium acid; clear, wavy boundary.

A2—3 to 6 inches, brown (10YR 4/3) loam; weak, medium, granular structure; very friable, soft; few, angular, sandstone fragments; strongly acid; clear, wavy boundary.

Figure 4.—**Sandstone parent material in an area of Hector stony loam, 2 to 12 percent slopes. The stone is being quarried for use as building material.**

B2—6 to 14 inches, yellowish-red (5YR 5/6) loam; weak, medium, subangular blocky structure; friable, slightly hard; common, angular, rock fragments in upper 5 inches, many in lower 3 inches; strongly acid; gradual, wavy boundary.

R—14 to 18 inches, sandstone bedrock.

Stones and rock fragments more than 3 inches in diameter cover 0 to 20 percent of the soil surface. Thickness of the solum and depth to sandstone bedrock range from 10 to 20 inches.

The A1 horizon is very dark grayish-brown, dark grayish-brown, dark-brown, or brown loam or fine sandy loam. It is strongly acid to slightly acid. The A2 horizon is brown, grayish-brown, or yellowish-brown fine sandy loam or loam. It is strongly acid to slightly acid. This horizon is 0 to 12 percent, by volume, stones and rock fragments more than 3 inches in diameter, and 0 to 15 percent, by volume, gravel-sized rock fragments. The B2 horizon is yellowish-brown, strong-brown, or yellowish-red fine sandy loam or loam. It is very strongly acid or strongly acid.

Hector soils are associated with Enders and Linker soils and are similar to Collinsville soils. They have a thinner surface layer than the Collinsville soils and a thinner solum than the Enders and Linker soils.

Hector stony loam, 2 to 12 percent slopes (HcD).—This soil is on uplands. It has the profile described as representative of the series, but in some areas the surface layer is 1 to 20 percent stones and rock fragments more than 3 inches in diameter.

Included with this soil in mapping are areas of Linker soils that make up about 8 percent of the acreage and areas of Enders soils that make up 5 percent. Also included are areas of a soil similar to this Hector soil, except that the surface layer is fine sandy loam or loam. These areas make up 25 percent of the acreage.

This soil is used dominantly for range and trees. It is also suited to tame pasture. Suitable grazing practices, protection from fire, and control of brush are needed to maintain or improve the quality of the grass. Capability unit VIs–1; Shallow Savannah range site; woodland group 5d2; pasture and hay group 14A.

Hector-Linker complex, 2 to 5 percent slopes (HlC).—This complex is about 45 percent Hector soil and 30 percent Linker soil. These soils are on uplands.

Each has a profile similar to the one described as representative of its respective series, except that tillage has mixed the original surface layer of the Hector soil with the subsurface layer, and the present surface layer is fine sandy loam; and the Linker soil has a thinner surface layer and subsoil. The Hector soil is mainly on ridgetops, and the Linker soil is on side slopes.

Included with this soil in mapping are areas of Enders and Naldo soils, each of which makes up 5 percent of the acreage. Also included are soils similar to Linker soils, except that the subsoil is more than 35 percent sandstone or shale fragments or the combined thickness of the surface layer and subsoil is more than 40 inches. These areas make up 15 percent of the acreage. The extent of the inclusions varies from area to area.

These soils are used dominantly for tame pasture and range. They are also suited to grain sorghum, cotton, peanuts, soybeans, small grains, and trees. Management is needed that maintains fertility and soil structure, reduces erosion, and conserves moisture. Use of terracing, contour farming, fertilizer, and crop residue is needed to reduce erosion, to conserve moisture, and to maintain fertility and soil structure. Both soils in capability unit IVe–3; Hector part in Shallow Savannah range site and Linker part in Sandy Savannah range site; both soils in woodland group 5d2; Hector part in pasture and hay group 14A, and Linker part in pasture and hay group 8B.

Kanima Series

The Kanima series consists of very gently sloping to steep soils on uplands. These soils formed under a sparse cover of trees and grasses in material weathered from shale that was displaced in strip-mining operations (fig. 5).

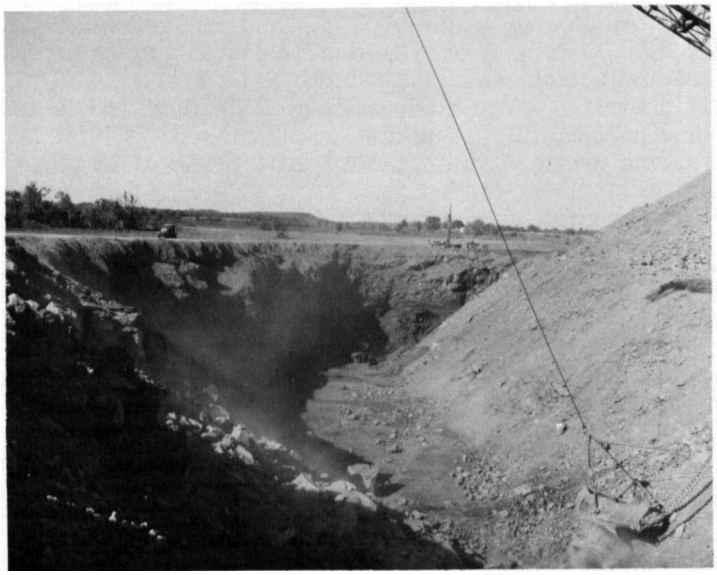

Figure 5.—**Coal strip mine in an area of Kanima soils, 1 to 30 percent slopes.**

In a representative profile the surface layer is 6 inches of very dark grayish-brown shaly silty clay loam. The underlying material is very dark grayish-brown very shaly silty clay loam.

Kanima soils are well drained and have moderate permeability. Available water capacity is low to moderate.

Representative profile of Kanima shaly silty clay loam from an area of Kanima soils, 1 to 30 percent slopes, 2,100 feet south and 1,300 feet west of the NE. corner of sec. 8, T. 10 N., R. 22 E.:

A1—0 to 6 inches, very dark grayish-brown (2.5YR 3/2) shaly silty clay loam; massive; friable, hard; 20 percent shale fragments and 1 percent coal fragments; neutral; diffuse, wavy boundary.

C—6 to 72 inches, very dark grayish-brown (2.5YR 3/2) very shaly silty clay loam; few fragments of very dark grayish-brown (10YR 3/2) silt loam and yellowish-brown (10YR 5/4) silty clay loam that has thin patchy clay films; massive; friable, hard; 70 percent very dark gray (N 3/0) shale fragments in the upper part and 85 percent shale and 2 percent coal fragments in the lower part; neutral.

The A horizon is dark grayish-brown, very dark grayish-brown, or dark-brown shaly silty clay loam, shaly silt loam, very shaly silty clay loam, or very shaly silt loam. It is slightly acid to moderately alkaline. This horizon is about 15 to 85 percent, by volume, shale fragments less than 3 inches in diameter, and typically 15 to 50 percent. It is 0 to 5 percent, by volume, rock fragments more than 3 inches in diameter. The C horizon is very dark grayish-brown, dark grayish-brown, grayish-brown, or brown shaly silty clay loam, shaly silt loam, very shaly silty clay loam, or very shaly silt loam. It is slightly acid to moderately alkaline. This horizon has fragments or pockets of soil material that have colors of higher chroma. It is about 35 to 90 percent, by volume, shale fragments less than 3 inches in diameter and typically 60 to 90 percent. It is 5 to 30 percent, by volume, rock fragments more than 3 inches in diameter. The shale is very dark grayish brown, dark grayish brown, olive gray, olive, dark olive gray, or very dark gray. The C horizon is subdivided in some areas because of differences in shale percentages. It has coal fragments that range from a trace to 5 percent.

Kanima soils are associated with Stigler, Tamaha, and Spiro soils. They have a less-developed solum than those soils, which have a Bt horizon.

Kanima soils, 1 to 30 percent slopes (KaE).—These soils are on spoil banks of shale displaced in strip mine operations. The surface layer is shaly silty clay loam, very shaly silty clay loam, very shaly silt loam, or shaly silt loam.

Included with these soils in mapping are areas of Kanima soils where slopes are more than 30 percent. These areas make up about 15 percent of the acreage. Also included are pits of water that remain after strip mine operations. Such areas make up 10 percent of the total acreage.

These soils are suited to range, grasses, tame pasture, and wildlife habitat. They are used dominantly for wildlife habitat and, to a limited extent, for pasture. Management is needed that establishes a vegetative cover and protects it from fire and overgrazing. Little bluestem, big bluestem, indiangrass, and bermudagrass are adapted to these soils for pasture and range. Cottonwood, persimmon, winged elm, hawthorn, and sumac are adapted to these soils for wildlife habitat. Capability unit VIIe–1; not in a range site; woodland group 5o0; pasture and hay group 9B.

Kiomatia Series

The Kiomatia series consists of nearly level or very gently sloping soils on flood plains of the Canadian and Arkansas Rivers. These soils formed under a cover of hardwood trees and an understory of grasses in material weathered from sandy sediment. They are protected from flooding by the Eufaula Dam.

In a representative profile the surface layer is 6 inches of brown fine sandy loam. The underlying material is brown and light-brown loamy fine sand that has thin strata of very fine sandy loam and silt loam.

Kiomatia soils are well drained and have rapid permeability. Available water capacity is moderate. A seasonal ground water table is at a depth of 48 to 60 inches.

Representative profile of Kiomatia fine sandy loam, 2,300 feet east and 2,200 feet north of the SW. corner of sec. 11, T. 9 N., R. 19 E.:

A1—0 to 6 inches, brown (7.5YR 5/4) fine sandy loam; weak, medium, granular structure; very friable, soft; few fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C1—6 to 10 inches, brown (7.5YR 5/4) loamy fine sand; single grained; very friable, loose; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—10 to 14 inches, brown (7.5YR 5/4) very fine sandy loam; weak, fine, granular structure; very friable, soft; calcareous; moderately alkaline; abrupt, smooth boundary.

C3—14 to 36 inches, brown (7.5YR 5/4) loamy fine sand; single grained; very friable, loose; calcareous; moderately alkaline; abrupt, smooth boundary.

C4—36 to 40 inches, brown (7.5YR 5/4) silt loam; few, medium, faint, strong-brown mottles; weak, fine, granular structure; friable, slightly hard; few, very thin, black strata of organic matter; calcareous; moderately alkaline; abrupt, smooth boundary.

C5—40 to 70 inches, light-brown (7.5YR 6/4) loamy fine sand; few, medium, faint, strong-brown mottles; single grained; very friable, loose; few, very thin, black strata of organic matter; calcareous; moderately alkaline.

The A1 horizon is mildly alkaline or moderately alkaline. The C horizon is brown or light-brown loamy fine sand or fine sand that has thin strata of finer textured material. It is mildly alkaline or moderately alkaline.

Kiomatia soils are associated with Oklared, Norwood, and Crevasse soils. They are more sandy between depths of 10 and 40 inches than the Oklared and Norwood soils. They differ from the Crevasse soils in having thin strata of finer textured material between depths of 10 and 40 inches.

Kiomatia fine sandy loam (Ko).—This nearly level or very gently sloping soil is on flood plains.

Included with this soil in mapping are areas of similar soils that have a surface layer of loamy fine sand or silt loam. These areas make up about 26 percent of the acreage. Also included are areas of Crevasse soils that make up 12 percent, areas of Oklared soils that make up 8 percent, and small areas of Mhoon soils, clayey variant.

This soil is used for crops or pasture. It is suited to alfalfa, cotton, soybeans, grain sorghum, small grains, range, trees, and tame pasture (fig. 6). Management is needed that maintains soil structure and reduces erosion. Plant cover is needed during winter and spring to control soil blowing. Use of fertilizer and crop residue is needed to conserve moisture, to maintain soil structure, and to reduce erosion. Capability unit IIIs–1; Sandy Bottomland range site; woodland group 3s6; pasture and hay group 3A.

Figure 6.—**Soybeans growing in an area of Kiomatia fine sandy loam.**

Liberal Series

The Liberal series consists of very gently sloping to moderately steep soils on uplands. These soils formed under a cover of mid and tall grasses in material weathered from shale.

In a representative profile the surface layer is 8 inches of very dark grayish-brown clay loam. The upper part of the subsoil, extending to a depth of 24 inches, is dark yellowish-brown clay. The lower part of the subsoil, extending to a depth of 36 inches, is olive-brown clay. The underlying material is a mixture of light olive-gray clay and olive shale that changes gradually to olive shale at a depth of 40 inches.

Liberal soils are moderately well drained and have slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 12 to 24 inches.

Representative profile of Liberal clay loam, 2 to 5 percent slopes, 2,000 feet north and 200 feet east of the SW. corner of sec. 33, T. 9 N., R. 20 E.:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, medium, granular structure; friable, hard; strongly acid; gradual, wavy boundary.

B2t—8 to 24 inches, dark yellowish-brown (10YR 4/4) clay; common, fine, distinct, yellowish-red (5YR 4/6) mottles and few, fine, faint, grayish-brown mottles; moderate, medium, blocky structure; extremely firm, extremely hard; distinct clay films on faces of peds; few, fine, iron-manganese concretions; strongly acid; gradual, wavy boundary.

B3t—24 to 36 inches, olive-brown (2.5YR 4/4) clay; common, fine, distinct, strong-brown (7.5YR 5/6) and dark-brown (10YR 3/3) mottles; weak, coarse, blocky structure; extremely firm, extremely hard;

distinct clay films on faces of peds; few to common shale fragments in lower part; common, medium and fine, iron-manganese concretions; slightly acid; gradual, wavy boundary.

C1—36 to 40 inches, 50 percent light olive-gray (5YR 6/2) clay and 50 percent olive (5YR 5/3) shale; moderately alkaline; gradual, wavy boundary.

C2—40 to 60 inches, olive (5YR 5/3) shale; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Depth to shale ranges from 40 to 60 inches.

The A horizon is dark-brown, very dark brown, or very dark grayish-brown loam, clay loam, or silt loam. On the surface and throughout it is 0 to 20 percent stones or rock fragments. It is very strongly acid to medium acid. In places a B1 horizon that is 3 to 6 inches thick is present in these soils. The B2t horizon is yellowish-brown, dark yellowish-brown, or olive-brown silty clay loam or clay. It contains grayish and, in places, brownish or reddish mottles. It is very strongly acid to medium acid. The B3t and C1 horizons are light olive-gray, olive-brown, gray, strong-brown, or yellowish-brown silty clay loam or clay. They have coarse grayish, brownish, or reddish mottles or coarse olive, gray, or brown mottles. The B3t horizon and C1 horizon are medium acid to moderately alkaline. The C2 horizon is olive or olive-gray shale.

Liberal soils are associated with Collinsville, Spiro, and Tamaha soils. They have a more clayey subsoil than the Spiro soils. The solum of Liberal soils is thinner than that of the Tamaha soils and is thicker than that of the Collinsville soils.

Liberal clay loam, 2 to 5 percent slopes (LbC).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are soils that are similar to this Liberal soil, except that they have a reddish-brown and red subsoil. Also included are areas of Tamaha soils, Spiro soils, and Collinsville soils, each of which makes up about 5 percent of the acreage.

This soil is used dominantly for range or tame pasture. It is also suitable for cotton, grain sorghum, soybeans, and small grains. Mangement is needed that improves soil structure and reduces surface crusting. Returning large amounts of crop residue to the soil improves soil structure, increases water intake, and reduces crusting. Terraces and contour tillage are needed if row crops are grown. Capability unit IVe–2; Loamy Prairie range site; woodland group 5o0; pasture and hay group 8A.

Liberal-Spiro complex, 2 to 5 percent slopes (LcC).—This complex is 30 percent Liberal soil and 20 percent Spiro soil. These soils are on uplands. Each has a profile similar to the one described as representative of its respective series, except that the Liberal soil has a surface layer of loam or silt loam, and the Spiro soil has a surface layer of loam. The Liberal soil is mainly on side slopes, and the Spiro soil is on ridgetops and upper parts of side slopes.

Included with these soils in mapping are areas of soils similar to Liberal soils, except that the combined thickness of the surface layer and subsoil is less than 20 inches or the subsoil is redder. These areas make up 18 percent of the acreage. Also included are areas of soils similar to Spiro soils, except that the subsoil is more than 35 percent sandstone fragments. These areas make up about 10 percent of the acreage. Areas of Tamaha and Collinsville soils make up about 10 and 12 percent, respectively, of the total acreage. The extent of the inclusions varies from area to area.

These soils are used dominantly for hay and tame pasture. They are also suitable for grain sorghum, cotton, soybeans, range plants, and small grains. Management is needed that maintains fertility, improves soil structure, increases water intake, and reduces erosion. Use of terracing, contour farming, fertilizer, and crop residue is needed to reduce erosion, to conserve moisture, and to maintain soil fertility and structure. Capability unit IVe–2; Loamy Prairie range site; woodland group 5o0; pasture and hay group 8A.

Liberal and Collinsville stony soils, 5 to 20 percent slopes (LdE).—This undifferentiated group is 40 percent Liberal soil and 35 percent Collinsville soil. These soils are on uplands. The Liberal soil has a profile similar to the one described as representative of the series, but the surface layer is loam or silt loam. The Collinsville soil has the profile described as representative of the series, but commonly the surface layer is fine sandy loam. Both soils have 1 to 20 percent, by volume, stones or rock fragments on the surface and in the surface layer. The Liberal soil is mainly on smooth side slopes, and the Collinsville soil is mainly on ridgetops and upper parts of side slopes.

Included with this soil in mapping are areas of Spiro soils that make up 10 percent of the total acreage. Also included are areas of soils that are similar to Liberal soils, except that the combined thickness of the surface layer and subsoil is less than 20 inches or the subsoil is reddish. These areas make up 10 percent of the acreage. Some areas of sandstone rock outcrop, and Tamaha soils that make up about 5 percent of the acreage, are also included in places. The extent of the inclusions varies from area to area.

These soils are used dominantly for range, but the less stony, less steep soils are suitable for tame pasture. Suitable grazing practices, protection from fire, and control of brush are needed to maintain or improve the quality of the grass. Both soils in capability unit VIIs–3; Liberal part in Loamy Prairie range site and Collinsville part in Shallow Prairie range site; both soils in woodland group 5o0; Liberal part in pasture and hay group 8A, and Collinsville part in pasture and hay group 14A.

Linker Series

The Linker series consists of very gently sloping to sloping soils on uplands. These soils formed under a cover of hardwood trees and an understory of tall grasses in material weathered from sandstone.

In a representative profile the surface layer is 8 inches of brown fine sandy loam. The upper part of the subsoil, extending to a depth of 12 inches, is strong-brown fine sandy loam. The middle part of the subsoil, extending to a depth of 32 inches, is yellowish-red clay loam. The lower part of the subsoil, extending to a deph of 36 inches, is coarsely mottled red, yellowish-brown, and light-brown sandy clay loam. The underlying material is sandstone.

Linker soils are well drained and have moderately rapid permeability. Available water capacity is moderate to high.

Representative profile of Linker fine sandy loam, 1 to 3 percent slopes, 1,500 feet west and 200 feet north of the SE. corner of sec. 2, T. 8 N., R. 19 E.:

A1—0 to 8 inches, brown (10YR 4/3) fine sandy loam; moderate, medium, granular structure; very friable, soft; medium acid; clear, smooth boundary.

B1—8 to 12 inches, strong-brown (7.5YR 5/6) fine sandy loam; moderate, coarse, subangular blocky structure; friable, hard; strongly acid; gradual, wavy boundary.

B2t—12 to 32 inches, yellowish-red (5YR 5/6) clay loam; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, hard; clay films bridging sand grains and patchy clay films on faces of peds; few iron-manganese concretions; very strongly acid; gradual, wavy boundary.

B3—32 to 36 inches, coarsely mottled red (2.5YR 4/6), yellowish-brown (10YR 5/6), and light-brown (7.5YR 6/4) sandy clay loam; weak, coarse, subangular blocky structure; firm, hard; patchy clay films on faces of peds; few sandstone fragments; very strongly acid; gradual, wavy boundary.

R—36 to 40 inches, consolidated sandstone.

Depth to sandstone is 20 to 40 inches.

The A1 or Ap horizon is brown, dark brown, dark grayish brown, or dark yellowish brown. It is very strongly acid to medium acid. In some forested areas a lighter colored A2 horizon is present. The B1 horizon is strong-brown, reddish-yellow, yellowish-red, or reddish-brown fine sandy loam or loam. It is very strongly acid or strongly acid. The B2t horizon is yellowish-red, reddish-brown, or red loam, clay loam, or sandy clay loam that in places has brownish mottles. It is very strongly acid or strongly acid. The B3 horizon has the same color range as the B2t horizon or is mottled with reddish or brownish colors. It is very strongly acid or strongly acid. The B3 horizon contains few to many sandstone fragments.

Linker soils are associated with Enders, Hector, Sallisaw, and Naldo soils and are similar to Spiro soils. They have a less clayey subsoil than the Enders soils. They differ from the Hector soils in having a thicker solum. They do not have the gravelly lower part of the subsoil that is typical of the Sallisaw soils. They have a thinner solum than the Naldo soils. They have a less silty subsoil than the Spiro soils.

Linker fine sandy loam, 1 to 3 percent slopes (LkB).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Enders soils that make up about 5 percent of the acreage. Also included, and making up about 30 percent of the acreage, are areas of soils similar to this Linker soil, except that the combined thickness of the surface layer and subsoil is 10 to 20 inches, the combined thickness of the surface layer and subsoil is more than 40 inches, or the subsoil is more yellow.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, peanuts, soybeans, small grains, and trees. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, crop residue, and fertilizer is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is returned to the soil yearly. Terraces and contour farming are needed if row crops are grown. Excessive tillage should be avoided. Capability unit IIe–2; Sandy Savannah range site; woodland group 4o1; pasture and hay group 8B.

Linker fine sandy loam, 3 to 5 percent slopes (LkC).—This soil is on uplands.

Included with this soil in mapping, and making up 10 percent of the acreage, are areas of Naldo soils and areas of soils, also making up 10 percent, that are similar to this Linker soil, except that the subsoil is more yellow and the combined thickness of the surface layer and subsoil is more than 40 inches. Also included, and making up about 5 percent of the acreage, are areas of soils similar to this Linker soil, except that the combined thickness of the surface layer and subsoil is 10 to 20 inches. Small areas of Enders soils are also included.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, soybeans, small grains, and trees. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, and crop residue is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and water erosion. Use of fertilizer and crop residue is needed to reduce erosion, to conserve moisture, and to maintain soil structure. Capability unit IIIe–2; Sandy Savannah range site; woodland group 4o1; pasture and hay group 8B.

Linker fine sandy loam, 2 to 5 percent slopes, eroded (LkC2).—This eroded soil is on uplands. It has a profile similar to the one described as representative of the series, except that part of the original surface layer has been removed by erosion, and where the soil has been thinned, tillage has mixed the surface layer with the subsoil. Also, few to many crossable gullies are present that are subject to sheet erosion.

Included with this soil in mapping are small areas of uncrossable gullies. Also included, and making up about 10 percent of the acreage, are areas of eroded Naldo soils and areas of similar soils, also making up 10 percent, that have a more yellow subsoil. About 5 percent of the acreage is included soils similar to this Linker soil, except that the combined thickness of the surface layer and subsoil is less than 20 inches.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, soybeans, small grains, and trees. Use of terracing, contour farming, crop residue, and fertilizer is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and water erosion. Deterioration of soil structure and loss of fertility can be controlled by use of crop residue and fertilizer. Capability unit IIIe–4; Sandy Savannah range site; woodland group 4o1; pasture and hay group 8B.

Linker-Hector complex, 2 to 8 percent slopes, severely eroded (LnD3).—This complex is about 60 percent Linker soil and 15 percent Hector soil. These soils are on uplands. Each has a profile similar to the one described as representative of its respective series, except that on about 40 percent of the acreage the surface layer has been lost through erosion or many un-

crossable gullies are present. The surface layer is fine sandy loam in uneroded areas and loam, clay loam, sandy clay loam, or fine sandy loam in eroded areas. The uncrossable gullies are 2 to 10 feet deep and 150 to 300 feet apart. The Linker soil is mainly on side slopes, and the Hector soil is mainly on ridgetops.

Included with these soils in mapping, and making up about 20 percent of the acreage, are areas of soils similar to the Linker soil, except that bedrock is at a depth of more than 40 inches. Also included are areas of Enders and Sallisaw soils that make up 5 percent of the acreage. The extent of the inclusions varies from area to area.

These soils are so severely eroded that they are unsuitable for cultivation and should be returned to permanent vegetation. Using fertilizer, sloping gully banks, diverting overhead water, and mulching critical areas with plant residue help in successful establishment of tame pasture or range. These soils are also suited to trees. Suitable grazing practices, protection from fire, and control of brush are needed to maintain or improve the quality of the grass. Both soils in capability unit VIe–4; Linker part in Eroded Sandy Savannah range site and Hector part in Eroded Shallow Savannah range site; both soils in woodland group 5c3e; Linker part in pasture and hay group 8F, and Hector part in pasture and hay group 14A.

Mhoon Variant

The Mhoon variant in Haskell County consists of soils that are more clayey than soils of the Mhoon series. These soils formed under a cover of hardwood trees in loamy and clayey sediment on flood plains along the Arkansas and Canadian Rivers. They are subject to flooding.

In a representative profile the surface layer is 8 inches of dark-brown and dark reddish-gray clay. The underlying material is stratified dark reddish-gray, dark reddish-brown, reddish-brown, and brown silty clay loam that has strata of less clayey material.

The Mhoon soils, clayey variant, are poorly drained and have very slow permeability. Available water capacity is high. A seasonal ground water table is at a depth of 0 to 12 inches.

Representative profile of Mhoon soils, clayey variant, 1,600 feet west and 300 feet north of the SE. corner of sec. 31, T. 11 N., R. 21 E.:

Ap—0 to 4 inches, dark-brown (7.5YR 4/2) clay; moderate, fine, granular structure; friable, hard; calcareous; moderately alkaline; clear, smooth boundary.

A1—4 to 8 inches, dark reddish-gray (5YR 4/2) clay; weak, medium, granular structure; friable, hard; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

C1—8 to 11 inches, brown (7.5YR 5/4) silt loam; structureless; friable, hard; calcareous; moderately alkaline; clear, smooth boundary.

C2—11 to 21 inches, dark reddish-gray (5YR 4/2) silty clay loam; many, medium, distinct, strong-brown (7.5YR 4/6) mottles; weak, medium, subangular blocky structure; firm, hard; many pores; calcareous; moderately alkaline; clear, smooth boundary.

C3—21 to 41 inches, stratified dark reddish-gray (5YR 4/2) and dark reddish-brown (5YR 3/2) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles and few, fine, faint, dark-brown mottles; structureless; firm, hard; few pores; calcareous; moderately alkaline; clear, smooth boundary.

C4—41 to 50 inches, stratified dark reddish-gray (5YR 4/2), brown (7.5YR 5/2), and reddish-brown (5YR 4/3) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and dark-brown (7.5YR 3/2) mottles; structureless; firm, hard; few pores; calcareous; moderately alkaline; clear, smooth boundary.

C5—50 to 72 inches, brown (10YR 4/3) silty clay loam; common thin strata of silt loam and very fine sandy loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; structureless; friable, hard; calcareous; moderately alkaline.

The A horizon is brown, dark grayish-brown, dark-brown, dark reddish-brown, or dark reddish-gray silty clay loam, silty clay, or clay. It is neutral to moderately alkaline. The C horizon is brown, very dark gray, very pale brown, dark grayish-brown, dark-brown, dark reddish-brown, reddish-brown, dark reddish-gray, or reddish-gray silty clay loam, silty clay, or clay that has thin strata of coarser textured material. In this horizon mottles are common, and 60 percent or more of the mass has chroma of 2 or less. The C horizon is neutral to moderately alkaline. Below a depth of 40 inches, this horizon's percentage of sand increases with increasing depth.

The Mhoon soils, clayey variant, are associated with Norwood soils. They have a higher amount of clay between depths of 10 and 40 inches and have poorer drainage than the Norwood soils.

Mhoon soils, clayey variant (Mv).—These nearly level soils are on flood plains. They are seasonally wet for extended periods because they are slightly concave and poorly drained. At times, water is ponded in places (fig. 7). The surface layer is clay, silty clay, or silty clay loam.

Included with these soils in mapping, and making up about 25 percent of the acreage, are areas of soils similar to these Mhoon soils, clayey variant, except that they have less clay between depths of 10 and 40 inches.

Figure 7.—**An area of Mhoon soils, clayey variant. Poor drainage has caused water to pond in the low area.**

These soils are used dominantly for tame pasture, range, and trees. The principal management need in the use of this soil for crops is drainage of excess surface water. Suitable grazing practices, control of brush, applications of fertilizer, and protection from fire are needed to maintain or improve the quality of the grass. Capability unit Vw-1; Heavy Bottomland range site; woodland group 3w6; pasture and hay group 1A.

Naldo Series

The Naldo series consists of nearly level to gently sloping soils on uplands. These soils formed under a cover of hardwood trees and pine trees and an understory of tall grasses in material weathered from loamy sediment.

In a representative profile the surface layer is 9 inches of dark grayish-brown fine sandy loam. The subsurface layer extends to a depth of 16 inches and is yellowish-brown fine sandy loam. The upper part of the subsoil, extending to a depth of 57 inches, is yellowish-brown and light yellowish-brown clay loam. The lower part of the subsoil, extending to a depth of 72 inches, is mottled grayish-, reddish-, and brownish-colored clay loam.

Naldo soils are moderately well drained and have moderate permeability. Available water capacity is high. A seasonal perched water table is at a depth of 36 to 60 inches.

Representative profile of Naldo fine sandy loam, 3 to 5 percent slopes, 2,400 feet south and 200 feet east of the NW. corner of sec. 26, T. 9 N., R. 20 E.:

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, medium, granular structure; very friable, slightly hard; many roots; medium acid; gradual, wavy boundary.

A2—9 to 16 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, coarse, prismatic structure parting to weak, medium, granular; friable, slightly hard; few roots; few iron-manganese concretions; very strongly acid; gradual, wavy boundary.

B21t—16 to 40 inches, yellowish-brown (10YR 5/6) clay loam; few, medium, faint, brownish-yellow mottles; moderate, medium, subangular blocky structure; firm, hard; clay films on faces of peds; few iron-manganese concretions; strongly acid; gradual, wavy boundary.

B22t—40 to 57 inches, light yellowish-brown (10YR 6/4) clay loam; many, medium, faint, brownish-yellow mottles and few, medium, faint, light brownish-gray mottles; moderate, medium, subangular blocky structure; firm, hard; clay films on face of peds and in pores; common iron-manganese concretions; few pockets of clean silt and sand grains; strongly acid; gradual, wavy boundary.

B3t—57 to 72 inches, coarsely mottled light-gray (10YR 6/1), yellowish-red (5YR 4/6), and yellowish-brown (10YR 5/6) clay loam; weak, medium, subangular blocky structure; firm, very hard; patchy clay films on faces of peds; common iron-manganese concretions; few sandstone fragments; about 6 percent, by volume, clean silt and sand grains in pockets and on faces of peds; very strongly acid.

The A1 horizon is brown, dark grayish brown, or very dark grayish brown. It is strongly acid to slightly acid. The A2 horizon is brown, light yellowish brown, pale brown, or yellowish brown. It is strongly acid to slightly acid. The B2t horizon is yellowish brown, light yellowish brown, or strong brown and has brownish- or reddish-colored mottles within 30 inches of the surface and brownish-, reddish-, yellowish-, or grayish-colored mottles below that depth. It is sandy clay loam or clay loam. It is very strongly acid to medium acid. The B3t horizon is similar in color, texture, and reaction to the B2t horizon; or it is mottled brownish, reddish, and grayish colors.

Naldo soils are associated with Linker and Sallisaw soils and are similar to Vian soils. They have a thicker solum than the Linker soils and a less silty subsoil than the Vian soils. They differ from the Sallisaw soils in not being gravelly in the lower part of the subsoil.

Naldo fine sandy loam, 0 to 3 percent slopes (NaB).—This soil is on uplands.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of similar soils that have a surface layer more than 20 inches thick and areas of similar soils, also making up 10 percent, that are more clayey in the upper part of the subsoil. Also included are areas of Whakana soils that make up about 5 percent of the acreage.

This soil is used dominantly for tame pasture and range. It is also suited to alfalfa, cotton, grain sorghum, peanuts, soybeans, small grains, and trees. Management is needed that maintains or improves fertility and reduces erosion. A cropping system is needed that provides a plant cover during winter and spring to protect the soil from soil blowing and water erosion. Cover crops are needed if low-residue crops are grown. Use of stripcropping, minimum tillage, and crop residue is needed to reduce erosion and to improve fertility. Capability unit IIe–2; Sandy Savannah range site; woodland group 2o7; pasture and hay group 8B.

Naldo fine sandy loam, 3 to 5 percent slopes (NaC).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Linker soils and areas of a soil similar to this Naldo soil, except that the subsoil is more red. Each of these makes up 10 percent of the acreage.

This soil is used dominantly for range and tame pasture. It is also suited to cotton, grain sorghum, peanuts, soybeans, small grains, and trees. Managment is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, and crop residue is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and erosion. Use of fertilizer and crop residue is needed to reduce erosion, to conserve moisture, and to maintain soil structure. Capability unit IIIe–2; Sandy Savannah range site; woodland group 2o7; pasture and hay group 8B.

Naldo fine sandy loam, 2 to 5 percent slopes, eroded (NaC2).—This eroded soil is on uplands. It has a profile similar to the one described as representative of the series, except that part of the surface layer has been removed by erosion, and where the soil has been thinned, tillage has mixed the surface layer and subsoil. Also, few to many crossable gullies are present that are subject to sheet erosion.

Included with these soils in mapping are small areas of uncrossable gullies. Also included, and making up

about 10 percent of the acreage, are areas of Linker soils and areas of soils, also making up 10 percent, that are similar to this Naldo soil, except that the subsoil is redder or is slightly more clayey.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, peanuts, soybeans, small grains, and trees. Use of terracing, contour farming, crop residue, and fertilizer is needed to control erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and water erosion. Deterioration of soil structure and loss of fertility can be controlled by proper use of crop residue and fertilizer. Capability unit IIIe–4; Sandy Savannah range site; woodland group 2o7; pasture and hay group 8B.

Norwood Series

The Norwood series consists of nearly level soils on flood plains. These soils formed under a cover of hardwood trees and an understory of tall grasses in material weathered from loamy sediment along the Arkansas and Canadian Rivers. They are protected from flooding by the Eufaula Dam (fig. 8).

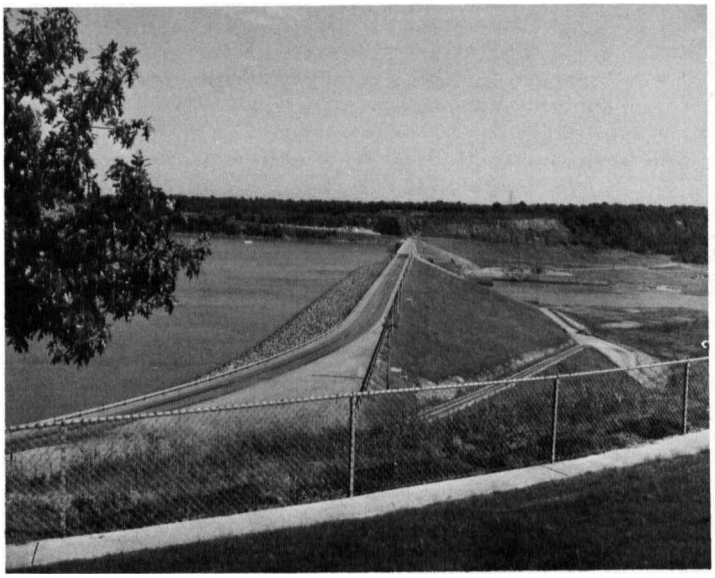

Figure 8.—**The Eufaula Dam. The area of Norwood silty clay loam below the dam is protected from damaging floods.**

In a representative profile the surface layer is 16 inches of reddish-brown silty clay loam. The underlying material is reddish-brown and brown silt loam that has thin strata of very fine sandy loam.

Norwood soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Norwood silty clay loam, 2,300 feet west and 2,100 feet south of the NE. corner of sec. 6, T. 10 N., R. 21 E.:

A1—0 to 16 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, medium, granular structure; friable, slightly hard; common worm casts that are dark reddish brown (5YR 3/3) and brown (7.5YR 5/3); calcareous; moderately alkaline; clear, smooth boundary.

C1—16 to 24 inches, reddish-brown (5YR 4/3) silt loam that has a few thin strata of dark reddish-brown (5YR 3/3) silty clay loam; structureless; friable, hard; common worm casts; few pores; calcareous; moderately alkaline; clear, smooth boundary.

C2—24 to 30 inches, brown (7.5YR 5/4) very fine sandy loam that has a few thin strata of dark reddish-brown (5YR 3/3) silty clay loam; structureless; friable, hard; calcareous; moderately alkaline; clear, smooth boundary.

C3—30 to 42 inches, brown (7.5YR 5/4) silt loam; structureless; friable, hard; calcareous; moderately alkaline; clear, smooth boundary.

C4—42 to 62 inches, brown (7.5YR 5/4) silt loam that has common thin strata of dark-brown (7.5YR 4/4) very fine sandy loam and loamy very fine sand; structureless; very friable, loose; calcareous; moderately alkaline.

The A1 and Ap horizons are reddish brown, brown, or dark brown. The C horizon is reddish-brown, brown, or reddish-yellow silt loam or silty clay loam that has strata of coarser textured material that increase with increasing depth.

Norwood soils are associated with Oklared, Kiomatia, and Caspiana soils, and Mhoon soils, clayey variant. They are more clayey and less sandy between depths of 10 and 40 inches than the Oklared and Kiomatia soils. They are less clayey between depths of 10 and 40 inches and are better drained than the Mhoon soils, clayey variant. They have a less developed subsoil than the Caspiana soils.

Norwood silty clay loam (No).—This nearly level soil is on flood plains along the Arkansas and Canadian Rivers. It is protected from damaging floods by the Eufaula Dam.

Included with this soil in mapping are areas of Oklared soils and Mhoon soils, clayey variant, that make up 10 and 3 percent, respectively, of the total acreage. Also included are areas of soils similar to this Norwood soil, except that the surface layer is silt loam or loam or is darker colored. These areas make up about 20 percent of the acreage.

This soil is used dominantly for alfalfa, cotton, soybeans, and small grains. It is also suited to tame pasture, grain sorghum, and trees. Management is needed that maintains soil structure and fertility. Use of crop residue, minimum tillage, and fertilizer is needed to maintain production and to improve soil structure. Capability unit I–1; Loamy Bottomland range site; woodland group 2o4; pasture and hay group 2A.

Oklared Series

The Oklared series consists of nearly level or very gently sloping soils on flood plains of the Canadian and Arkansas Rivers. These soils formed under a cover of hardwood trees and an understory of tall grasses in material weathered from loamy and sandy sediment. They are protected from flooding by the Eufaula Dam.

In a representative profile the surface layer is 8 inches of dark-brown fine sandy loam. The upper part of the underlying material, extending to a depth of 40 inches, is mostly reddish-brown fine sandy loam and loam that has thin strata of coarser textured material. The lower part of the underlying material is strong-brown loamy fine sand that has common strata of sand and fine sandy loam.

Oklared soils are well drained and have moderately rapid permeability. Available water capacity is high.

Representative profile of Oklared fine sandy loam, 2,500 feet east and 50 feet south of the NW. corner of sec. 27, T. 10 N., R. 20 E.:

A1—0 to 8 inches, dark-brown (7.5YR 4/4) fine sandy loam; weak, medium, granular structure; very friable, soft; many fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C1—8 to 15 inches, reddish-brown (5YR 5/4) fine sandy loam; weak, fine, granular structure; very friable, soft; few roots; calcareous; moderately alkaline; clear, smooth boundary.

C2—15 to 20 inches, light reddish-brown (5YR 6/4) loamy fine sand; single grained; very friable, loose; calcareous; moderately alkaline; abrupt, smooth boundary.

C3—20 to 28 inches, reddish-brown (5YR 5/4) loam; weak, fine, granular structure; friable, slightly hard; calcareous; moderately alkaline; clear, smooth boundary.

C4—28 to 40 inches, reddish-brown (5YR 5/4) fine sandy loam; single grained; very friable, soft; calcareous; moderately alkaline; clear, smooth boundary.

C5—40 to 60 inches, strong-brown (7.5YR 5/6) loamy fine sand that has common strata of sand and fine sandy loam; single grained; loose; calcareous; moderately alkaline.

The A1 and Ap horizons are brown or dark brown. The C horizon is light reddish brown, strong brown, yellowish red, or reddish brown. Between depths of 10 and 40 inches, it is mostly fine sandy loam, loam, or very fine sandy loam stratified with thin layers of finer textured or coarser textured material. Between depths of 40 and 60 inches, it is loamy fine sand, fine sandy loam, loam, or very fine sandy loam stratified with thin layers of coarser textured or finer textured material.

Oklared soils are associated with Kiomatia, Norwood, and Caspiana soils and are similar to Dela soils. They are less sandy between depths of 10 and 40 inches than the Kiomatia soils. They are less clayey and more sandy between depths of 10 and 40 inches than the Norwood soils. They are less acid than the Dela soils and do not have the B2t horizon that is typical of the Caspiana soils.

Oklared fine sandy loam (Ok).—This nearly level or very gently sloping soil is on flood plains. It is protected from damaging floods by the Eufaula Dam.

Included with this soil in mapping are areas of Norwood soils that make up about 12 percent of the acreage, areas of Kiomatia soils that make up 8 percent, and areas of similar soils that are slightly more silty at a depth of 10 to 40 inches and make up about 10 percent. Also included are small areas of Mhoon soils, clayey variant, and Crevasse soils.

This soil is used dominantly for cotton, alfalfa (fig. 9), soybeans, and small grains. It is also suited to grain sorghum, tame pasture, hay, and trees. Management is needed that maintains soil structure and reduces erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing. Use of fertilizer and crop residue is needed to conserve moisture, to maintain soil structure, and to reduce erosion. Capability unit I–2; not in a range site; woodland group 2o4; pasture and hay group 2A.

Porum Series

The Porum series consists of gently sloping soils on uplands. These soils formed under a cover of hardwood trees and an understory of tall grasses in clayey sediment.

Figure 9.—**Hay conditioner cutting alfalfa in an area of Oklared fine sandy loam.**

In a representative profile the surface layer is 5 inches of dark grayish-brown sandy loam. The subsurface layer extends to a depth of 10 inches and is brown fine sandy loam. The upper part of the subsoil, extending to a depth of 14 inches, is strong-brown loam. The middle part of the subsoil, extending to a depth of 52 inches, is yellowish-red silty clay loam. The lower part of the subsoil, extending to a depth of 65 inches, is strong-brown clay loam.

Porum soils are moderately well drained and have very slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 24 to 36 inches.

Representative profile of Porum fine sandy loam, 3 to 5 percent slopes, 1,000 feet east and 100 feet south of the NW. corner of sec. 36, T. 10 N., R. 20E.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, medium, granular structure; very friable, soft; many small roots; medium acid; clear, wavy boundary.

A2—5 to 10 inches, brown (10YR 5/3) fine sandy loam; weak, medium, granular structure; friable, slightly hard; few fine roots; strongly acid; gradual, wavy boundary.

B1—10 to 14 inches, strong-brown (7.5YR 5/6) loam; weak, coarse, subangular blocky structure; friable, hard; few roots; strongly acid; gradual, wavy boundary.

B21t—14 to 28 inches, yellowish-red (5YR 4/6) silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, blocky structure; firm, hard; clay films on faces of peds; silt coatings on faces of some peds; very strongly acid; gradual, wavy boundary.

B22t—28 to 52 inches, yellowish-red (5YR 5/6) silty clay loam; many, medium and fine, distinct, pale-brown (10YR 6/3) mottles and few light-gray (10YR 6/1) mottles; weak, medium, blocky structure; very firm, hard; clay films on faces of peds; very strongly acid; gradual, wavy boundary.

B3t—52 to 65 inches, strong-brown (7.5YR 5/6) clay loam; many, medium and coarse, distinct, light-gray (10YR 6/1) mottles; weak, coarse, blocky structure; firm, hard; few clay films on faces of peds; about 7 percent, by volume, clean silt and sand grains on faces of some peds and in pockets; the gray color is clay, and the strong-brown color is fine sandy loam or clay loam; medium acid.

The A1 horizon is dark brown, grayish brown, or dark grayish brown. It is strongly acid or medium acid. The A2 horizon is brown or yellowish brown. It is strongly acid to medium acid. In some places a B1 horizon as much as 9 inches thick is present. Where present, the B1 horizon is strong-brown, yellowish-brown, or brown loam, clay loam, or silt loam. It is very strongly acid to strongly acid. The B2t horizon is strong-brown, red, yellowish-red, reddish-brown, or reddish-yellow clay loam, silty clay loam, silty clay, or clay. It has mottles that range from few to many in grayish, brownish, or reddish colors. Its grayish mottles are within 30 inches of the surface. The B2t horizon is very strongly acid to strongly acid. The B3t horizon is yellowish-red or strong-brown clay loam, silty clay loam, or sandy clay loam that has grayish-, brownish-, or reddish-colored mottles. It is medium acid to mildly alkaline. It is 5 to 15 percent, by volume, clean sand grains and clean silt grains that are in pockets or on faces of peds.

Porum soils are associated with Whakana soils. They have more clay in the upper part of the subsoil than those soils.

Porum fine sandy loam, 3 to 5 percent slopes (PoC).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Whakana soils that make up 15 percent of the acreage and areas of Porum soils that have slopes of less than 3 percent or more than 5 percent and make up 20 percent of the acreage.

This soil is used dominantly for tame pasture, range, and trees. It is also suited to cotton, grain sorghum, soybeans, and small grains. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, and crop residue is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from soil blowing and water erosion. Use of fertilizer and crop residue is needed to conserve moisture, to maintain soil structure, and to reduce erosion. Capability unit IVe–4; Loamy Savannah range site; woodland group 4c2; pasture and hay group 8C.

Porum fine sandy loam, 3 to 5 percent slopes, eroded (PoC2).—This eroded soil is on uplands. It has a profile similar to the one described as representative of the series, except that on about 40 percent of the area part of the original surface layer has been removed by erosion. and where the soil has been thinned, tillage has mixed the surface layer with the subsoil. Few to many crossable gullies are present, and sheet erosion occurs along them.

Included with this soil in mapping, and making up about 15 percent of the acreage, are areas of Whakana soils and areas of Porum soils, also making up 15 percent, that have slopes of more than 5 percent.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, small grain, and trees. Management is needed that improves the suitability of this soil for cultivation, improves soil structure, and increases growth of crops. Use of terracing, contour farming, tame pasture, range, crop residue, and fertilizer is needed to reduce erosion. Plant cover is needed during winter and spring to protect this soil from erosion. Capability unit IVe–5; Loamy Savannah range site; woodland group 4c2; pasture and hay group 8C.

Rexor Series

The Rexor series consists of nearly level or very gently sloping soils on flood plains of local streams. These soils formed under a cover of hardwood trees in material weathered from loamy sediment. They are subject to flooding.

In a representative profile the surface layer is 11 inches of dark grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 30 inches, is dark yellowish-brown silty clay loam. The lower part of the subsoil, extending to a depth of 60 inches, is yellowish-brown silt loam.

Rexor soils are well drained and have moderate permeability. Available water capacity is high. A seasonal ground water table is at a depth of 36 to 48 inches.

Representative profile of Rexor silt loam, 300 feet east and 250 feet south of the NW. corner of sec. 7, T. 7 N., R. 20 E.:

A1—0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable, slightly hard; medium acid; gradual, smooth boundary.

B21t—11 to 30 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, medium, subangular blocky structure; firm, hard; few patchy clay films in root channels and on faces of some peds; few iron-manganese concretions; strongly acid; gradual, wavy boundary.

B22t—30 to 60 inches, yellowish-brown (10YR 5/4) silt loam; common, fine, faint, yellowish-brown and dark-brown mottles; weak, medium and coarse, subangular blocky structure; firm, hard; few patchy clay films in root channels and on faces of peds; common iron-manganese concretions; very strongly acid.

The A horizon is dark grayish-brown or brown silt loam or loam. It is strongly acid to medium acid. The B2t horizon is yellowish-brown, dark yellowish-brown, dark-brown, or brown loam, silt loam, clay loam, or silty clay loam. In some places this horizon has a few brownish-colored mottles in the upper part and few to many, coarse, medium, or fine, distinct, grayish- or brownish-colored mottles in the lower part. The B2t horizon is very strongly acid to medium acid. A B3 horizon is in some areas, above a depth of 60 inches. Where present, the B3 horizon is typically mottled with brownish and grayish colors.

Rexor soils are associated with Guyton and Dela soils. They are better drained than the Guyton soils. They have a Bt horizon, which does not occur in the Dela soils.

Rexor silt loam (Re).—This nearly level soil is on flood plains. It has the profile described as representative of the series. It is subject to occasional damaging flooding.

Included with this soil in mapping, and making up about 7 percent of the acreage, are areas of soils similar to this Rexor soil, except that the upper part of the subsoil has grayish mottles. Also included are areas of Guyton soils that make up about 6 percent of the acreage, areas of Dela soils that make up 2 percent, and small areas of soils similar to this Rexor soil, except that they have a darker colored surface layer.

This soil is used dominantly for tame pasture and trees. It is also suited to alfalfa, cotton, grain sorghum, soybeans, and small grains. Management is needed that maintains soil structure and fertility and protects the soil from damaging overflow from

streams. Use of crop residue, minimum tillage, and fertilizer is needed to maintain production and to improve soil structure. Capability unit IIw–1; not in a range site; woodland group 2o7; pasture and hay group 2A.

Rexor soils, channeled (Rf).—These nearly level or very gently sloping soils are on flood plains. They have a profile similar to the one described as representative of the series, except that the surface layer ranges to loam and the soils are flooded more often. Areas are commonly 200 to 400 feet wide. They are dissected by stream channels and are frequently flooded.

Included with these soils in mapping are areas of Guyton soils that make up about 13 percent of the acreage, areas of Dela soils that make up 12 percent, and stream channels that make up 7 percent. Also included are small areas of soils similar to these Rexor soils, except that the upper part of the subsoil has grayish-colored mottles.

These soils are used dominantly for tame pasture and trees. They are not suited to cultivated crops because flooding is a hazard. Suitable grazing practices, control of brush, applications of fertilizer, and protection from fire are needed to maintain or improve the quality of the grass. Capability unit Vw–2; not in a range site; woodland group 2o7; pasture and hay group 2A.

Sallisaw Series

The Sallisaw series consists of very gently sloping soils on uplands. These soils formed under a cover of hardwood trees in material derived from loamy sediment.

In a representative profile the surface layer is 9 inches of brown loam. The upper part of the subsoil, extending to a depth of 14 inches, is reddish-brown loam. The middle part of the subsoil, extending to a depth of 40 inches, is reddish-brown and yellowish-red clay loam that is 5 percent gravel. The lower part of the subsoil, extending to a depth of 65 inches, is yellowish-red gravelly clay loam that is about 50 percent gravel and rounded rock fragments as much as 10 inches in diameter.

Sallisaw soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Sallisaw loam, 1 to 3 percent slopes, 2,000 feet north and 1,500 feet east of the SW. corner of sec. 33, T. 8 N., R. 22 E.:

A1—0 to 9 inches, brown (7.5YR 4/2) loam; weak, medium, granular structure; friable, slightly hard; few, small, rounded, sandstone fragments; medium acid; gradual, smooth boundary.

B1—9 to 14 inches, reddish-brown (5YR 5/4) loam; moderate, medium, granular structure; friable, hard; few pebbles; few roots and pores; medium acid; gradual, smooth boundary.

B21t—14 to 30 inches, reddish-brown (5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm, hard; clay films on faces of peds and lining pores; about 5 percent gravel; strongly acid; gradual, smooth boundary.

B22t—30 to 40 inches, yellowish-red (5YR 4/6) clay loam; weak, medium; subangular blocky structure; firm, hard; clay films on faces of peds; about 5 percent gravel; strongly acid; gradual, wavy boundary.

IIB3t—40 to 65 inches, yellowish-red (5YR 5/6) gravelly clay loam; many, medium, distinct, red (2.5YR 4/6) and pale-brown (10YR 6/3) mottles; weak, fine, subangular blocky structure; firm, hard; clay films on faces of peds; 45 percent gravel; strongly acid.

The A1 or Ap horizon is brown or dark grayish brown. It is medium acid to slightly acid. The B1 horizon is brown, strong-brown, or reddish-brown loam or clay loam. It is strongly acid or medium acid. The B2t horizon is reddish-brown, red, yellowish-red, brown, or strong-brown loam, clay loam, or sandy clay loam. It is strongly acid or medium acid. The IIB3t horizon is yellowish-red, reddish-brown, red, brown, or strong-brown gravelly clay loam, gravelly loam, gravelly sandy clay loam, very gravelly clay loam, very gravelly loam, or very gravelly sandy clay loam. This horizon has common grayish-, reddish-, and brownish-colored mottles. It is strongly acid or medium acid, and is 35 to 80 percent gravel, by volume.

Sallisaw soils are associated with Linker and Naldo soils. They differ from those soils in being gravelly in the lower part of the subsoil.

Sallisaw loam, 1 to 3 percent slopes (SfB).—This soil is on uplands.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Naldo soils and areas of soils, also making up 10 percent, that are similar to this Sallisaw soil, except that the surface layer is fine sandy loam, the surface layer is darker colored, or the upper part of the subsoil has grayish mottles. Also included are small areas of similar soils that have rock or gravel on the surface or have a gravelly substratum less than 30 inches from the surface.

This soil is used dominantly for tame pasture and trees. It is also suited to alfalfa, cotton, soybeans, grain sorghum, and small grains. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, crop residue, and fertilizer is needed to control erosion. Crop residue should be returned to the soil, and excessive tillage should be avoided. Sown crops can be grown year after year if fertilizer is added and crop residue is returned to the soil. Terraces and contour farming are needed if row crops are grown. Capability unit IIe–2; not in a range site; woodland group 3o7; pasture and hay group 8A.

Spiro Series

The Spiro series consists of very gently sloping or gently sloping soils on uplands. These soils formed under a cover of mid and tall grasses and scattered hardwood trees in material weathered from silty sandstone.

In a representative profile the surface layer is 10 inches of dark-brown silt loam. The upper part of the subsoil, extending to a depth of 15 inches, is brown silt loam. The middle part of the subsoil, extending to a depth of 32 inches, is dark yellowish-brown silty clay loam. The lower part of the subsoil, extending to a depth of 36 inches, is yellowish-brown silty clay loam. The underlying material is silty sandstone.

Spiro soils are well drained and have moderate permeability. Available water capacity is high. A seasonal perched water table is at a depth of 36 to 48 inches.

Representative profile of Spiro silt loam, 1 to 3 percent slopes, 1,200 feet north and 300 feet east of the SW. corner of sec. 20, T. 9 N., R. 19 E.:

A1—0 to 10 inches, dark-brown (10YR 3/3) silt loam; moderate, medium, granular structure; friable, slightly hard; common roots and pores; few iron-manganese concretions; strongly acid; gradual, smooth boundary.

B1—10 to 15 inches, brown (10YR 4/3) silt loam; weak, coarse, prismatic structure and weak, medium, granular; friable, slightly hard; few roots and pores; few iron-manganese concretions; strongly acid; gradual, smooth boundary.

B2t—15 to 32 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm, hard; clay films on faces of peds and lining pores; common iron-manganese concretions; strongly acid; diffuse, wavy boundary.

B3—32 to 36 inches, yellowish-brown (10YR 5/4) silty clay loam; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky struture; firm, hard; common iron-manganese concretions and siltstone or sandstone fragments; strongly acid; abrupt, smooth boundary.

R—36 to 40 inches, light yellowish-brown (10YR 6/4) silty sandstone; strongly acid; extremely hard.

All of the horizons may have few to many iron-manganese concretions. Depth to bedrock ranges from 20 to 40 inches.

The A1 horizon is dark-brown, brown, dark grayish-brown, or very dark grayish-brown loam or silt loam. It is strongly acid to slightly acid. The B1 horizon is brown, yellowish-brown, or dark yellowish-brown silt loam or loam. It is strongly acid to medium acid. The B2t and B3 horizons are brown, yellowish-brown, dark yellowish-brown, light yellowish-brown, dark-brown, or strong-brown clay loam or silty clay loam. The B2t horizon is very strongly acid or strongly acid and the B3 horizon is strongly acid or medium acid. The B3 horizon has few to many sandstone or siltstone fragments and in places is mottled.

Spiro spoils are associated with Collinsville, Liberal, Tamaha, and Kanima soils and are similar to Linker soils. They have a more silty subsoil than the Linker soils. They have a thicker solum than the Collinsville soils. They are less clayey in the upper part of the subsoil than the Liberal and Tamaha soils. They have a Bt horizon, which does not occur in the Kanima soils.

Spiro silt loam, 1 to 3 percent slopes (SnB).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Tamaha soils that make up about 5 percent of the acreage and areas of Collinsville soils that make up 3 percent. Also included are areas of a soil similar to this Spiro soil, except that the subsoil is redder or the combined thickness of the surface layer and subsoil is 40 to 50 inches. These areas make up about 45 percent of the acreage.

This soil is used dominantly for range and tame pasture. It is also suited to cotton, grain sorghum, small grains, and soybeans. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, stripcropping, and crop residue are needed to reduce erosion. Sown crops can be grown year after year if fertilizer is added and crop residue is used. Crop residue should be returned to the soil, and excessive tillage should be avoided. Terraces and contour farming are needed if row crops are grown. Capability unit IIe–1; Loamy Prairie range site; woodland group 5o0; pasture and hay group 8A.

Spiro silt loam, 3 to 5 percent slopes (SnC).—This soil is on uplands. It has a profile similar to the one described as representative of the series, except that in most places it is a few inches deeper over bedrock.

Included with this soil in mapping, and making up about 5 percent of the acreage each, are areas of Vian soils, Tamaha soils, and Collinsville soils. Also included are soils similar to this Spiro soil, except that the subsoil is redder. These areas make up about 20 percent of the acreage.

The soil is used dominantly for range and tame pasture (fig. 10). It is also suited to cotton, grain sorghum, small grains, and soybeans. Management is needed that maintains fertility and soil structure and protects from erosion. Use of terracing, contour farming, stripcropping, fertilizer, and crop residue is needed to reduce erosion. Use of fertilizer and crop residue also is needed to conserve moisture and to maintain soil structure. Capability unit IIIe–1; Loamy Prairie range site; woodland group 5o0; pasture and hay group 8A.

Figure 10.—**Coastal bermudagrass and Kobe lespedeza in an area of Spiro silt loam, 3 to 5 percent slopes.**

Spiro silt loam, 2 to 5 percent slopes, eroded (SnC2).—This eroded soil is on uplands. It has a profile similar to the one described as representative of the series, except that on about 40 percent of the area the surface layer has been removed by erosion, and where the soil has been thinned, tillage has mixed the surface layer with the subsoil. Few to many crossable gullies are present, and sheet erosion occurs along them.

Included with this soil in mapping, and making up about 40 percent of the acreage, are areas of similar soils that have a redder subsoil, a combined thickness of the surface layer and subsoil of less than 20 inches or more than 40 inches, or a more clayey subsoil.

This soil is used dominantly for tame pasture. It is also suited to cotton, grain sorghum, soybeans, small grains, and range. Management is needed that improves soil structure and fertility. Use of terracing, contour farming, crop residue, and tame pasture or range is needed to reduce erosion. Fertilizer is needed

to improve the suitability of this soil for crops and to increase the growth of crops. Capability unit IIIe–3; Loamy Prairie range site; woodland group 5o0; pasture and hay group 8A.

Stigler Series

The Stigler series consists of nearly level or very gently sloping soils on uplands. These soils formed under a cover of tall and mid grasses and scattered hardwood trees in material derived from shale or clayey sediment.

In a representative profile the surface layer is 12 inches of dark grayish-brown silt loam. The subsurface layer extends to a depth of 21 inches and is brown silt loam. The subsoil extends to a depth of 78 inches and is yellowish-brown silty clay.

Stigler soils are moderately well drained and have very slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 12 to 24 inches.

Representative profile of Stigler silt loam, 1 to 3 percent slopes, 1,800 feet west and 500 feet north of the SE. corner of sec. 15, T. 9 N., R. 19 E.:

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, yellowish-brown mottles; weak, medium, granular structure; friable, slightly hard; few iron-manganese concretions; strongly acid; gradual, wavy boundary.

A2—12 to 21 inches, brown (10YR 5/3) silt loam; few, fine, faint, yellowish-brown mottles; weak, medium, granular structure; friable, slightly hard; few iron-manganese concretions; strongly acid; clear, wavy boundary.

B21t—21 to 33 inches, yellowish-brown (10YR 5/6) silty clay; many, medium and coarse, distinct, pale-brown (10YR 6/3), grayish-brown (10YR 5/2), and yellowish-red (5YR 4/6) mottles; moderate, medium, blocky structure; very firm, very hard; clay films on faces of peds; few iron-manganese concretions; medium acid; diffuse, wavy boundary.

B22t—33 to 65 inches, yellowish-brown (10YR 5.6) silty clay; common, medium, distinct, light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 4/4) mottles; moderate, medium and coarse, blocky structure; extremely firm, extremely hard; clay films on faces of peds; few iron-manganese concretions and black streaks; neutral; diffuse, wavy boundary.

B3t—65 to 78 inches, yellowish-brown (10YR 5/6) silty clay; common, distinct, light-gray (10YR 6/1) mottles and black streaks; weak, medium, blocky structure; extremely firm, extremely hard; patchy clay films on faces of peds; neutral.

The A1 horizon is brown, dark brown, dark grayish brown, or grayish brown. It is strongly acid or very strongly acid. The A2 horizon is pale brown, brown, light yellowish brown, light brownish gray, or grayish brown. It is very strongly acid or strongly acid. The A horizon ranges from 16 to 30 inches in thickness. The B2t horizon is yellowish-brown, dark yellowish-brown, brown, or dark-brown clay loam, silty clay loam, silty clay, or clay mottled with brownish, reddish, or grayish colors. Its grayish-colored mottles are at a depth of 10 to 30 inches. This horizon is very strongly acid to medium acid in the upper part and strongly acid to mildly alkaline in the lower part. The B3t horizon has the same colors as the B2t horizon or is coarsely mottled with brownish, reddish, and grayish colors. It is clay loam, silty clay loam, silty clay, or clay. It is strongly acid to mildly alkaline. In some places the B3t horizon has few to common shale fragments.

Stigler soils are associated with Vian, Kanima, and Wing soils and are similar to Counts soils. They have thicker combined surface and subsurface layers than the Counts soils. They are more clayey in the upper part of the subsoil than the Vian soil. They have a Bt horizon, which does not occur in the Kanima soils. They contain less sodium in the subsoil than the Wing soils.

Stigler silt loam, 0 to 1 percent slopes (SrA).—This soil is on moundy uplands. It has a profile similar to the one described as representative of the series, except that in most places the surface layer is a few inches thicker.

Included with this soil in mapping are areas of Counts soils that make up about 15 percent of the acreage, areas of Vian soils that make up 5 percent, and areas of circular mounds that are 1 to 2 feet high and 20 to 50 feet in diameter that make up about 7 percent. The mounds consist of soils similar to this Stigler soil, except that the combined thickness of the surface and subsurface layers is more than 30 inches.

This soil is used dominantly for tame pasture and hay. It is also suited to cotton, grain sorghum, small grains, range, soybeans, and trees. Management is needed that maintains or improves fertility and soil structure and removes excess surface water. A cropping system that provides crops that produce large amounts of residue is needed to maintain or improve fertility and soil structure. Crop residue should be returned to the soil. In places the moundy relief retards runoff. Land smoothing improves surface drainage. Occasionally, crop rows can be so arranged that the furrows help to drain ponded surface water. Capability unit IIw–2; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Stigler silt loam, 1 to 3 percent slopes (SrB).—This soil is on moundy uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Counts soils that make up 15 percent of the acreage. Also included are areas of Tamaha soils, Vian soils, and circular mounds 2 feet high and 20 to 50 feet in diameter. Each of these makes up 5 percent of the acreage. The mounds consist of soils similar to this Stigler soil, except that the combined thickness of the surface and subsurface layers is more than 30 inches.

This soil is used dominantly for tame pasture and hay. It is also suited to cotton, grain sorghum, small grains, soybeans, range, and trees. Management is needed that maintains or improves fertility and soil structure and reduces erosion. Plant cover is needed during winter and spring to protect the soil from erosion. Sown crops can be grown year after year if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe–1; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Tamaha Series

The Tamaha series consists of very gently sloping to sloping soils on uplands. These soils formed under an open stand of hardwood trees and an understory of

tall grasses in material weathered from clayey sediment or shale.

In a representative profile the surface layer is 12 inches of dark grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 17 inches, is yellowish-brown silty clay loam. The middle part of the subsoil, extending to a depth of 34 inches, is yellowish-brown clay. The lower part of the subsoil, extending to a depth of 68 inches, is coarsely mottled reddish-, yellowish-, brownish-, and grayish-colored clay.

Tamaha soils are moderately well drained and have very slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 12 to 24 inches.

Representative profile of Tamaha silt loam, 1 to 3 percent slopes, 500 feet north and 500 feet west of the SE. corner of sec. 33, T. 8 N, R. 19 E.:

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, slightly hard; many roots; strongly acid; gradual, smooth boundary.

B1—12 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm, hard; common iron-manganese concretions; strongly acid; gradual, smooth boundary.

B21t—17 to 34 inches, yellowish-brown (10YR 5/6) clay; many, coarse, distinct, pale-brown (10YR 6/3) mottles, common, medium, prominent, red (2.5YR 4/6) mottles, and few, fine, distinct, light-gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; very firm, very hard; few patchy clay films on faces of peds; few iron-manganese concretions; very strongly acid; gradual, wavy boundary.

B22t—34 to 48 inches, coarsely mottled yellowish-brown (10YR 5/6), red (2.5YR 4/6), grayish-brown (10YR 5/2), and light-gray (10YR 6/1) clay; moderate, medium, blocky structure; very firm, very hard; nearly continuous clay films on faces of peds; few iron-manganese concretions; strongly acid; gradual, wavy boundary.

B3t—48 to 68 inches, coarsely mottled brownish-yellow (10YR 6/6), red (2.5YR 4/6), and gray (10YR 6/1) clay; weak, coarse, blocky structure; very firm, very hard; thin clay films on faces of peds; few iron-manganese concretions and shale fragments; medium acid.

The A1 or Ap horizon is dark grayish-brown, brown, dark-brown, very dark grayish-brown, grayish-brown, or dark yellowish-brown silt loam or loam. It is very strongly acid to slightly acid. The B1 horizon is brown, yellowish-brown, pale-brown, light yellowish-brown, or dark yellowish-brown loam, silt loam, clay loam, or silty clay loam. It is very strongly acid to strongly acid. The B21t horizon is yellowish-brown, dark yellowish-brown, brownish-yellow, or brown clay, silty clay, clay loam, or silty clay loam mottled with brownish, reddish, or grayish colors. Its grayish mottles are within 15 to 30 inches of the surface. This horizon is very strongly acid to strongly acid. The B22t and B3t horizons have the same colors as the B21t horizon or are coarsely mottled with brownish, reddish, yellowish, and grayish colors. They are clay, silty clay, clay loam, or silty clay loam. They are strongly acid to slightly acid, and have few to common shale fragments in most areas.

Tamaha soils are associated with Counts, Collinsville, Liberal, Kanima, and Spiro soils. They differ from the Counts soils in having a gradual boundary between the surface layer and subsoil. They have a thicker solum than the Collinsville and Liberal soils. They have a Bt horizon, which does not occur in the Kanima soils. They are more clayey in the upper part of the subsoil than the Spiro soils.

Tamaha silt loam, 1 to 3 percent slopes (TmB).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Stigler soils that make up about 3 percent of the acreage, areas of Spiro soils that make up 4 percent, areas of Counts soils that make up 3 percent, and areas of a soil similar to this Tamaha soil, except that the combined thickness of the surface layer and subsoil is less than 60 inches or the surface layer is thinner, that make up about 10 percent.

This soil is used dominantly for tame pasture and hay. It is also suited to cotton, grain sorghum, small grains, and soybeans. Management is needed that maintains or improves fertility and soil structure and reduces erosion. Plant cover is needed during winter and spring to protect the soil from erosion. Sown crops can be grown year after year if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe–1; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Tamaha silt loam, 3 to 5 percent slopes (TmC).—This soil is on uplands.

Included with this soil in mapping are areas of Spiro soils that make up 8 percent of the acreage and areas of Stigler and Counts soils that make up 3 percent. Also included are areas of a soil similar to this Tamaha soil, except that the combined thickness of the surface layer and subsoil is less than 60 inches or the surface layer is thinner. These areas make up about 20 percent of the acreage.

This soil is used dominantly for tame pasture or hay. It is also suited to cotton, grain sorghum, small grains, and soybeans. Management is needed that maintains fertility and soil structure and reduces erosion. Use of terracing, contour farming, fertilizer, and crop residue is needed to reduce erosion, to conserve moisture, and to maintain soil structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIIe–1; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Tamaha silt loam, 2 to 5 percent slopes, eroded (TmC2).—This eroded soil is on uplands. It has a profile similar to the one described as representative of the series, except that on about 35 percent of the area part of the original surface layer has been removed by erosion, and where the soil has been thinned, tillage has mixed the surface layer with the subsoil. Few to many crossable gullies are present, and sheet erosion occurs along them.

Included with this soil in mapping are areas of Counts soils that make up about 10 percent of the acreage, areas of Spiro soils that make up 7 percent, and areas of Stigler soils that make up 5 percent. Also included are small areas of soils similar to this Tamaha soil, except that the combined thickness of the surface layer and subsoil is less than 60 inches.

This soil is used dominantly for tame pasture and range. It is also suited to cotton, grain sorghum, soybeans, and small grains. Use of terracing, contour farming, tame pasture, range, crop residue, and fertilizer is needed to reduce erosion. Management is needed that improves the suitability of this soil for crops, improves soil structure, and increases growth of crops. Plant cover is needed during winter and spring to protect this soil from erosion. Capability unit IIIe–3; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8C.

Tamaha soils, 3 to 8 percent slopes, severely eroded (TnC3).—These severely eroded soils are on uplands. They have a profile similar to the one described as representative of the series, except that on about 70 percent of the area part or all of the surface layer has been removed by erosion. Also, the surface layer ranges to loam. About 10 percent of the area is uncrossable gullies 3 to 10 feet deep and 75 to 250 feet apart.

Included with these soils in mapping are areas of Stigler soils that make up about 15 percent of the acreage, areas of Spiro soils that make up 10 percent, and areas of Counts and Wing soils that each make up 5 percent.

These soils are so severely eroded that they are not suitable for cultivation and should be returned to permanent vegetation. Adding fertilizer, sloping gully banks, diverting overhead water, and mulching critical areas with plant residue help in successful establishment of tame pasture or range. These soils are also suited to trees. Suitable grazing practices, control of brush, and protection from fire are needed to maintain or improve the quality of the grass. Capability unit VIe–2; Loamy Savannah range site; woodland group 5c3e; pasture and hay group 8F.

Vian Series

The Vian series consists of very gently sloping soils on uplands. These soils formed under an open cover of hardwood trees and an understory of tall grasses in material weathered from loamy sediment.

In a representative profile the surface layer is 12 inches of dark grayish-brown silt loam. The subsurface layer extends to a depth of 18 inches and is brown silt loam. The subsoil extends to a depth of 72 inches and is yellowish-brown silty clay loam.

Vian soils are moderately well drained and have moderately slow permeability. Available water capacity is high. A seasonal perched water table is at a depth of 24 to 48 inches.

Representitive profile of Vian silt loam, 1 to 3 percent slopes, 1,800 feet north and 300 feet west of the SE. corner of sec. 1, T. 9 N., R. 23 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable, slightly hard; common roots; medium acid; clear, smooth boundary.

A1—6 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, slightly hard; common roots; few iron-manganese concretions; strongly acid; gradual, smooth boundary.

A2—12 to 18 inches, brown (10YR 5/3) silt loam; weak, medium, granular structure; friable, hard; few iron-manganese concretions; few roots; strongly acid; gradual, smooth boundary.

B1—18 to 27 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine and medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable, hard; few roots; common iron-manganese concretions; strongly acid; gradual, wavy boundary.

B21t—27 to 46 inches, yellowish-brown (10YR 5/6) silty clay loam; many, coarse and medium, distinct, gray (10YR 6/1), brown (10YR 5/3), and grayish-brown (10YR 5/2) mottles and few red (2.5YR 4/6) mottles; moderate, medium, subangular blocky structure; firm, very hard; clay films on faces of some peds and lining pores; few iron-manganese concretions and dark stains; strongly acid; diffuse, wavy boundary.

B22t—46 to 72 inches, yellowish-brown (10YR 5/4) silty clay loam; many, coarse and medium, distinct, dark grayish-brown (10YR 4/2), brown (10YR 5/3), and gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm, very hard; clay films on faces of peds; few iron-manganese concretions and many dark-brown or black stains; strongly acid.

The A1 or Ap horizon is dark grayish brown or brown. It is strongly acid to medium acid. The A2 horizon is brown, grayish brown, or pale brown. It is very strongly acid or strongly acid. The B1 horizon is brown, yellowish-brown, or light yellowish-brown silt loam or silty clay loam. In some places it has reddish- or brownish-colored mottles. It is very strongly acid or strongly acid. The B2t horizon is yellowish brown, dark yellowish brown, light yellowish brown, or brownish yellow mottled with brownish, reddish, or grayish colors. Its grayish mottles are at a depth of 20 to 30 inches. In some areas this horizon is coarsely mottled with brownish, reddish, and grayish colors in the lower part. The B2t horizon is very strongly acid or strongly acid. It has few to common iron-manganese concretions.

Vian soils are associated with Stigler soils and are similar to Naldo soils. They are less clayey in the upper part of the subsoil than the Stigler soils. They have a more silty subsoil than the Naldo soils.

Vian silt loam, 1 to 3 percent slopes (VaB).—This soil is on uplands.

Included with this soil in mapping are areas of Stigler soils that make up about 15 percent of the acreage and areas of Spiro soils that make up 5 percent. Also included are areas of soils similar to this Vian soil, except that grayish mottles are at a depth of 30 to 48 inches. These areas make up about 25 percent of the acreage.

This soil is used dominantly for tame pasture and hay. It is also suited to cotton, grain sorghum, small grains, and soybeans. Management is needed that maintains or improves fertility and soil structure and reduces erosion. Use of terracing, contour tillage, and crop residue is needed to reduce erosion. Plant cover is needed during winter and spring to protect the soil from erosion. Sown crops can be grown year after year if fertilizer is added and crop residue is used. Terraces and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe–1; Loamy Savannah range site; woodland group 4o1; pasture and hay group 8A.

Whakana Series

The Whakana series consists of gently sloping or sloping soils on uplands. These soils formed under a cover of hardwood trees in material weathered from sandy and loamy sediment.

In a representative profile the surface and subsurface layers are 15 inches of brown loamy fine sand. The upper part of the subsoil, extending to a depth of 54 inches, is yellowish-red sandy clay loam. The lower part of the subsoil, extending to a depth of 76 inches, is yellowish-red fine sandy loam.

Whakana soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Whakana loamy fine sand, 3 to 8 percent slopes, 300 feet south and 200 feet west of the NE. corner of sec. 4, T. 9 N., R. 18 E.:

Ap—0 to 6 inches, brown (10YR 4/3) loamy fine sand; weak, fine granular structure; very friable, soft; many roots; medium acid; clear, smooth boundary.

A2—6 to 15 inches, brown (7.5YR 5/4) loamy fine sand; weak, fine, granular structure; very friable, soft; common roots; medium acid; clear, smooth boundary.

B21t—15 to 40 inches, yellowish-red (5YR 4/6) sandy clay loam; moderate, coarse, prismatic structure; friable, hard; few clay films on faces of peds; medium acid; diffuse, wavy boundary.

B22t—40 to 54 inches, yellowish-red (5YR 4/6) sandy clay loam; weak, coarse, prismatic structure; friable, hard; clay films on faces of peds; medium acid; diffuse, wavy boundary.

B3t—54 to 76 inches, 70 percent yellowish-red (5YR 4/6) fine sandy loam, 24 percent red (2.5YR 4/6) sandy clay loam in a mixed pattern, and 6 percent pockets and coatings of clear sand grains, 1 to 5 milliemters thick, between adjacent peds; weak, coarse, prismatic structure; friable, slightly hard; patchy clay films on faces of peds; medium acid.

The Ap and A1 horizons are brown or dark grayish-brown loamy fine sand or fine sandy loam. They are medium acid or slightly acid. The A2 horizon is brown or light yellowish-brown loamy fine sand or fine sandy loam. It is strongly acid to slightly acid. The B2t horizon is red, yellowish-red, or reddish-brown sandy clay loam or clay loam. It is strongly acid to slightly acid. The B3t horizon is red or yellowish-red fine sandy loam or sandy clay loam. The B3 horizon is 5 to 8 percent, by volume, skeletons or pockets of clean sand grains.

Whakana soils are associated with Porum soils. They are less clayey in the upper part of the subsoil than those soils.

Whakana loamy fine sand, 3 to 8 percent slopes (WhD).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 30 percent of the acreage, are areas of a soil similar to this Whakana soil, except that the combined thickness of the surface and subsurface layers is more than 20 inches or the subsoil is more clayey.

This soil is used dominantly for tame pasture and range (fig. 11). It is also suited to cotton, grain sorghum, peanuts, soybeans, small grains, and trees. Management is needed that maintains or improves fertility and reduces erosion. A cropping system is needed that provides plant cover during winter and spring to protect the soil from soil blowing and water erosion. Use of stripcropping, minimum tillage, crop residue, and fertilizer is needed to reduce erosion and maintain fertility. Cover crops are needed when low residue crops are grown. Diversion terraces are needed in some areas to divert water. Capability unit IVe–1; Sandy Savannah range site; woodland group 2o7; pasture and hay group 9A.

Figure 11.—**A good stand of lovegrass in an area of Whakana loamy fine sand, 3 to 8 percent slopes.**

Whakana soils, 3 to 8 percent slopes, severely eroded (WkD3).—These severely eroded soils are on uplands. They have a profile similar to the one described as representative of the series, except that on about 70 percent of the area part or all of the surface layer has been removed by erosion. The surface layer in uneroded areas is fine sandy loam or loamy fine sand. The surface layer in severely eroded areas is loam, sandy clay loam, or clay loam. About 12 percent of the area is uncrossable gullies 1 to 12 feet deep and 60 to 400 feet apart. Between the gullies sheet erosion has thinned the surface layer and, in places, exposed the subsoil.

Included with these soils in mapping, and making up about 15 percent of the acreage each, are areas of Naldo soils and Porum soils.

These soils are so severely eroded that they are not suitable for cultivation and should be returned to permanent vegetation. Adding fertilizer, sloping gully banks, diverting overhead water, and mulching critical areas with plant residue help in successful establishment of tame pasture or range. Suitable grazing practices, control of brush, and protection from fire are needed to maintain or improve the quality of the grass. This soil is also suited to trees. Capability unit VIe–3; Eroded Sandy Savannah range site; woodland group 5c3e; pasture and hay group 8F.

Wing Series

The Wing series consists of very gently sloping soils on uplands. These soils formed under a sparse cover of short grasses in material derived from clayey sediment or shale.

In a representative profile the surface layer is 8 inches of brown silt loam. The subsoil extends to a depth of 70 inches and is brown, dark-brown, and yellowish-brown silty clay.

Wing soils are somewhat poorly drained to moderately well drained and have very slow permeability. Available water capacity is moderate, because the soils contain sodium. A seasonal perched water table is at a depth of 12 to 24 inches.

Representative profile of Wing silt loam from an area of Counts-Wing complex, 1 to 3 percent slopes, 700 feet west and 150 feet south of the NE. corner of sec. 22, T. 9 N., R. 23 E.:

A1—0 to 8 inches, brown (10YR 4/3) silt loam; weak, thin, platy structure in upper 3 inches and weak, medium, granular in lower 5 inches; friable, slightly hard; medium acid; clear, wavy boundary.

B21t—8 to 24 inches, brown (10YR 4/3) silty clay; common, fine and medium, distinct, yellowish-red (5YR 4/6) mottles and few, fine, faint, grayish-brown mottles; weak, columnar structure breaking to weak, medium, angular blocky; very firm, very hard; very dark grayish-brown (10YR 3/2) coatings on faces of some peds; continuous clay films on faces of peds; few iron-manganese concretions; moderately alkaline; more than 15 percent sodium; gradual, smooth boundary.

B22t—24 to 48 inches, dark-brown (10YR 4/3) silty clay; few, fine, distinct, brownish-yellow (10YR 6/6) and light-gray (10YR 6/1) mottles; moderate, medium, angular blocky structure; very firm, very hard; continuous clay films on faces of peds; common white crystals in pockets; few iron-manganese concretions; moderately alkaline; more than 15 percent sodium; diffuse, wavy boundary.

B3t—48 to 70 inches, yellowish-brown (10YR 5/6) silty clay; many, coarse and medium, distinct, gray (10YR 5/1) and brown (10YR 4/3) mottles; weak, medium, angular blocky structure; very firm, very hard; clay films on faces of some peds; few iron-manganese concretions; common black stains or streaks; moderately alkaline; more than 15 percent sodium.

The A horizon is dark grayish-brown or brown fine sandy loam, loam, or silt loam. The B2t horizon is brown or yellowish brown clay loam, silty clay loam, or silty clay. Its mottles are brownish, reddish, and grayish colored and are more abundant and coarser in the lower part. Its grayish mottles always occur in the upper part. The upper part has coatings or stains on faces of some peds. This horizon has iron-manganese concretions and white crystals in most places. The B3t horizon is similar to the B2t horizon in color and texture, but ranges to clay.

Wing soils are associated with Counts and Stigler soils. They contain more sodium in the subsoil than those soils.

Wing soils in Haskell County are mapped only with Counts soils.

Use and Management of the Soils

This section explains the system of capability classification used by the Soil Conservation Service and shows estimated yields of the principal crops grown in the county under a high level of management. The capability classification of each soil mapped in the county can be learned by referring to the "Guide to Mapping Units." Information about management needs of a particular soil is in the section "Descriptions of the Soils."

This section also contains information about management of soils for cultivated crops and tame pasture and about the use of the soils for woodland, range, and wildlife habitat. It also contains a table that shows ratings of the soils for several recreational uses and a section that gives information about engineering uses of the soils.

Management of the Soils for Cultivated Crops [2]

This section contains information about the use and management of soils for cultivated crops. Alfalfa, soybeans, small grain, cotton, grain sorghum, and cowpeas are the main crops grown. Cultivated land occupies 2 percent of the acreage, or approximately 7,300 acres. Extensive acreage used for tame pasture and native forage can be safely returned to cultivation if proper conservation measures are used.

Practices that can be used to prevent excessive erosion in cultivated areas are managing crop residue, growing cover crops following low-residue crops, terracing. contour farming, minimum tillage, and no-tillage. The practices needed depend on the nature of the soils and the cropping system the farmer uses.

Minimum tillage is a good practice to help maintain good soil tilth. It increases the rate of water intake and reduces farming costs. Excessive tillage of Norwood silty clay loam, Stigler silt loam, Vian silt loam, and similar soils causes compaction and surface crusting and inhibits the emergence of plants. Where tillage is needed, it should be done when the soil has a moisture range that results in a minimum of compaction.

Terraces are needed to prevent excessive erosion where clean-tilled row crops are grown on sloping upland soils, such as Tamaha silt loam, 3 to 5 percent slopes. Terraces are not needed for row crops where a no-till cropping system is followed.

[2] By ERNEST O. HILL, conservation agronomist, Soil Conservation Service.

No-till farming keeps sod crops or large amounts of residue on the surface throughout the year (3,000 to 4,000 pounds air-dry residue per acre). Both row crops and sown crops are grown in a no-till system. This system requires some machinery changes and weed and insect control.

Cover crops are not needed where good residue management or a no-till system is followed.

Capability grouping

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

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

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the paragraphs that follow.

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

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.

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Haskell County are described, and suggestions for the use and management of the soils are given.

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

- Unit I–1. Deep, nearly level, well-drained, loamy soils that have a loamy subsoil; on flood plains and terraces within the flood plains.
- Unit I–2. Deep, nearly level or very gently sloping, well-drained, loamy soils that have a loamy subsoil; on flood plains.

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

Subclass IIe. Soils subject to moderate erosion unless protected.

- Unit IIe–1. Deep or moderately deep, very gently sloping, well drained or moderately well drained, loamy soils that have a loamy or clayey subsoil; on uplands.
- Unit IIe–2. Deep or moderately deep, nearly level or very gently sloping, well drained or moderately well drained, loamy soils that have a loamy subsoil; on uplands.

Subclass IIw. Soils have moderate limitations caused by excess water or seasonal overflow.

- Unit IIw–1. Deep, nearly level or very gently sloping, well drained or moderately well drained, loamy soils that have a loamy subsoil; on flood plains.
- Unit IIw–2. Deep, nearly level, moderately well drained or somewhat poorly drained, loamy soils that have a loamy or clayey subsoil; on uplands.

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

Subclass IIIe. Soils subject to severe erosion unless protected.

- Unit. IIIe–1. Deep or moderately deep, very gently sloping or gently sloping, well-drained to somewhat poorly drained, loamy soils that have a loamy or clayey subsoil; on uplands.
- Unit IIIe–2. Deep or moderately deep, gently sloping, well drained or moderately well drained, loamy soils that have a loamy subsoil; on uplands.
- Unit IIIe–3. Deep or moderately deep, very gently sloping or gently sloping, well drained or moderately well drained, eroded, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit IIIe–4. Deep or moderately deep, very gently sloping or gently sloping, moderately well drained or well drained, eroded, loamy soils that have a loamy subsoil; on uplands.

Subclass IIIw. Soils have severe limitations caused by excess water.

Unit IIIw–1. Deep, nearly level, poorly drained, loamy soils that have a loamy subsoil; on flood plains.

Subclass IIIs. Soils have severe limitations caused by soil features.

Unit IIIs–1. Deep, nearly level or very gently sloping, well-drained, loamy soils that have a sandy subsoil; on flood plains.

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

Subclass IVe. Soils subject to very severe erosion in cultivated areas unless protected.

Unit IVe–1. Deep, gently sloping or sloping, well-drained, sandy soils that have a loamy subsoil; on uplands.

Unit IVe–2. Deep or moderately deep, very gently sloping or gently sloping, well drained or moderately well drained, loamy soils that have a clayey or loamy subsoil; on uplands.

Unit IVe–3. Moderately deep or shallow, very gently sloping or gently sloping, well-drained, loamy soils that have a loamy subsoil; on uplands.

Unit IVe–4. Deep, gently sloping, moderately well drained, loamy soils that have a clayey or loamy subsoil; on uplands.

Unit IVe–5. Deep, gently sloping, moderately well drained, eroded, loamy soils that have a clayey or loamy subsoil; on uplands.

Subclass IVs. Soils have very severe limitations caused by soil features.

Unit IVs–1. Deep, very gently sloping, moderately well drained or somewhat poorly drained, loamy soils that have a clayey or loamy subsoil high in content of sodium; on uplands.

Unit IVs–2. Deep, nearly level or very gently sloping, excessively drained, sandy or loamy soils that have a sandy subsoil; on flood plains.

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

Subclass Vw. Soils subject to frequent flooding.

Unit Vw–1. Deep, nearly level, poorly drained, clayey soils that have a loamy or clayey subsoil; on flood plains.

Unit Vw–2. Deep, nearly level or very gently sloping, well-drained, loamy soils that have a loamy subsoil; on flood plains.

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 habitat.

Subclass VIe. Soils limited chiefly by risk of erosion unless protected.

Unit VIe–1. Deep, nearly level to moderately steep, somewhat poorly drained or moderately well drained, loamy soils that have a loamy or clayey subsoil; on uplands and flood plains.

Unit VIe–2. Deep, gently sloping or sloping, moderately well drained, severely eroded, loamy soils that have a clayey or loamy subsoil; on uplands.

Unit VIe–3. Deep, gently sloping or sloping, well-drained, severely eroded, sandy or loamy soils that have a loamy subsoil; on uplands.

Unit VIe–4. Moderately deep or shallow, very gently sloping to sloping, well-drained, severely eroded, loamy soils that have a loamy subsoil; on uplands.

Subclass VIs. Soils severely limited by low available water capacity, shallowness, stones, or other soil features.

Unit VIs–1. Shallow, very gently sloping to strongly sloping, well-drained, stony, loamy soils that have a loamy subsoil; on uplands.

Unit VIs–2. Deep to shallow, gently sloping to moderately steep, well-drained, stony, loamy soils that have a loamy or clayey subsoil; on uplands.

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

Subclass VIIe. Soils very severely limited by risk of erosion.

Unit VIIe–1. Deep, very gently sloping to steep, well-drained soils that are shaly and loamy throughout; on uplands.

Subclass VIIs. Soils very severely limited by soil features.

Unit VIIs–1. Deep to shallow, moderately steep or steep, well-drained, stony, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit VIIs–2. Deep, steep, well-drained, stony, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit VIIs–3. Very shallow to deep, sloping to moderately steep, somewhat excessively drained to moderately well drained, stony, loamy soils that have a loamy or clayey subsoil; on uplands.

Class VIII. Soils and land types have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes. (None in Haskell County.)

Estimated yields

Table 2 lists estimated yields of the principal crops grown in the county. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The estimated yields are average yields per acre that can be expected by good commercial farmers at the level of management that tends to produce the highest economic returns. The yields are for dryland soils. Crops other than those shown in table 2 are grown in the county, but their estimated yields are not included because their acreage is small or reliable data on yields are not available.

The yields in table 2 can be expected if the following management practices are used: rainfall is effectively used and conserved; surface or subsurface drainage systems, or both, are installed; crop residue is managed to maintain soil tilth; minimum but timely tillage is used; insect, disease, and weed control measures are consistently used; fertilizer is applied according to soil tests and crop needs; and adapted crop varieties are used at recommended seeding rates.

TABLE 2.—*Estimated average yields per acre of cultivated crops and tame pasture plants*

[Yields are those to be expected under a high level of management. Absence of a yield figure indicates that the plant is seldom grown on the soil, that the soil is not suitable for the plant, or that the soil is not arable]

Soil	Cotton	Grain sorghum	Soybeans	Wheat	Alfalfa hay	Bermudagrass	Fescue
	Lb./cu. ft.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*AUM*[1]	*AUM*[1]
Caspiana silt loam	800	70	35	40	5.0	9.5	8.0
Counts silt loam, 0 to 1 percent slopes	450	45	25	30		6.5	5.0
Counts silt loam, 1 to 3 percent slopes	400	45	25	25		6.0	4.5
Counts-Dela complex, 0 to 20 percent slopes						6.0	4.5
Counts-Wing complex, 1 to 3 percent slopes		25	15	15		4.0	
Crevasse soils	300	30				5.5	
Dela fine sandy loam	600	65	30	35	3.0	8.0	
Enders-Hector complex, 3 to 15 percent slopes						4.0	
Enders-Hector complex, 15 to 30 percent slopes							
Enders stony soils, 30 to 45 percent slopes							
Guyton silt loam	400	40	25	30		5.5	5.5
Hector stony loam, 2 to 12 percent slopes						4.0	
Hector-Linker complex, 2 to 5 percent slopes	300	30	15	20		5.0	
Kanima soils, 1 to 30 percent slopes						2.0	
Kiomatia fine sandy loam	500	45	25	30	3.6	6.5	5.5
Liberal clay loam, 2 to 5 percent slopes	400	45	20	25		6.0	5.0
Liberal-Spiro complex, 2 to 5 percent slopes	400	40	20	25		6.0	5.0
Liberal and Collinsville stony soils, 5 to 20 percent slopes							
Linker fine sandy loam, 1 to 3 percent slopes	450	45	25	30		7.0	5.5
Linker fine sandy loam, 3 to 5 percent slopes	400	40	20	25		6.0	5.0
Linker fine sandy loam, 2 to 5 percent slopes, eroded	350	35	15	20		5.5	4.5
Linker-Hector complex, 2 to 8 percent slopes, severely eroded						4.5	
Mhoon soils, clayey variant						8.0	8.0
Naldo fine sandy loam, 0 to 3 percent slopes	500	50	25	30	3.0	7.5	5.5
Naldo fine sandy loam, 3 to 5 percent slopes	450	40	20	25		6.5	5.0
Naldo fine sandy loam, 2 to 5 percent slopes, eroded	400	35	15	20		5.5	4.5
Norwood silty clay loam	800	70	35	40	5.0	9.0	8.0
Oklared fine sandy loam	750	65	30	35	4.4	8.5	6.5
Porum fine sandy loam, 3 to 5 percent slopes	350	35	20	20		6.0	5.5
Porum fine sandy loam, 3 to 5 percent slopes, eroded	250	25		15		5.5	4.5
Rexor silt loam	650	70	30	35	3.6	8.0	6.5
Rexor soils, channeled						7.5	6.0
Sallisaw loam, 1 to 3 percent slopes	450	45	25	30	2.6	7.5	5.5
Spiro silt loam, 1 to 3 percent slopes	450	40	25	30	2.6	7.0	5.0
Spiro silt loam, 3 to 5 percent slopes	400	35	20	25	2.4	6.0	4.5
Spiro silt loam, 2 to 5 percent slopes, eroded	350	30	15	20		5.5	4.0
Stigler silt loam, 0 to 1 percent slopes	500	45	25	30		7.5	6.0
Stigler silt loam, 1 to 3 percent slopes	500	45	25	30		7.0	5.5
Tamaha silt loam, 1 to 3 percent slopes	450	45	25	30		7.0	6.0
Tamaha silt loam, 3 to 5 percent slopes	400	40	20	25		6.5	5.5
Tamaha silt loam, 2 to 5 percent slopes, eroded	350	35	15	20		5.5	4.5
Tamaha soils, 3 to 8 percent slopes, severely eroded						4.5	
Vian silt loam, 1 to 3 percent slopes	450	45	25	30		7.0	6.0
Whakana loamy fine sand, 3 to 8 percent slopes	350	50	30	30		6.5	
Whakana soils, 3 to 8 percent slopes, severely eroded						4.5	

[1] AUM is Animal Unit Month, or the number of months during a year that 1 acre provides grazing for 1 animal of 1,000 pounds of live weight; or it is the number of months times the number of animal units. For example, 1 acre of Linker fine sandy loam, 3 to 5 percent slopes, in a pasture of improved bermudagrass under improved management provides grazing for 3 animals for a period of 2 months; therefore, it is rated at 6 animal unit months.

Management of the Soils for Tame Pasture [3]

A large acreage of tame pasture is grown in the county. Where the pasture is properly managed, erosion is not a hazard. Much of the forage for livestock and game animals comes from tame pasture. A considerable acreage of the soils that are poorly suited to production of crops, such as Hector-Linker complex, 2 to 5 percent slopes, grows productive pasture under good management.

Bermudagrass is adapted to most soils in the county and is more widely grown than fescue. It is well suited to Vian, Linker, and similar soils. Bermudagrass can be grown alone, but in most places is grown in a mixture with legumes, such as Korean lespedeza, Ladino clover, or yellow hop clover. Where grown on suitable soils and managed well, improved bermudagrass produces approximately 20 percent more forage than common bermudagrass.

Bahiagrass is adapted to the same soils and has about the same growing season as Bermudagrass. Bahiagrass is a palatable grass that is established by seeding.

Fescue and southland brome provide green forage late in fall and early in spring, while bermudagrass is dormant. Fescue is better suited to soils that are wet or subject to overflow, such as Guyton silt loam. Bromegrass and Ladino clover are better suited to fertile, well-drained soils and are not recommended on wet soils. More lime is required for Ladino clover and alfalfa than for other legumes commonly grown in Haskell County.

Alfalfa, sericea lespedeza, and similar legumes can be grown in a pure stand for hay and pasture. Small grains, such as rye, wheat, and oats, are used for temporary cool-season pasture. Sudangrass is used for temporary summer pasture and hay.

Proper use of pasture is necessary if plant growth is to be optimum. If grasses are grazed too short, the amount of forage is reduced. Proper use of pasture includes rotation grazing, controlling undesirable vegetation, applying fertilizer effectively, providing adequate water, and stocking properly. Production is increased 15 to 20 percent where a good rotation grazing system is followed.

Tame pasture is more successful if properly fertilized. Most of the soils in Haskell County give good response to applications of lime. The increased value of land and the need for more forage make improvement in the fertilizer program necessary. Applications of fertilizer are normally needed to establish stands of perennial pasture crops and to maintain forage growth.

On such soils as Linder fine sandy loam, brush and weeds should be controlled or pasture plants will be crowded out in a few years.

For management of specific soils, refer to the section "Descriptions of the Soils." For predicted average yields per acre of tame pasture, refer to table 2.

[3] By ERNEST O. HILL, conservation agronomist, Soil Conservation Service.

Pasture and hay groups

Soils that produce about the same kind and amount of forage make up a pasture and hay group. The pasture and hay groups in Haskell County are described in the paragraphs that follow.

PASTURE AND HAY GROUP 1A

Only Mhoon soils, clayey variant, are in this group. These are deep soils that have a clayey surface layer and a loamy or clayey subsoil. These soils are poorly drained. They are on flood plains and are subject to flooding.

PASTURE AND HAY GROUP 2A

In this group are deep soils that are loamy throughout. These soils are well drained or moderately well drained. They are on flood plains or on terraces on flood plains and are subject to flooding.

PASTURE AND HAY GROUP 2B

Only Guyton silt loam is in this group. This is a deep soil that has a loamy surface layer and subsoil. This soil is poorly drained. It is on flood plains and is subject to flooding.

PASTURE AND HAY GROUP 3A

In this group are deep soils that are mostly sandy throughout. These soils are excessively drained or well drained. They are on flood plains and are subject to flooding.

PASTURE AND HAY GROUP 8A

In this group are deep or moderately deep soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are well drained or moderately well drained. They are on uplands.

PASTURE AND HAY GROUP 8B

In this group are deep or moderately deep soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are well drained or moderately well drained and are low in fertility. They are on uplands.

PASTURE AND HAY GROUP 8C

In this group are deep soils that have a loamy surface layer and a clayey or loamy subsoil. These soils are somewhat poorly drained or moderately well drained and seasonally are moderately wet. They are on uplands.

PASTURE AND HAY GROUP 8D

Only the Wing soil from Counts-Wing complex, 1 to 3 percent slopes, is in this group. It is a deep soil that has a loamy surface layer and a clayey or loamy subsoil that is high in content of sodium. This soil is somewhat poorly drained or moderately well drained. It is on uplands.

PASTURE AND HAY GROUP 8F

In this group are deep or moderately deep soils that have a loamy surface layer and a loamy or clayey subsoil. These soils are well drained or moderately well drained and are severely eroded. They are on uplands.

PASTURE AND HAY GROUP 9A

Only Whakana loamy fine sand, 3 to 8 percent slopes, is in this group. It is a deep soil that has a sandy surface layer and a loamy subsoil. This soil is well drained. It is on uplands.

PASTURE AND HAY GROUP 9B

Only Kanima soils, 1 to 30 percent slopes, are in this group. They are deep soils that are loamy throughout. These soils are well drained and contain a high percentage of shale in the surface layer and subsoil. They are on uplands.

PASTURE AND HAY GROUP 14A

In this group are shallow or very shallow soils that are loamy throughout. These soils are well drained or somewhat excessively drained. They are on uplands.

Use of the Soils for Range [4]

This section contains information about the use and management of soils for range. Range is land on which the natural plant community is composed principally of grasses, grasslike plants, forbs, and shrubs that are valuable for grazing and sufficient in quantity to justify grazing use. About 10 percent of the soils in Haskell County are in native range, on which domestic animals are raised.

A few large ranches are in the county, but most of the cattle are raised on small livestock farms. Supplemental feeding of cattle with protein cubes and hay is necessary when grazing is done during the dormant season of the grasses.

Range sites and condition classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage, if the range is in similar condition, make up a range site.

Range sites are kinds of rangeland that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does not change so long as the environment remains unchanged. Throughout the prairie and the plains, the climax vegetation consists of the plants that were growing there when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They are generally the tallest and most productive perennial grasses and forbs and the most palatable to livestock (fig. 12).

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Hence, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many invaders are annual weeds, some are shrubs that have some grazing value, and others have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand (fig. 13). It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is less than 25.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

A primary objective of good range management is to keep the range in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. The main management need is to recognize important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall can lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some range that has been closely grazed for short periods, under the supervision of a careful manager, may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites

In the following pages the range sites of Haskell County are described, and the climax plants and principal invaders on the sites are named. An estimate is also given of the potential annual yield of air-dry herbage for each site if it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey. Some of the soils in Haskell County were not assigned to a range site, because their climax vegetation is woodland.

ERODED SANDY SAVANNAH RANGE SITE

This range site consists of deep and moderately deep, very gently sloping to sloping soils of the uplands. These soils have a loamy or sandy surface layer and a loamy subsoil. They are severely eroded.

[4] By NEAL STIDHAM, range conservationist, Soil Conservation Service.

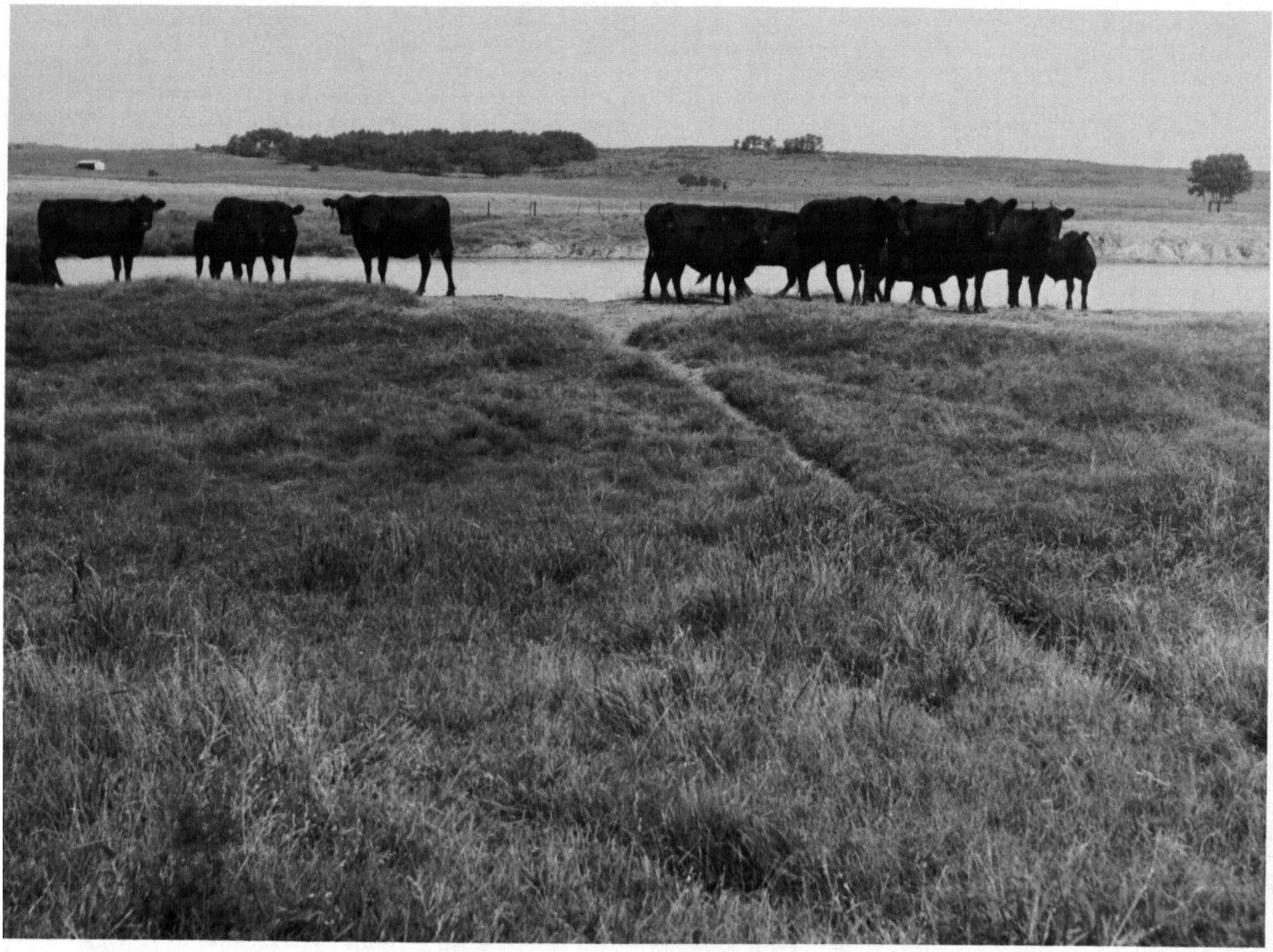

Figure 12.—**An area of Vian silt loam, 1 to 3 percent slopes. The native grass range is in excellent condition. Most of the grasses are decreasers. They are maintained through use of moderate grazing.**

Little bluestem makes up approximately 35 percent by weight of the plant community; indiangrass, 15 percent; big bluestem, purpletop, and post oak, 10 percent each; switchgrass and blackjack oak, 5 percent each; persimmon and sassafras, 4 percent; Scribner panicum, 3 percent; red lovegrass, 2 percent; and hickory, 1 percent.

This site produces approximately 2,500 pounds of air-dry herbage per acre in years having favorable growing conditions and 1,250 pounds per acre in years having poor growing conditions. Approximately 80 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, little bluestem, indiangrass, and big bluestem decrease in the plant community. Such plants as Scribner panicum, red lovegrass, purpletop, and persimmon increase. If overgrazing is prolonged, broomsedge, splitbeard bluestem, ragweed, bitterweed, and annual three-awn make up a substantial part of the plant community, and forage production is greatly reduced.

ERODED SHALLOW SAVANNAH RANGE SITE

Only the Hector soil from Linker-Hector complex, 2 to 8 percent slopes, severely eroded, is in this site. It is a shallow, very gently sloping to sloping soil on uplands. This soil is loamy throughout. It is severely eroded.

Little bluestem makes up about 35 percent by weight of the plant community; indiangrass, 15 percent; purpletop and post oak, 10 percent each; big bluestem, switchgrass, Scribner panicum, red lovegrass, and blackjack oak, 5 percent each; persimmon, 2 percent; and hickory, blackberry, and flameleaf sumac, 1 percent each.

This site produces approximately 2,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 1,000 pounds per acre in years having poor growing conditions. Approximately 85 percent of this production is from plants that furnish forage for cattle and sheep.

Under continued heavy grazing by cattle, little bluestem, indiangrass, and big bluestem decrease in

Figure 13.—**An area of Loamy Prairie range site in excellent condition. The soil in the foreground is Spiro silt loam, 3 to 5 percent slopes. Very well managed meadows in this range site produce 6,000 pounds of bluestem hay per acre annually.**

the plant community. Such plants as purpletop, Scribner panicum, red lovegrass, blackjack oak, and persimmon increase. If overgrazing is prolonged, broomsedge, splitbeard bluestem, sumac, persimmon, and blackjack oak make up a substantial part of the plant community, and forage production is greatly reduced.

HEAVY BOTTOMLAND RANGE SITE

Only Mhoon soils, clayey variant, are in this site. They are deep, nearly level and slightly concave soils on flood plains. These soils have a clayey surface layer and a clayey or loamy subsoil.

Cottonwood makes up about 20 percent by weight of the plant community; green ash, 15 percent; switchgrass, wildrye, and sycamore, 10 percent each; and prairie cordgrass, carex, braodleaf uniola, red oak, sedges, low panicums, and meadow dropseed, 5 percent each.

This site produces approximately 7,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 3,500 pounds per acre in years having poor growing conditions. Approximately 50 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, broadleaf uniola, wildrye, and switchgrass decrease in the plant community. Such plants as sedges and Scribner panicum increase. If overgrazing is prolonged, seacoast sumpweed, ragweed, peppervine, trumpetcreeper, and hawthorn make up a substantial part of the plant community, and forage production is greatly reduced.

LOAMY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level soils on flood plains or terraces. These soils are loamy throughout.

Big bluestem, eastern gamagrass, black walnut, pecan, American elm, and green ash each makes up about 10 percent by weight of the plant community; prairie cordgrass, switchgrass, broadleaf uniola, switchcane, wildrye, and red oak make up 5 percent

each; carex and rushes, 5 percent; and purpletop and dropseeds, 5 percent.

This site produces approximately 8,500 pounds of air-dry herbage per acre in years having favorable growing conditions and 4,250 pounds per acre in years having poor growing conditions. Approximately 50 percent of this production is from plants that furnish forage for cattle and sheep.

Under continued heavy grazing by cattle, big bluestem, eastern gamagrass, switchgrass, and prairie cordgrass decrease in the plant community. Such plants as sedges, rushes, purpletop, low panicum, and dropseeds increase. If overgrazing is prolonged, greenbrier, hawthorn, winged elm, ironweed, ragweed, post oak, and blackjack oak make up a substantial part of the plant community, and forage production is greatly reduced.

LOAMY PRAIRIE RANGE SITE

This range site consists of deep and moderately deep, very gently sloping to moderately steep soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Big bluestem makes up about 30 percent by weight of the plant community; indiangrass and little bluestem, 25 percent each; switchgrass, 10 percent; purpletop, 3 percent; tall dropseed, 2 percent; and Scribner panicum, prairie clover, tick clover, heath aster, and goldenrod, 1 percent each.

This site produces approximately 7,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 3,500 pounds per acre in years having poor growing conditions. Approximately 100 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, big bluestem, indiangrass, little bluestem, and switchgrass decrease in the plant community. Such plants as tall dropseed, Scribner panicum, and wildindigo increase. If overgrazing is prolonged, broomsedge, splitbeard bluestem, tridens, and three-awn make up a substantial part of the plant community, and forage production is greatly reduced.

LOAMY SAVANNAH RANGE SITE

This range site consists of deep, nearly level to moderately steep soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Big bluestem makes up about 25 percent by weight of the plant community; indiangrass, 15 percent; little bluestem and post oak, 10 percent each; switchgrass, low panicum, purpletop, blackjack oak, and red oak, 5 percent each; tick clover and wildindigo, 5 percent; heather aster and goldenrod, 5 percent; sassafras, 3 percent; and hickory, 2 percent.

This site produces approximately 5,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 2,500 pounds per acre in years having poor growing conditions. Approximately 80 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, big bluestem, indiangrass, switchgrass, and little bluestem decrease in the plant community. Such plants as low panicum, goldenrod, blackjack oak, red oak, and post oak increase. If overgrazing is prolonged, splitbeard bluestem, broomsedge bluestem, annual three-awn, and winged elm make up a substantial part of the plant community and forage production is greatly reduced.

SANDY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level or very gently sloping soils on flood plains. These soils have a sandy or loamy surface layer and a sandy subsoil.

Switchgrass and cottonwood each make up about 20 percent by weight of the plant community; big bluestem, indiangrass, and black willow, 10 percent each; little bluestem, beaked panicum, dropseed, and purpletop, 5 percent each; tick clover and bundleflower, 5 percent; sand plum, 3 percent; and wild grape, 2 percent.

This site produces approximately 3,800 pounds of air-dry herbage per acre in years having favorable growing conditions and 1,900 pounds per acre in years having poor growing conditions. Approximately 65 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, switchgrass, indiangrass, and big bluestem decrease in the plant community. Such plants as tall dropseed, willow, and cottonwood increase. If overgrazing is prolonged, dropseed, bushy bluestem, bermudagrass, and saltcedar make up a substantial part of the plant community, and forage production is greatly reduced.

SANDY SAVANNAH RANGE SITE

This range site consists of deep and moderately deep, very gently sloping to steep soils on uplands. These soils have a loamy or sandy surface layer and a loamy or clayey subsoil.

Little bluestem and post oak each make up about 20 percent by weight of the plant community; big bluestem, 15 percent; indiangrass and blackjack oak, 10 percent each; switchgrass, purpletop, beaked panicum, 5 percent each; goldenrod and sunflower, 5 percent; and red oak and hickory, 5 percent.

This site produces approximately 5,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 2,500 pounds per acre in years having poor growing conditions. Approximately 70 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, little bluestem, big bluestem, and indiangrass decrease in the plant community. Such plants as purpletop, Scribner panicum, and goldenrod increase. If overgrazing is prolonged, broomsedge bluestem, oldfield three-awn, and splitbeard bluestem make up a substantial part of the plant community, and forage production is greatly reduced.

SAVANNAH BREAKS RANGE SITE

Only Enders stony soils, 30 to 45 percent slopes, are in this site. These are deep, steep, stony soils on uplands. These soils have a loamy surface layer and a clayey subsoil.

Little bluestem makes up about 30 percent by weight of the plant community; post oak, 20 percent; big bluestem, indiangrass, and shortleaf pine, 10 percent each; purpletop and blackjack oak, 5 percent each; red oak and hickory, 5 percent; Scribner panicum, 3 percent; and tall dropseed, 2 percent.

This site produces approximately 3,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 1,500 pounds per acre in years having poor growing conditions. Approximately 65 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, little bluestem, big bluestem, and indiangrass decrease in the plant community. Such plants as purpletop, tall dropseed, and Scribner panicum increase. If overgrazing is prolonged, broomsedge and splitbeard bluestem make up a substantial part of the plant community, and forage production is greatly reduced.

SHALLOW PRAIRIE RANGE SITE

Only the Collinsville soil from Liberal and Collinsville stony soils, 5 to 20 percent slopes, is in this site. It is a shallow and very shallow, sloping to moderately steep soil on uplands. This soil is loamy throughout.

Little bluestem makes up about 25 percent by weight of the plant community; big bluestem and indiangrass, 15 percent each; and switchgrass, perennial sunflowers, catclaw sensitivebrier, Virginia tephrosia, meadow dropseed, purpletop, and hawthorn, 5 percent each; persimmon and winged elm, 5 percent; and sumacs and poison ivy, 5 percent.

This site produces approximately 4,500 pounds of air-dry herbage per acre in years having favorable growing conditions and 2,250 pounds per acre in years having poor growing conditions. Approximately 85 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, little bluestem, big bluestem, and indiangrass decrease in the plant community. Such plants as meadow dropseed, Scribner panicum, and persimmon increase. If overgrazing is prolonged, meadow dropseed, splitbeard bluestem, broomsedge bluestem, ragweed, bitter sneezeweed, and sticky goldenrod make up a substantial part of the plant community, and forage production is greatly reduced.

SHALLOW SAVANNAH RANGE SITE

This range site consists of shallow, very gently sloping to steep soils on uplands. These soils are loamy throughout.

Little bluestem and post oak make up about 15 percent by weight of the acreage; big bluestem, indiangrass, and shortleaf pine, 10 percent each; switchgrass, purpletop, tall dropseed, Scribner panicum, lespedeza, blackjack oak, 5 percent each; sunflower and heath aster, 5 percent; and hickory and red oak, 5 percent.

This site produces approximately 4,750 pounds of air-dry herbage per acre in years having favorable growing conditions and 2,375 pounds per acre in years having poor growing conditions. Approximately 70 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, little bluestem, big bluestem, and indiangrass decrease in the plant community. Such plants as purpletop, Scribner panicum, blackjack oak, and post oak increase. If overgrazing is prolonged, winged elm, persimmon, and broomsedge bluestem make up a substantial part of the plant community, and forage production is greatly reduced.

SLICKSPOT RANGE SITE

Only the Wing soil from Counts-Wings complex, 1 to 3 percent slopes, is in this site. It is a deep, very gently sloping soil on uplands. This soil has a loamy surface layer and a clayey or loamy subsoil that is high in content of sodium.

Switchgrass makes up about 15 percent by weight of the plant community; Canada wildrye, Scribner panicum, Texas dropseed, longspike tridens, meadow dropseed, and prairie scurfpea, 10 percent each; sedges, pointed dropseed, dotted gayfeather, and yellow neptunia, 5 percent each; and hawthorn and coralberry, 5 percent.

This site produces approximately 2,000 pounds of air-dry herbage per acre in years having favorable growing conditions and 1,000 pounds per acre in years having poor growing conditions. Approximately 95 percent of this production is from plants that furnish forage for cattle or sheep.

Under continued heavy grazing by cattle, switchgrass, wildrye, and dotted gayfeather decrease in the plant community. Such plants as longspike, tridens, meadow dropseed, and western ragweed increase. If overgrazing is prolonged, annual three-awn, tumblegrass, lanceleaf ragweed, and narrowleaf sumpweed make up a substantial part of the plant community, and forage production is greatly reduced.

Woodland [5]

This section explains how soils affect the growth and management of trees in Haskell County. The information given is helpful to woodland owners and operators in farming and in carrying out plans for establishing and maintaining tree resources.

Although Haskell County originally was mainly wooded, trees now cover about 35 percent of the acreage. Good stands of commercial trees are produced in the woodlands of the county. Needleleaf forest types occur most frequently on the hills, and broadleaf types generally predominate on the bottoms along rivers and creeks.

The value of the wood products is substantial, although it is below its potential. Other values of woodland are grazing, wildlife habitat, recreation, natural beauty, and conservation of soil and water.

[5] By LESTER E. STILLSON, forester, and NEAL STIDHAM, range conservationist, Soil Conservation Service.

In table 3, the soils of Haskell County are rated on the basis of their performance when used to produce wood crops. The ratings are a means of expressing information useful in managing wood crops according to kinds of soils. The column headings used in table 3 are explained in the paragraphs that follow.

The woodland group in which individual mapping units are placed consists of soils that have comparable potential productivity and comparable limitations, that produce similar wood crops, and that require similar management practices or treatment.

Each woodland group is identified by a three-part symbol. The first part of the symbol indicates the relative productivity of the soils in the group for wood crops, and is based on the site index of one or more important forest types or species. The numeral *1* means a rating of very high, *2* means high, *3* means moderately high, *4* means moderate, and *5* means low. In Haskell County the numeral *1* was not used.

The second element in the symbol indicates the soil property that imposes a moderate or severe hazard or limitation in managing the soils for woodland. The letter *x* shows that the main limitation is stoniness or rockiness; *w* shows that excessive water in or on the soil is the main limitation; *t* shows that toxic substances are in the soil; *d* shows that the rooting depth is restricted; *c* shows that clay in the upper part of the soil is a limitation; *s* shows that the soil is sandy; *f* shows that the soil has large amounts of rock fragments; *r* shows that the soil has steep slopes; and *o* shows that the soil has no significant restrictions or limitations for woodland use or management. In Haskell County the letters *t* and *f* were not used.

The third element in the symbol indicates the degree of management limitations and the general suitability of the soils for certain kinds of trees. The numeral *1* indicates the soils have no significant management limitations and are better suited to needleleaf trees than to others; *2* indicates the soils have one or more moderate limitations and are better suited to needleleaf trees; *3* indicates one or more severe limitations and better suitability for needleleaf trees; *4* indicates the soils have no significant limitations and are better suited to broadleaf trees; *5* indicates one or more moderate limitations and better suitability for broadleaf trees; *6* indicates one or more severe limitations and better suitability for broadleaf trees; *7* indicates the soils have no significant limitations and are well suited to either needleleaf or broadleaf trees; *8* indicates the soils have one or more moderate limitations and are well suited to needleleaf or broadleaf trees; *9* indicates one or more severe limitations and better suitability for needleleaf or broadleaf trees; and *0* indicates the soils are not suitable for the production of major commercial wood products. In Haskell County the numerals *5* and *8* were not used.

A fourth element, *e*, has been added to the three-part symbol in Haskell County to indicate soils that are severely eroded.

The erosion hazard column rates the soil by risk of soil loss in well-managed woodland. The erosion hazard is *slight* if expected soil loss is small, *moderate* if some measures are needed to control erosion in logging and construction, and *severe* if intensive measures or special equipment and methods are needed to prevent excessive soil loss.

Equipment limitations are ratings that reflect the soil conditions that restrict the use of equipment normally used in woodland management or harvesting. A rating of *slight* indicates equipment use is not limited as to kind of equipment or time of year. A rating of *moderate* indicates a seasonal limitation or need for modification in methods or equipment. *Severe* indicates specialized equipment or operations are required on the soil.

Seedling mortality ratings indicate the degree of expected mortality of planted seedlings where plant competition is not a limiting factor. Normal rainfall, good planting stock, and proper planting techniques are assumed. A rating of *slight* indicates an expected mortality of less than 25 percent; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent.

Selected species refers to the principal commercial tree species that should be favored in existing stands and for intermediate or improvement cuttings, and indicates the tree species suitable for planting. The selection of preferred species is influenced by their growth rates and by the quality, value, and general marketability of the products obtained from each species.

The site index is a numerical means of expressing the quality of a forest site that is based on the height of the dominant stand at a certain age; for example, the average height in feet attained by dominant and codominant trees in a fully stocked stand at age 30 years for cottonwood, 35 years for sycamore, 25 years for planted pines, and 50 years for others.

The important understory vegetation (medium canopy) lists the potential productivity of understory grasses, forbs, or low shrubs for a medium tree canopy class, or 36 to 55 percent canopy. Productivity is expressed in pounds of air-dry forage per acre. Where yield data are not available and estimates cannot be made, the species are listed in order of productivity.

Use of the Soils as Wildlife Habitat [6]

Soils directly influence the kinds and amount of vegetation and the amount of water available, and in this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to crops, texture of the surface layer, available water capacity to a depth of 40 inches, wetness, surface stoniness or rockiness, flood hazard, slope, and permeability of the soil to air and water.

In table 4 the soils of Haskell County are rated as to their ability to produce eight elements of wildlife habitat and also for three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements. A rating of *good* means wildlife habitat generally is easily created, improved, and maintained. Few or no limitations affect management in this category, and satisfactory results are expected when the soil is used for the prescribed purpose.

[6] By GEORGE L. POLLARD, biologist, Soil Conservation Service.

A rating of *fair* means wildlife habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention may be required for satisfactory results.

A rating of *poor* means limitations for the designated use are rather severe. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort.

A rating of *very poor* means limitations are very severe and that unsatisfactory results are to be expected. Wildlife habitat is either impossible or impractical to create, improve, or maintain on soils in this category.

Each soil in table 4 is rated according to its suitability for producing various kinds of plants and other elements that make up wildlife habitat. The ratings mainly take into account the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as wildlife habitat requires onsite inspection.

The column heading *Grain and seed crops* refers to annual grain-producing plants, such as wheat, sorghum, and soybeans.

Grasses and legumes are domestic grasses and legumes that are established by planting. They provide food and cover for wildlife. Grasses include bahiagrass, ryegrass, and panicgrass; legumes include annual lespedeza, shrub lespedeza, and other clovers.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for wildlife. Beggarweed, perennial lespedeza, wild bean, pokeweed, and cheatgrass are typical examples. On rangeland, typical plants are bluestem, grama, perennial forbs, and legumes.

Hardwood trees, shrubs, and vines are nonconiferous trees, shrubs, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants commonly grow in their natural environment, but they may be planted and developed through wildlife management programs. Typical species in this category are oak, beech, cherry, dogwood, maple, viburnum, grape, honeysuckle, greenbrier, and silverberry.

Coniferous woody plants are cone-bearing trees and shrubs that provide cover and in many places furnish food in the form of browse, seeds, or fruitlike cones. They commonly grow in their natural environment, but they can be planted and managed. Typical plants in this category are pines, cedars, and ornamental trees and shrubs.

Wetland food and cover plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical plants in this group are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema. Submerged and floating aquatics are not included in this category.

Shallow-water developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitat that is suitable for waterfowl. Some are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submersed aquatics.

Ponds are dugout ponds or a combination of dugout ponds and low dikes or dams. They hold enough water of suitable quality and depth primarily to support fish production.

Table 4 also rates the soils according to their suitability as habitat for the three kinds of wildlife in the county—openland, woodland, and wetland. These ratings are related to those made for the elements of habitat. For example, soils rated very poor for shallow-water developments are rated very poor for wetland wildlife.

Openland wildlife are birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, doves, meadowlarks, field sparrows, cottontail rabbits, and foxes are typical examples of openland wildlife.

Woodland wildlife are birds and mammals that normally live in wooded areas of hardwood trees, coniferous trees, and shrubs. Woodcocks, thrushes, wild turkeys, vireos, deer, squirrels, and raccoons are typical examples of woodland wildlife.

Wetland wildlife are birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, minks, and muskrats are typical examples of wetland wildlife.

Engineering Uses of the Soils [7]

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

Among the properties of soils that are highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect the construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

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

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of

[7] By GEORGE ENSMINGER, engineer, Soil Conservation Service.

TABLE 3.—*Woodland groups and*

[Absence of an entry in a column means that commercial production of

Soil series and map symbols	Woodland group	Management concerns		
		Erosion hazard	Equipment limitations	Seedling mortality
Caspiana: Cp	2o4	Slight	Slight	Slight
Collinsville Mapped only with Liberal soils.	5o0			
Counts: CuA, CuB, CvE	4o1	Slight	Slight	Slight
CwB For Wing part, see Wing series.	5o0			
Crevasse: Cz	3s6	Slight	Moderate	Severe
Dela: Da	2o7	Slight	Slight	Slight
Enders: EhD, EhE	4x2	Moderate to severe	Moderate to severe	Slight to moderate

See footnotes at end of table.

factors in woodland management

trees is not practical on the soil or that the information is not available]

Potential productivity		Preferred species for planting	Understory vegetation (medium canopy)	
Selected species	Site index		Species	Yield
Cottonwood	100	Cottonwood [1], black walnut, sycamore	Switchgrass	200
Sycamore			Little bluestem	300
Pecan			Big bluestem	200
Black walnut			Virginia wildrye	800
Green ash	70		Uniolas	500
			Beaked panicum	300
			Sedges and rushes	300
			Other grasses	600
			Forbs	400
			Shrubs [2]	1,350
			Total	4,950
Shortleaf pine	60	Shortleaf pine, loblolly pine, redcedar	Big bluestem [3]	500
Redcedar	40		Little bluestem	400
Southern red oak			Low panicums	100
			Indiangrass	100
			Switchgrass	100
			Other grasses	150
			Sedges and rushes	150
			Forbs	250
			Legumes	250
			Woody species	500
			Total	2,500
Cottonwood	88	Sycamore, cottonwood	Switchgrass	200
Sycamore			Switchcane	1,000
			Wildrye	200
			Uniolas	200
			Beaked panicum [2]	300
			Low panicum	200
			Other grasses	600
			Forbs	200
			Shrubs and vines	1,200
			Total	4,100
Cottonwood	100	Cottonwood [1], shortleaf pine, loblolly pine, black walnut.	Little bluestem	600
Shortleaf pine	76		Big bluestem	200
Red oak	80		Indiangrass	200
			Shrubs	850
			Low panicums	300
			Sedges and rushes	250
			Other grasses and forbs	1,050
			Total	3,450
Shortleaf pine	56	Shortleaf pine, redcedar	Little bluestem [3]	450
Redcedar	40		Big bluestem	300
			Indiangrass	150
			Switchgrass	100
			Low panicums	200
			Other grasses	100
			Forbs	150
			Woody species	750
			Total	2,200

TABLE 3.—*Woodland groups and*

Soil series and map symbols	Woodland group	Management concerns		
		Erosion hazard	Equipment limitations	Seedling mortality
Enders: Continued.				
EkF	5r3	Severe	Severe	Moderate
Guyton: Gu	2w9	Slight	Severe	Moderate
Hector: HcD, HlC	5d2	Slight	Slight	Severe
Kanima: KaE	5o0			
Kiomatia: Ko	3s6	Slight	Moderate	Moderate
Liberal: LbC, LcC, LdE For Spiro part of LcC, see Spiro series; for Collinsville part of LdE, see Collinsville series.	5o0			
Linker:				
LkB, LkC, LkC2	4o1	Slight	Slight	Slight

See footnotes at end of table.

factors in woodland management—Continued

Potential productivity		Preferred Species for planting	Understory vegetation (medium canopy)	
Selected species	Site index		Species	Yield
Shortleaf pine	45	Planting not recommended for commercial timber production.	Little bluestem [3]	600
Redcedar	30		Big bluestem	200
			Indiangrass	200
			Purpletop	100
			Scribner panicum	200
			Other grasses	100
			Forbs	100
			Woody species	500
			Total	2,000
Water oak		Nuttall oak, green ash	Big bluestem	100
Willow oak			Little bluestem [2]	300
			Beaked panicum	300
			Uniolas	200
			Low panicums	300
			Other grasses	500
			Sedges and rushes	100
			Forbs	100
			Shrubs	800
			Total	2,700
Shortleaf pine	45	Planting not recommended for commercial timber production.	Little bluestem [3]	250
Redcedar	30		Big bluestem	150
			Indiangrass	150
			Low panicums	150
			Legumes	100
			Other grasses	250
			Forbs	150
			Woody species	600
			Total	1,800
Cottonwood		Cottonwood [1], sycamore [1], cherrybark oak.	Switchgrass	200
Black walnut			Switchcane	1,000
			Wildrye	200
			Uniolas	200
			Beaked panicum	300
			Low panicums	200
			Other grasses	600
			Forbs	200
			Shrubs and vines [2]	1,200
			Total	4,100
Shortleaf pine	60	Shortleaf pine, loblolly pine, redcedar	Big bluestem	500
Redcedar	40		Little bluestem [3]	400
Red oak	60		Low panicums	100
			Indiangrass	100
			Switchgrass	100
			Other grasses	150
			Sedges and rushes	150
			Legumes	250
			Forbs	250
			Woody species	500
			Total	2,500

TABLE 3.—*Woodland groups and*

Soil series and map symbols	Woodland group	Management concerns		
		Erosion hazard	Equipment limitations	Seedling mortality
Linker: Continued.				
LnD3 For Hector part, see Hector series.	5c3e	Severe	Severe	Severe
Mhoon variant: Mv	3w6	Slight	Severe	Moderate
Naldo: NaB, NaC, NaC2	2o7	Slight	Slight	Slight
Norwood: No	2o4	Slight	Slight	Slight
Oklared: Ok	2o4	Slight	Slight	Slight
Porum: PoC, PoC2	4c2	Slight	Moderate	Moderate

See footnotes at end of table.

factors in woodland management—Continued

Potential productivity		Preferred Species for planting	Understory vegetation (medium canopy)	
Selected species	Site index		Species	Yield
Shortleaf pine	45	Planting not recommended for commercial timber production.	Little bluestem [3]	400
			Big bluestem	100
			Indiangrass	100
			Low panicums	200
			Other grasses	300
			Sedges and rushes	100
			Legumes	150
			Forbs	150
			Woody species	600
			Total	2,100
Cottonwood		Cottonwood [1], sycamore [1]	Switchgrass	200
Sycamore			Indiangrass	200
			Switchcane	800
			Eastern gamagrass [2]	200
			Wildrye	200
			Panicums	200
			Other grasses	400
			Sedges and rushes	200
			Forbs	300
			Shrubs	600
			Total	3,300
Shortleaf pine		Shortleaf pine, loblolly pine, black walnut, cherrybark oak.	Little bluestem	600
Red oak			Big bluestem	200
			Indiangrass	200
			Other grasses and forbs	1,050
			Low panicums	300
			Sedges and rushes	250
			Shrubs [2]	850
			Total	3,450
Cottonwood		Cottonwood [1], sycamore [1], pecan, black walnut, cherrybark oak.	Switchgrass [2]	200
Pecan			Little bluestem	300
			Big bluestem	200
			Virginia wildrye	800
			Uniolas	500
			Beaked panicum	300
			Sedges and rushes	300
			Other grasses	600
			Forbs	400
			Shrubs [2]	1,350
			Total	4,950
Cottonwood		Cottonwood [1], pecan, black walnut	Switchgrass [2]	200
Pecan			Little bluestem	300
			Big bluestem	200
			Virginia wildrye	800
			Uniolas	500
			Beaked panicum	300
			Sedges and rushes	300
			Other grasses	600
			Forbs	400
			Shrubs [2]	1,350
			Total	4,950
Shortleaf pine	56	Shortleaf pine, loblolly pine	Big bluestem [3]	500
Red oak	60		Little bluestem	400
			Low panicums	100
			Indiangrass	100
			Switchgrass	100
			Other grasses	150
			Sedges and rushes	150
			Legumes	250
			Forbs	250
			Woody species	500
			Total	2,500

TABLE 3.—*Woodland groups and*

Soil series and map symbols	Woodland group	Management concerns		
		Erosion hazard	Equipment limitations	Seedling mortality
Rexor: Re, Rf	2o7	Slight	Slight	Slight
Sallisaw: SfB	3o7	Slight	Slight	Slight
Spiro: SnB, SnC, SnC2	5o0			
Stigler: SrA, SrB	4o1	Slight	Slight	Slight
Tamaha: TmB, TmC, TmC2	4o1	Slight	Slight	Slight
TnC3	5c3e	Severe	Severe	Severe
Vian: VaB	4o1	Slight	Slight	Slight

See footnotes at end of table.

factors in woodland management—Continued

Potential productivity		Preferred Species for planting	Understory vegetation (medium canopy)	
Selected species	Site index		Species	Yield
Shortleaf pine	76	Shortleaf pine, loblolly pine, black walnut, cherrybark oak.	Little bluestem	600
Red oak	80		Big bluestem	200
			Indiangrass	200
			Other grasses and forbs	1,050
			Low panicums	300
			Sedges and rushes	250
			Shrubs [2]	850
			Total	3,450
Shortleaf pine	66	Shortleaf pine, loblolly pine, black walnut, cherrybark oak.	Little bluestem	300
Red oak			Big bluestem	200
			Other grasses	250
			Uniolas	200
			Low panicums	300
			Sedges and rushes	150
			Forbs	300
			Shrubs	700
			Total	2,400
Shortleaf pine	56	Shortleaf pine, loblolly pine	Big bluestem	500
Red oak	60		Little bluestem [3]	400
			Low panicums	100
			Indiangrass	100
			Switchgrass	100
			Other grasses	150
			Sedges and rushes	150
			Legumes	250
			Forbs	250
			Woody species	500
			Total	2,500
Shortleaf pine	56	Shortleaf pine, loblolly pine	Big bluestem [3]	500
			Little bluestem	400
			Low panicums	100
			Indiangrass	100
			Switchgrass	100
			Other grasses	150
			Sedges and rushes	150
			Legumes	250
			Forbs	250
			Woody species	500
			Total	2,500
Shortleaf pine	45	Planting not recommended for commercial timber production.	Big bluestem	100
			Little bluestem [3]	400
			Low panicums	200
			Indiangrass	100
			Other grasses	300
			Sedges and rushes	100
			Legumes	150
			Forbs	150
			Woody species	600
			Total	2,100
Red oak		Shortleaf pine, loblolly pine	Big bluestem [3]	500
			Little bluestem	400
			Low panicums	100
			Switchgrass	100
			Indiangrass	100
			Other grasses	150
			Sedges and rushes	150
			Legumes	250
			Forbs	250
			Woody species	500
			Total	2,500

TABLE 3.—*Woodland groups and*

Soil series and map symbols	Woodland group	Management concerns		
		Erosion hazard	Equipment limitations	Seedling mortality
Whakana:				
WhD	2o7	Slight	Slight	Slight
WkD3	5c3e	Severe	Severe	Severe
Wing	5o0			
Mapped only with Counts soils.				

[1] Field planting only.
[2] No grazing on young stand.

TABLE 4.—*Suitability of soils for elements of*

Soil series and map symbols	Suitability for elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees, shrubs, and vines
Caspiana: Cp	Good	Good	Good	Good
Collinsville	Poor	Poor	Fair	Fair
Mapped only with Liberal soils.				
Counts:				
CuA	Fair	Good	Good	Good
CuB	Fair	Good	Good	Good
CvE	Fair	Good	Good	Good
For Dela part of CvE, see Dela series.				
CwB	Fair	Good	Good	Good
For Wing part of CwB, see Wing series.				
Crevasse: Cz	Poor	Poor	Fair	Poor
Dela:				
Dela part of CvE	Poor	Fair	Fair	Good
Da	Fair	Good	Good	Good
Enders:				
EhD	Fair	Good	Good	Good
For Hector part, see Hector series.				
EhE	Poor	Fair	Good	Good
For Hector part, see Hector series.				
EkF	Very poor	Poor	Good	Good
Guyton: Gu	Poor	Fair	Fair	Fair

factors in woodland management—Continued

Potential productivity		Preferred species for planting	Understory vegetation (medium canopy)	
Selected species	Site index		Species	Yield
Red oak		Shortleaf pine, loblolly pine, cherrybark oak, black walnut.	Little bluestem	600
Shortleaf pine			Big bluestem	200
			Indiangrass	200
			Other grasses and forbs	1,050
			Low panicums	300
			Sedges and rushes	250
			Shrubs [2]	850
			Total	3,450
Shortleaf pine		Planting not recommended for commercial tree production.	Little bluestem [3]	400
			Big bluestem	100
			Indiangrass	100
			Low panicums	200
			Other grasses	300
			Sedges and rushes	100
			Legumes	150
			Forbs	150
			Woody species	600
			Total	2,100

[3] Estimated yields.

wildlife habitat and kinds of wildlife

Suitability for elements of wildlife habitat—Continued				Suitability for kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow-water developments	Ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Good	Poor	Very poor	Fair	Good	Good	Poor.
Fair	Very poor	Very poor	Very poor	Poor	Fair	Very poor.
Good	Fair	Fair	Good	Good	Good	Fair.
Good	Fair	Poor	Good	Good	Good	Poor.
Good	Very poor	Very poor	Good	Good	Good	Very poor.
Good	Fair	Poor	Good	Good	Good	Poor.
Poor	Very poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Poor	Poor	Fair	Good	Poor.
Good	Poor	Poor	Poor	Good	Good	Poor.
Good	Very poor	Very poor	Good	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Fair	Good	Very poor.
Good	Very poor	Very poor	Good	Poor	Fair	Very poor.
Fair	Good	Fair	Fair [1]	Fair	Fair	Fair.

See footnote at end of table.

TABLE 4.—*Suitability of soils for elements of*

Soil series and map symbols	Suitability for elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees, shrubs, and vines
Hector: HcD, HlC For Linker part of HlC, see Linker series.	Poor	Poor	Fair	Fair
Kanima: KaE	Poor	Fair	Fair	Poor
Kiomatia: Ko	Poor	Poor	Poor	Good
Liberal: LbC, LcC For Spiro part of LcC, see Spiro series. LdE For Collinsville part, see Collinsville series.	Good Poor	Good Fair	Good Good	Fair Fair
Linker: LkB, LkC, LkC2 LnD3 For Hector part, see Hector series.	Good Fair	Good Good	Good Good	Good Fair
Mhoon variant: Mv	Poor	Fair	Fair	Fair
Naldo: NaB, NaC, NaC2	Good	Good	Good	Good
Norwood: No	Good	Good	Good	Good
Oklared: Ok	Good	Good	Good	Good
Porum: PoC, PoC2	Good	Good	Good	Good
Rexor: Re Rf	Good Poor	Good Fair	Good Fair	Good Good
Sallisaw: SfB	Good	Good	Good	Good
Spiro: SnB, SnC, SnC2	Fair	Good	Good	Good
Stigler: SrA SrB	Fair Fair	Good Good	Good Good	Good Good
Tamaha: TmB TmC, TmC2 TnC3	Good Good Fair	Good Good Good	Good Good Good	Good Good Good
Vian: VaB	Good	Good	Good	Good
Whakana: WhD, WkD3	Fair	Fair	Good	Good
Wing Mapped only with Counts soils.	Poor	Fair	Very poor	Poor

[1] Excavated ponds.

predicting performance of structures on the same or similar kinds of soil in other locations.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, several estimated soil properties significant to engineering, interpretations for various engineering uses, and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this soil survey, can be used to make interpretations in addition to those given in tables 5, 6, and 7. It also can be used to make other useful maps.

wildlife habitat and kinds of wildlife—Continued

Suitability for elements of wildlife habitat—Continued				Suitability for kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow-water developments	Ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Fair	Very poor	Very poor	Very poor	Poor	Fair	Very poor.
Poor	Very poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Very poor	Poor	Fair	Very poor.
Fair	Poor	Very poor	Fair	Good	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Fair	Very poor.
Good	Poor	Very poor	Fair	Good	Good	Very poor.
Fair	Poor	Very poor	Fair	Good	Good	Very poor.
Fair	Poor	Good	Fair [1]	Fair	Fair	Fair.
Good	Poor	Very poor	Fair	Good	Good	Very poor.
Good	Poor	Very poor	Fair [1]	Good	Good	Very poor.
Good	Poor	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Good	Poor.
Good	Poor	Very poor	Fair [1]	Good	Good	Very poor.
Good	Poor	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Good	Very poor.
Good	Fair	Good	Good	Good	Good	Fair.
Good	Fair	Poor	Good	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Good	Very poor.
Good	Poor	Poor	Fair	Good	Good	Poor.
Good	Poor	Very poor	Fair	Fair	Good	Very poor.
Poor	Poor	Poor	Poor	Poor	Poor	Poor.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this survey have special meaning to soil scientists not known to all engineers. The Glossary defines many of these terms as they are commonly used in soil science.

TABLE 5.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means more than; the symbol

Soil series and map symbols	Depth to—		Corrosivity		Depth from surface	Classification		
	Bedrock	Seasonal high water table	Uncoated steel	Concrete		USDA texture	Unified	AASHO
	Inches	*Inches*			*Inches*			
Caspiana: Cp	>60	>72	Moderate	Low	0–16	Silt loam	CL or ML	A–4
					16–42	Silty clay loam, loam, and silt loam.	CL or CL–ML	A–6 or A–4
					42–65	Very fine sandy loam, silt loam, and loam.	CL or ML	A–4
Collinsville Mapped only with Liberal soils.	4–20	>72	Low	Moderate	0–16	Loam, fine sandy loam.	CL, SC, SM, or ML	A–4
					16	Sandstone.		
*Counts: CuA, CuB, CvE, CwB. For Dela part of CvE, see Dela series; for Wing part of CwB, see Wing series.	>60	12–24	High	Low	0–12	Silt loam	CL, CL–ML	A–4
					12–68	Silty clay, silty clay loam, clay loam, and clay.	CL, CH, or MH	A–7
					68	Shale.		
Crevasse: Cz	>60	48–72	Low	Low	0–7	Loamy fine sand, sand, and fine sandy loam.	SM or ML	A–2 or A–4
					7–65	Sand, fine sand, and loamy sand.	SM or SP–SM	A–2
Dela: Da	>60	36–48	Moderate	Moderate	0–64	Fine sandy loam	SM, ML, SM–SC, or CL–ML	A–4
*Enders: EhD, EhE, EkF For Hector part of EhD and EhE, see Hector series.	40–60	>60	High	Moderate to high.	0–8	Loam, fine sandy loam, silt loam.	ML or CL	A–4 or A–6
					8–42	Clay, silty clay	CL, CH, or MH	A–7
					42–46	Shale.		
Guyton: Gu	>60	0–12	High	High	0–28	Silt loam	ML or CL	A–4
					28–80	Silt loam, silty clay loam.	CL or CL–ML	A–6 or A–4
*Hector: HcD, HlC Lor Linker part of HlC, see Linker series.	10–20	>72	Low	Moderate to high.	0–14	Loam, fine sandy loam.	ML, SM, CL, or SC	A–4
					14	Sandstone.		
Kanima: KaE	>60	>72	Low to moderate.	Low to moderate.	0–6	Shaly silt loam, shaly silty clay, loam, very shaly silt loam, very shaly silty clay loam.	GM, ML, CL, GC, SM, SC, GP–GM, SP–SM, or GM–GW	A–1, A–2, A–4, or A–6
					6–72	Shaly silt loam, shaly silty clay loam, very shaly silt loam, very shaly silty clay loam.	GM, ML, CL, GC, SM, SC, SW, SP, GW, GP, SP–SM, GP–GM, or GM–GW	A–1, A–6, A–2, or A–4

See footnotes at end of table.

significant to engineering

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear
< means less than. Absence of entry indicates estimate not made.]

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Placticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
Percent							*Inches per hour*	*Inches per inch of soil*	*pH*	
0	100	100	100	80–97	<31	[2] NP–10	0.6–2.0	0.16–0.24	6.1–7.3	Low.
0	100	100	100	80–98	25–40	6–20	0.6–2.0	0.15–0.24	6.1–7.3	Moderate.
0	100	100	95–100	55–85	<30	NP–10	0.6–2.0	0.13–0.24	6.1–7.3	Low.
0–20	70–100	65–100	60–95	36–75	<30	NP–10	2.0–6.0	0.11–0.20	5.1–6.5	Low.
0	100	100	96–100	80–97	20–30	4–10	0.6–2.0	0.16–0.24	5.1–6.0	Low.
0	100	100	100	90–95	41–65	15–35	<0.06	0.12–0.22	5.1–8.4	High.
0	100	98–100	90–100	15–65	<26	NP	6.0–20.0	0.04–0.15	6.6–8.4	Low.
0	100	98–100	82–100	10–35	--------	NP	6.0–20.0	0.04–0.10	6.6–8.4	Low.
0	100	98–100	94–100	36–60	<26	NP–6	2.0–6.0	0.11–0.15	5.1–6.0	Low.
0–10	80–100	75–100	65–100	55–85	<36	NP–15	0.60–2.0	0.11–0.24	4.5–5.5	Low.
0	98–100	95–100	90–100	85–95	41–60	18–35	<0.06	0.12–0.18	4.5–5.5	High.
0	100	100	95–100	65–80	<30	NP–10	0.20–0.60	0.16–0.24	4.5–6.0	Low.
0	100	100	95–100	80	25–40	6–20	<0.06	0.16–0.24	4.5–7.3	Low to moderate.
0–15	80–100	80–100	75–100	36–80	<30	NP–10	6.0–20.0	0.11–0.20	4.5–6.5	Low.
0–7	10–80	7–78	7–78	7–70	15–35	1–14	0.6–2.0	0.06–0.15	5.6–8.4	Low.
7–40	10–60	3–60	3–60	3–60	15–35	1–14	0.6–2.0	0.03–0.10	5.6–8.4	Low.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Corrosivity		Depth from surface	Classification		
	Bedrock	Seasonal high water table	Uncoated steel	Concrete		USDA texture	Unified	AASHO
	Inches	*Inches*			*Inches*			
Kiomatia: Ko	>60	48–60	Low	Low	0–6	Fine sandy loam	SM or SM-SC	A-2 or A-4
					6–70	Loamy fine sand, fine sand that has strata of very fine sandy loam and silt loam, loamy sand.	SM, SP-SM, or SM-SC	A-2
*Liberal: LbC, LcC, LdE. For Spiro part of LcC, see Spiro series; for Collinsville part of LdE, see Collinsville series.	40–60	12–24	High	Moderate to high.	0–8	Clay loam, loam, silt loam.	CL or ML	A-6 or A-4
					8–40	Clay, silty clay loam.	CL or CH	A-6 or A-7-6
					40–60	Shale.		
*Linker: LkB, LkC, LkC2, LnD3. For Hector part of LnD3, see Hector series.	20–40	>60	Moderate	High	0–8	Fine sandy loam	SM-SC, SM, ML, or CL-ML	A-4
					8–12	Loam, fine sandy loam.	CL-ML, CL, SC, or SM-SC	A-4 or A-6
					12–36	Loam, clay loam, sandy clay loam.	CL or SC	A-6 or A-4
					36	Sandstone.		
Mhoon variant: Mv	>60	0–12	High	Low	0–72	Clay, silty clay, silty clay loam that has thin strata of coarse-textured material.	CL or CH	A-6 or A-7
Naldo: NaB, NaC, NaC2	>60	36–60	Moderate to high.	Moderate to high.	0–16	Fine sandy loam	SM or ML, CL-ML, or SM-SC	A-4
					16–72	Clay loam, sandy clay loam.	CL or SC	A-6 or A-4
Norwood: No	>60	>72	High	Low	0–16	Silty clay loam	CL	A-6 or A-7
					16–62	Silty clay loam, silt loam that has strata of coarser textured material.	CL	A-6 or A-7
Oklared: Ok	>60	>72	Low	Low	0–8	Fine sandy loam	SM or ML, SM-SC, or CL-ML	A-4 or A-2
					8–60	Very fine sandy loam, fine sandy loam, loam, loamy fine sand that has strata of coarser or finer textured material.	ML or SM, SM-SC, or CL-ML	A-4 or A-2

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
Percent							*Inches per hour*	*Inches per inch of soil*	*pH*	
0	100	100	80–100	30–45	18–26	1–4	6.0–20.0	0.11–0.15	7.4–8.4	Low.
0	100	98–100	80–90	10–35	<22	NP–6	6.0–20.0	0.05–0.11	7.4–8.4	Low.
0–10	90–95	85–95	80–95	65–90	22–40	1–22	0.6–2.0	0.15–0.24	4.5–6.0	Moderate.
0–10	85–95	85–95	85–95	85–95	33–60	13–35	0.06–0.20	0.12–0.22	4.5–8.4	Moderate to high.
0–3	95–100	90–100	70–100	40–60	<20	NP–7	2.0–6.0	0.11–0.15	4.5–6.0	Low.
0–3	95–100	90–100	75–90	40–60	20–30	5–15	2.0–6.0	0.11–0.22	4.5–5.5	Low.
0–3	95–100	90–100	80–100	40–70	25–40	8–20	2.0–6.0	0.11–0.20	4.5–5.5	Low.
0	100	100	94–100	75–95	25–55	11–30	<0.06	0.12–0.22	6.6–8.4	Moderate to high.
0	100	100	94–100	36–75	<26	NP–7	2.0–6.0	0.11–0.15	5.1–6.5	Low.
0	100	90–100	90–100	36–90	22–40	8–18	0.60–2.0	0.12–0.20	4.5–6.0	Low.
0	100	100	98–100	85–95	30–45	15–25	0.60–2.0	0.18–0.22	7.9–8.4	Moderate.
0	100	100	90–100	85–95	24–45	11–25	0.60–2.0	0.16–0.24	7.9–8.4	Low to moderate.
0	100	100	90–100	30–60	<26	NP–6	2.0–6.0	0.11–0.15	7.9–8.4	Low.
0	100	100	80–100	20–80	<26	NP–6	2.0–6.0	0.07–0.20	7.9–8.4	Low.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Corrosivity		Depth from surface	Classification		
	Bedrock	Seasonal high water table	Uncoated steel	Concrete		USDA texture	Unified	AASHO
	Inches	*Inches*			*Inches*			
Porum: PoC, PoC2	>60	24–36	High	Moderate to high.	0–10	Fine sandy loam	SM or ML, SM–SC, or CL–ML	A–4
					10–14	Loam, silt loam, clay loam.	ML or CL	A–4 or A–6
					14–52	Clay loam, silty clay loam, silty clay, clay.	CL or CH	A–6 or A–7
					52–65	Clay loam, silty clay loam.	CL	A–6 or A–7
Rexor: Re, Rf	>60	36–48	Moderate	Moderate	0–11	Silt loam, loam	CL or ML	A–4 or A–6
					11–60	Silty clay loam, clay loam, loam, silt loam.	CL or ML	A–4 or A–6
Sallisaw: SfB	>60	>72	Moderate	Moderate	0–9	Loam	ML or CL	A–4
					9–40	Clay loam, loam, sandy clay loam.	CL or SC	A–4 or A–6
					40–65	Gravelly or very gravelly counterparts of clay loam, loam, sandy clay loam.	GC	A–2
Spiro: SnB, SnC, SnC2	20–40	36–48	Moderate	Moderate to high.	0–10	Silt loam	CL or ML	A–4 or A–6
					10–36	Silty clay loam, clay loam.	CL	A–6 or A–7
					36	Siltstone.		
Stigler: SrA, SrB	>60	12–24	Moderate to high.	Moderate to high.	0–21	Silt loam, loam, very fine sandy loam.	CL or ML	A–4 or A–6
					21–78	Clay, silty clay, clay loam, silty clay loam.	CL or CH	A–7 or A–6
Tamaha: TmB, TmC, TmC2, TnC3.	>60	12–24	High	High	0–12	Silt loam, loam	CL or ML	A–4 or A–6
					12–17	Silty clay loam, clay loam, loam, silt loam.	CL	A–4, A–6, or A–7
					17–68	Clay, silty clay, silty clay loam, clay loam.	CL or CH	A–7
Vian: VaB	>60	24–48	High	Moderate to high.	0–18	Silt loam	CL or ML	A–4 or A–6
					18–72	Silty clay loam, silt loam.	CL or ML	A–4, A–6, or A–7

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
Percent							*Inches per hour*	*Inches per inch of soil*	*pH*	
0	100	98–100	94–100	40–85	<26	NP–6	2.0–6.0	0.11–0.15	5.1–6.0	Low.
0	100	100	96–100	65–97	21–40	8–20	0.60–2.0	0.15–0.24	4.5–5.5	Low to moderate.
0	100	100	96–100	75–99	33–65	13–35	<0.06	0.12–0.22	4.5–5.5	Moderate to high.
0	100	100	90–100	75–98	33–50	13–26	0.06–0.2	0.15–0.22	5.6–6.5	Moderate.
0	100	100	100	55–85	22–36	1–15	0.6–2.0	0.15–0.24	5.1–6.0	Low.
0	100	100	100	75–98	22–40	1–20	0.60–2.0	0.15–0.24	4.5–6.0	Low to moderate.
---	95–100	95–100	95–100	65–85	20–30	1–10	0.60–2.0	0.15–0.20	5.1–6.0	Low.
---	90–100	90–100	90–100	36–95	25–40	8–20	0.60–2.0	0.12–0.20	5.1–6.0	Low.
0–10	25–30	20–30	15–25	13–17	25–40	8–20	2.0–6.0	0.02–0.10	5.1–6.0	Low.
0	100	100	96–100	60–90	20–35	1–12	0.60–2.0	0.16–0.24	5.1–6.5	Low.
0	100	100	96–100	75–98	33–50	13–26	0.60–2.0	0.15–0.22	4.5–6.0	Moderate to low.
0	100	100	96–100	75–90	20–35	1–12	0.6–2.0	0.13–0.24	4.5–5.5	Low.
0	100	100	98–100	85–95	35–60	15–35	<0.06	0.12–0.22	4.5–7.8	Moderate to high.
0	100	100	96–100	75–90	20–35	1–12	0.06–2.0	0.15–0.24	4.5–6.5	Low.
0	100	100	97–100	85–95	30–50	8–20	0.20–0.60	0.15–0.24	4.5–5.5	Moderate to low.
0	100	100	94–100	90–98	40–65	20–35	<0.06	0.12–0.22	4.5–6.5	High.
0	100	100	96–100	80–90	21–35	1–15	0.60–2.0	0.16–0.24	4.5–6.0	Low.
0	100	100	97–100	85–95	25–45	8–26	0.20–0.60	0.16–0.24	4.5–5.5	Low to moderate.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Corrosivity		Depth from surface	Classification		
	Bedrock	Seasonal high water table	Uncoated steel	Concrete		USDA texture	Unified	AASHO
	Inches	*Inches*			*Inches*			
Whakana: WhD, WkD3	>60	>72	Moderate	Moderate	0–15	Fine sandy loam, loamy fine sand.	SM or ML, CL–ML, or SM–SC	A–2 or A–4
					15–54	Sandy clay loam, clay loam, loam.	SC or CL	A–4 or A–6
					54–76	Fine sandy loam, sandy clay loam.	SC, CL, SM, or ML	A–6 or A–4
Wing Mapped only with Counts soils.	>60	12–24	High	Low	0–8	Fine sandy loam, silt loam, loam.	CL, ML, SM, or SC.	A–4 or A–6
					8–70	Silty clay, silty clay loam, clay loam.	CL or CH	A–7

[1] Not to be confused with the coefficient "K" used by engineers.

TABLE 6.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitations for—		
	Road fill	Sand and gravel	Topsoil	Septic-tank absorption fields	Sewage lagoons	Shallow excavations
Caspiana: Cp	Fair: expansive; low strength.	Unsuited	Fair: thin layer of suitable material.	Moderate: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Collinsville Mapped only with Liberal soils.	Poor: rock at a depth of 4 to 20 inches.	Unsuited	Fair: rock at a depth of 4 to 20 inches; coarse fragments.	Severe: rock at a depth of 4 to 20 inches; stones.	Severe: rock at a depth of 4 to 20 inches; excessive permeability; slope.	Severe: rock at a depth of 4 to 20 inches; stones.
*Counts: CuA	Poor: expansive; low strength.	Unsuited	Fair: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Slight	Severe: wetness; too clayey.
CuB, CwB For Wing part of CwB, see Wing series.	Poor: expansive; low strength.	Unsuited	Fair: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Moderate: slope	Severe: wetness; too clayey.
CvE For Dela part, see Dela series.	Poor: expansive; low strength.	Unsuited	Fair: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Severe: slope	Severe: wetness; too clayey.

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
Percent							*Inches per hour*	*Inches per hour*	*pH*	
0	100	98–100	90–100	15–85	<30	NP–6	2.0–6.0	0.07–0.15	5.1–6.5	Low.
0	100	98–100	90–100	36–90	22–40	8–20	0.60–2.0	0.12–0.20	5.1–6.5	Low.
0	100	98–100	90–100	36–65	<35	NP–15	2.0–6.0	0.11–0.17	5.1–6.5	Low.
0	100	98–100	94–100	36–97	<35	NP–15	0.60–2.0	0.11–0.24	5.6–6.0	Low.
0	100	100	90–100	75–99	41–65	20–35	<0.06	0.06–0.10	7.9–8.4	Moderate to high.

[2] NP = nonplastic.

engineering properties of the soils

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitations for—Continued					Soil features affecting—		
Dwellings without basements	Sanitary landfill [1]	Local roads and streets	Pond reservoir areas	Pond embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Severe: subject to flooding.	Moderate: clayey; subject to flooding.	Moderate: subject to flooding; expansive; low strength.	Moderate: excessive permeability.	Moderate: unstable slope; compressible; piping hazard.	Well drained	Features generally favorable.	Slopes of 0 to 1 percent.
Severe: rock at a depth of 4 to 20 inches; stones.	Severe: rock at a depth of 4 to 20 inches; excessive permeability; stones.	Severe: rock at a depth of 4 to 20 inches; low strength.	Severe: rock at a depth of 4 to 20 inches; excessive permeability.	Severe: rock at a depth of 4 to 20 inches.	Rock at a depth of 4 to 20 inches; slope.	Shallow rooting depth; slope; stones.	Rock at a depth of 4 to 20 inches; slope; stones.
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: expansive; low strength.	Slight	Moderate: unstable slope.	Restrictive permeability; wetness.	Wetness; restrictive permeability.	Restrictive permeability; slopes of 0 to 1 percent.
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: expansive; low strength.	Slight	Moderate: unstable slope.	Restrictive permeability; wetness.	Wetness; restrictive permeability.	Restrictive permeability.
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: expansive; low strength.	Slight	Moderate: unstable slope.	Restrictive permeability; slope.	Restrictive permeability; slope.	Restrictive permeability; slope.

TABLE 6.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitations for—		
	Road fill	Sand and gravel	Topsoil	Septic-tank absorption fields	Sewage lagoons	Shallow excavations
Crevasse: Cz	Good	Fair	Poor: too sandy	Severe: subject to flooding.	Severe: excessive permeability; subject to flooding.	Severe: subject to flooding; too sandy.
Dela: Da	Good to fair: low strength.	Unsuited	Good	Severe: subject to flooding.	Severe: excessive permeability; subject to flooding.	Severe: subject to flooding.
*Enders: EhD, EhE, EkF. For Hector part of EhD and EhE, see Hector series.	Poor: expansive; low strength.	Unsuited	Poor: thin layer of suitable material.	Severe: restrictive permeability.	Severe: slope	Severe: too clayey; stones.
Guyton: Gu	Poor: wetness; low strength.	Unsuited	Poor: wetness	Severe: subject to flooding; restrictive permeability; wetness.	Severe: subject to flooding.	Severe: wetness; subject to flooding.
*Hector: HcD, HIC For Linker part of HIC, see Linker series.	Poor: thin layer	Unsuited	Poor: thin layer of suitable material; coarse fragments.	Severe: rock at a depth of 10 to 20 inches.	Severe: rock at a depth of 10 to 20 inches; excessive permeability; slope.	Severe: rock at a depth of 10 to 20 inches; stones.
Kanima: KaE	Fair: low strength.	Poor	Poor: coarse fragments.	Severe: slope	Severe: excessive permeability; slope.	Severe: slope
Kiomatia: Ko	Good	Poor	Poor: thin layer of suitable material.	Severe: subject to flooding.	Severe: subject to flooding; excessive permeability.	Severe: subject to flooding; too sandy.
*Liberal: LbC, LcC For Spiro part of LcC, see Spiro series.	Poor: low strength; expansive.	Unsuited	Poor: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Moderate: rock at a depth of 40 to 60 inches.	Severe: wetness; too clayey.
LdE For Collinsville part, see Collinsville series.	Poor: low strength; expansive.	Unsuited	Poor: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Severe: slope	Severe: wetness; too clayey; stones.
*Linker: LkB, LkC, LkC2, LnD3. For Hector part of LnD3, see Hector series.	Fair: low strength.	Unsuited	Fair: thin layer of suitable material.	Severe: rock at a depth of 20 to 40 inches.	Severe: rock at a depth of 20 to 40 inches; excessive permeability.	Severe: rock at a depth of 20 to 40 inches.

engineering properties of the soils—Continued

Degree and kind of limitations for—Continued					Soil features affecting—		
Dwellings without basements	Sanitary landfill [1]	Local roads and streets	Pond reservoir areas	Pond embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Severe: subject to flooding.	Severe: subject to flooding; too sandy.	Severe: subject to flooding.	Severe: excessive permeability.	Severe: excessive permeability; unstable slope.	Subject to flooding.	Subject to flooding; excessive permeability.	Subject to flooding; complex slopes.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: excessive permeability.	Moderate: excessive permeability; unstable slope; piping hazard.	Subject to flooding.	Subject to flooding.	Slope.
Severe: expansive; low strength; stones.	Severe: too clayey.	Severe: expansive; low strength.	Slight	Moderate: unstable slope.	Well drained; slope.	Restrictive permeability; slope; stones.	Restrictive permeability; slope; stones.
Severe: wetness; subject to flooding.	Severe: subject to flooding.	Severe: wetness; subject to flooding.	Slight	Moderate: unstable slope; low strength; piping hazard.	Restrictive permeability; wetness; subject to flooding.	Restrictive permeability; wetness; subject to flooding.	Restrictive permeability; slopes of 0 to 1 percent.
Severe: rock at a depth of 10 to 20 inches.	Severe: rock at a depth of 10 to 20 inches; excessive permeability; stones.	Severe: rock at a depth of 10 to 20 inches.	Severe: excessive permeability; thin layer.	Severe: excessive permeability; thin layer of suitable material; unstable slope; piping hazard.	Well drained; rock at a depth of 10 to 20 inches; slope.	Shallow rooting depth; excessive permeability; slope; stones.	Rock at a depth of 10 to 20 inches; slope; stones.
Severe: settlement under load.	Moderate: too clayey; slope.	Severe: low strength; slope.	Moderate: excessive permeability.	Moderate: excessive permeability; unstable slope; piping hazard.	Well drained; slope.	Droughty; slope.	Complex slopes.
Severe: subject to flooding.	Severe: excessive permeability; subject to flooding.	Severe: subject to flooding.	Severe: excessive permeability.	Severe: excessive permeability; unstable slope.	Well drained; subject to flooding.	Excessive permeability; subject to flooding.	Complex slopes.
Severe: wetness; expansive.	Severe: too clayey.	Severe: low strength; expansive.	Slight	Moderate: unstable slope; thin layer of suitable material.	Restrictive permeability; slope.	Restrictive permeability; slope.	Restrictive permeability.
Severe: wetness; expansive; stones.	Severe: too clayey; stones.	Severe: low strength; expansive.	Slight	Moderate: unstable slope; thin layer of suitable material.	Restrictive permeability; slope.	Restrictive permeability; slope; stones.	Restrictive permeability; slope; stones.
Moderate: rock at a depth of 20 to 40 inches; low strength.	Severe: rock at a depth of 20 to 40 inches.	Moderate: rock at a depth of 20 to 40 inches; low strength.	Severe: rock at a depth of 20 to 40 inches; excessive permeability.	Moderate: rock at a depth of 20 to 40 inches; unstable slope; piping hazard.	Well drained	Moderately deep root zone; slope.	Moderately deep root zone.

TABLE 6.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitations for—		
	Road fill	Sand and gravel	Topsoil	Septic-tank absorption fields	Sewage lagoons	Shallow excavations
Mhoon variant: Mv.	Poor: low strength; expansive; wetness.	Unsuited.	Poor: too clayey; wetness.	Severe: restrictive permeability; wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding; too clayey.
Naldo: NaB, NaC, NaC2.	Fair: low strength.	Unsuited.	Fair: thin layer of suitable material.	Moderate: restrictive permeability.	Moderate: excessive permeability.	Moderate: wetness.
Norwood: No	Fair to poor: low strength.	Unsuited.	Fair: too clayey.	Moderate: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Oklared: Ok	Fair: low strength.	Poor	Good	Moderate: subject to flooding.	Severe: subject to flooding; excessive permeability.	Moderate: subject to flooding.
Porum: PoC, PoC2	Fair to poor: low strength; expansive.	Unsuited.	Fair: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Moderate: slope.	Severe: too clayey.
Rexor:						
Re	Fair: low strength; expansive.	Unsuited.	Fair: thin layer of suitable material.	Severe: subject to flooding; wetness.	Severe: subject to flooding.	Severe: subject to flooding.
Rf	Fair: low strength; expansive.	Unsuited.	Fair: thin layer of suitable material.	Severe: subject to flooding; wetness.	Severe: subject to flooding.	Severe: subject to flooding.
Sallisaw: SfB	Fair: low strength.	Poor	Fair: thin layer of suitable material.	Slight	Severe: excessive permeability.	Moderate: too clayey.
Spiro: SnB, SnC, SnC2.	Fair to poor: low strength.	Unsuited.	Fair: thin layer of suitable material.	Severe: rock at a depth of 20 to 40 inches.	Severe: rock at a depth of 20 to 40 inches.	Severe: rock at a depth of 20 to 40 inches.
Stigler:						
SrA	Poor: low strength; expansive.	Unsuited.	Good	Severe: restrictive permeability; wetness.	Slight	Severe: wetness; too clayey.
SrB	Poor: low strength; expansive.	Unsuited.	Good	Severe: restrictive permeability; wetness.	Moderate: slope.	Severe: wetness; too clayey.

engineering properties of the soils—Continued

Degree and kind of limitations for—Continued					Soil features affecting—		
Dwellings without basements	Sanitary landfill [1]	Local roads and streets	Pond reservoir areas	Pond embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Severe: wetness; subject to flooding; expansive; low strength.	Severe: subject to flooding; wetness; too clayey.	Severe: wetness; subject to flooding; low strength; expansive.	Slight	Moderate: unstable slope.	Wetness; subject to flooding.	Wetness; restrictive permeability; subject to flooding.	Restrictive permeability; subject to flooding.
Slight	Moderate: too clayey.	Moderate: low strength.	Moderate: excessive permeability.	Slight	Slope	Features generally favorable.	Features generally favorable.
Severe: subject to flooding.	Moderate: too clayey.	Moderate to severe: low strength; subject to flooding.	Moderate: excessive permeability.	Moderate: piping hazard; unstable slope.	Well drained	Features generally favorable.	Slopes of 0 to 1 percent.
Severe: subject to flooding.	Severe: excessive permeability.	Moderate: low strength; subject to flooding.	Severe: excessive permeability.	Moderate: unstable slope; piping hazard.	Well drained	Features generally favorable.	Complex slopes.
Moderate: wetness; expansive; low strength.	Severe: too clayey.	Moderate to severe: low strength; expansive.	Slight	Moderate: unstable slope.	Slope	Restrictive permeability; slope.	Restrictive permeability.
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding; low strength; expansive.	Moderate: excessive permeability.	Moderate: unstable slope; excessive permeability; piping hazard.	Well drained; subject to flooding.	Features generally favorable, but subject to flooding.	Subject to flooding.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: excessive permeability.	Moderate: unstable slope; excessive permeability; piping hazard.	Well drained; subject to flooding.	Subject to flooding.	Subject to flooding.
Moderate: low strength.	Slight	Moderate: low strength.	Severe: excessive permeability.	Moderate: unstable slope; piping hazard.	Well drained; slope.	Features generally favorable.	Features generally favorable.
Moderate: low strength; rock at a depth of 20 to 40 inches.	Severe: rock at a depth of 20 to 40 inches.	Moderate: rock at a depth of 20 to 40 inches; low strength; expansive.	Severe to moderate: thin layer of suitable material; excessive permeability.	Moderate: thin layer; unstable slope; piping hazard.	Well drained; slope.	Moderately deep root zone.	Moderately deep root zone.
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: low strength; expansive.	Slight	Moderate: unstable slope.	Restrictive permeability.	Restrictive permeability; wetness.	Restrictive permeability; slopes of 0 to 1 percent.
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: low strength; expansive.	Slight	Moderate: unstable slope.	Restrictive permeability; slope.	Restrictive permeability; wetness.	Restrictive permeability.

TABLE 6.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitations for—		
	Road fill	Sand and gravel	Topsoil	Septic-tank absorption fields	Sewage lagoons	Shallow excavations
Tamaha: TmB, TmC, TmC2, TnC3.	Poor: low strength; expansive.	Unsuited.	Fair: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Moderate: slope.	Severe: wetness; too clayey.
Vian: VaB.	Fair to poor: low strength.	Unsuited.	Good.	Severe: restrictive permeability; wetness.	Moderate: slope.	Moderate: wetness.
Whakana: WhD, WkD3.	Fair: low strength.	Unsuited.	Poor: too sandy.	Moderate: restrictive permeability.	Severe: excessive permeability.	Slight.
Wing. Mapped only with Counts soils.	Poor: low strength; expansive; sodium.	Unsuited.	Poor: thin layer of suitable material.	Severe: restrictive permeability; wetness.	Moderate: slope; unstable embankments.	Severe: wetness; too clayey.

[1] Onsite deep studies of the underlying strata, water tables, and hazards of aquifier pollution and drainage into ground water need to be

TABLE 7.—*Engineering*

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

Soil name and location	Parent material	Report No.	Depth	Shrinkage limit	Shrinkage ratio	Volume change from field moisture equivalent
			Inches			
Caspiana silt loam:						
800 feet west and 300 feet south of the northeast corner of sec. 10, T. 9 N., R. 19 E. (modal)	Loamy sediment.	3117	0–16	17	1.76	15
		3118	26–42	15	1.82	34
		3119	42–65	18	1.72	11
Crevasse soils:						
2,700 feet north and 2,000 feet east of the southwest corner of sec. 11, T. 9 N., R. 19 E. (modal)	Sandy sediment.	3102	0–6	(4)	(4)	(4)
		3103	6–60	(4)	(4)	(4)
Linker fine sandy loam, 1 to 3 percent slopes:						
2,200 feet east and 1,900 feet north of the southwest corner of sec. 6, T. 9 N., R. 19 E (modal)	Sandstone.	3114	4–11	(4)	(4)	(4)
		3115	11–36	15	1.84	17
Naldo fine sandy loam, 0 to 3 percent slopes:						
2,500 feet west and 1,200 feet north of the southeast corner of sec. 14, T. 9 N., R. 19 E. (modal)	Loamy sediment.	3111	7–17	(4)	(4)	(4)
		3112	29–52	13	1.93	16
		3113	64–80	13	1.87	15

engineering properties of the soils—Continued

Degree and kind of limitations for—Continued					Soil features affecting—		
Dwellings without basements	Sanitary landfill [1]	Local roads and streets	Pond reservoir areas	Pond embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Severe: wetness; expansive; low strength.	Severe: too clayey.	Severe: low strength; expansive.	Slight	Moderate: unstable slope.	Restrictive permeability; slope.	Restrictive permeability; wetness.	Restrictive permeability.
Moderate: wetness; low strength.	Moderate: too clayey.	Severe to moderate: low strength.	Moderate: excessive permeability.	Moderate: unstable slope; piping hazard.	Slope	Features generally favorable.	Features generally favorable.
Slight	Slight	Moderate: low strength.	Moderate: excessive permeability.	Moderate: unstable slope; piping hazard.	Well drained	Features generally favorable.	Features generally. favorable.
Severe: wetness; expansive; low strength; sodium.	Severe: too clayey.	Severe: low strength; expansive; sodium.	Slight	Moderate: unstable slope; piping hazard.	Wetness; restrictive permeability; alkali.	Alkali; restrictive permeability; wetness.	Restrictive permeability; piping hazard; outlets.

made for land fills deeper than 5 or 6 feet.

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—						
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHO [2]	Unified [3]
						Percent			
100	100	87	70	24	20	30	9	A–4(8)	CL–ML
100	100	94	81	31	28	37	16	A–6(10)	CL
100	100	83	58	23	19	26	7	A–4(8)	CL–ML
100	100	65	48	9	7	(4)	(4)	A–4(6)	ML
100	100	17	14	2	2	(4)	(4)	A–2–4(6)	SM
100	98	59	46	10	7	(4)	(4)	A–4(5)	ML
100	100	66	54	28	24	27	9	A–4(6)	CL
100	98	51	40	8	4	(4)	(4)	A–4(3)	ML
100	98	55	48	21	18	24	9	A–4(4)	CL
100	96	36	33	24	23	24	10	A–4(0)	SC

TABLE 7.—*Engineering*

Soil name and location	Parent material	Report No.	Depth	Shrinkage limit	Shrinkage ratio	Volume change from field moisture equivalent
Oklared fine sandy loam: 800 feet north and 300 feet west of the southeast corner of sec. 33, T. 10 N., R. 19 E. (modal)	Loamy and sandy sediment.	3131	12–30	(4)	(4)	(4)
		3132	30–65	(4)	(4)	(4)
Stigler silt loam, 1 to 3 percent slopes: 800 feet north and 300 feet east of the southwest corner of sec. 5, T. 7 N., R. 21 E. (modal)	Shale or clayey sediment.	3123	0–12	19	1.80	0
		3124	33–65	16	1.83	36
		3125	65–78	12	2.02	39
Vian silt loam, 1 to 3 percent slopes: 900 feet north and 200 feet west of the southeast corner of sec. 12, T. 9 N., R. 23 E. (modal)	Loamy sediment.	3126	0–12	22	1.60	9
		3127	21–28	20	1.78	11
		3128	28–52	16	1.87	39
		3129	52–80	14	1.87	31

[1] Mechanical analysis according to AASHO Designation T88–57(*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-sized fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-sized fractions.

[2] Based on standard specifications for highway material and methods of sampling and testing: The classification of soils and soil-aggregate

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the Soil Conservation Service, Department of Defense, and other agencies (*7*), and the AASHO system, adopted by the American Association of State Highway Officials (*1*).

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

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups ranging from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b; A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5 and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in Table 7; the estimated classification, without group index numbers, is shown in table 5 for all soils mapped in the county.

Estimated soil properties significant in engineering

Several estimated soil properties significant in engineering are shown in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance in soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

test data—Continued

Mechanical analysis [1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—					AASHO [2]	Unified [3]
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm				
100	100	54	30	5	4	(4)	(4)	A-4(4)	ML
100	99	49	15	1	1	(4)	(4)	A-4(3)	SM
100	98	78	62	15	10	21	5	A-4(8)	CL-ML
100	99	90	83	52	45	43	20	A-7-6(12)	CL
100	100	89	81	45	35	39	21	A-6(12)	CL
100	96	89	80	15	10	30	9	A-4(8)	ML-CL
100	97	90	83	25	20	29	9	A-4(8)	ML-CL
100	99	93	87	40	37	42	19	A-7-6(12)	CL
100	99	94	85	33	29	35	17	A-6(11)	CL

mixture for highway construction purposes, AASHO designation M145-49 (*1*). Oklahoma Department of Highways classification procedure further subdivides the AASHO A-2-4 subgroup in the following: A-2-3(0) when PI = nonplastic; A-2(0) when PI = NP to 5; and A-2-4(0) when PI = 5 to 10.

[3] Based on the Unified Soil Classification System (*7*). Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils that have plasticity indexes within 2 points of the A-line are to be given a borderline classification. Examples are CL and ML-CL.

[4] Nonplastic.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations made entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that the probability of soil-induced corrosion damage is low. A rating of *high* means that the probability of damage is high, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Soil texture is described in table 5 in the standard terms used by the U.S. Department of Agriculture. These terms take into account the relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. Loam, for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added; for example, gravelly loamy sand. "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index in table 7 are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such

transient soil features as plowpans and surface crusts. This rating should not be confused with the coefficient "K" used by engineers.

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

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Engineering interpretations

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this county and others nearby, and on the experience of engineers and soil scientists with the soils of Haskell County. In table 6, ratings are used to summarize limitation of suitability of the soils for all listed purposes other than for drainage of crops and pasture, irrigation, and terraces and diversions. For these particular uses table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome or modified by special planning and design. *Moderate* means that some properties are unfavorable but can be overcome by special planning or design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome that they require major soil reclamation, special design, or intensive maintenance.

Soil suitability is rated by the terms *good, fair,* and *poor,* which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of the columns in table 6.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a good source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants grown on it if fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that results at the area from which topsoil is taken.

Septic-tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Soil properties that affect difficulty of layout and construction are slope, the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and has sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, and slope. If the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet; for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 6, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that

relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 6 apply only to a depth of about 6 feet; therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet. Regardless of that, every site should be investigated before it is selected.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material and, also, the shrink-swell potential indicate its load-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoirs hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Pond embankments are raised structures of soil material constructed across drainageways in order to impound water. These embankments are generally less than 20 feet high, are constructed of "homogeneous" soil material, and are compacted to medium density. Embankments having the core and shell type of construction are not rated in this table. Embankment foundation, reservoir area, and slope are assumed to be suitable for pond construction. Soil properties are considered that affect the embankment and the availability of borrow material. The best soils have good slope stability, low permeability, slight compressibility under load, and good resistance to piping and erosion. The best borrow material is free of stones or rocks and thick enough for easy excavation.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slopes; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Engineering test data

Table 7 contains engineeering test data for some of the major soil series in Haskell County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications shown are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by the combined sieve and hydrometer method.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when it is oven dry.

The data on *volume change* indicate the amount of shrinking and swelling that is obtained from samples prepared at optimum moisture content and then subjected to drying and wetting. The total change that can occur in a specified soil is the sum of the values given for shrinking and for swelling.

Tests to determine *liquid limit* and plasticity index measure the effect of water on the consistence of soil material, as has been explained for table 5.

Soils for Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 8 the soils of Haskell County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 8 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can easily be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by

TABLE 8.—*Limitations of the soils for recreational development*

Soil series and map symbols	Degree and kind of soil limitations for—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Caspiana: Cp	Moderate: subject to flooding.	Slight	Slight	Slight.
Collinsville Mapped only with Liberal soils.	Moderate: slope; stones.	Moderate: slope; stones.	Severe: slope; rock at depth of 4 to 20 inches.	Moderate: stones.
Counts: CuA, CuB, CvE, CwB. For Dela part of CvE, see Dela series; for Wing part of CwB, see Wing series.	Severe: restrictive permeability; wetness.	Moderate: wetness	Severe: wetness; restrictive permeability.	Moderate: wetness.
Crevasse: Cz	Severe: subject to flooding.	Moderate: subject to flooding; too sandy.	Severe: too sandy	Moderate: too sandy.
Dela:				
Dela part of CvE	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Da	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Slight.
Enders:				
EhD For Hector part, see Hector series.	Severe: restrictive permeability.	Moderate: slope	Severe: slope; restrictive permeability.	Moderate: stones.
EhE For Hector part, see Hector series.	Severe: restrictive permeability; slope.	Severe: slope	Severe: restrictive permeability; slope.	Moderate: slope; stones.
EkF	Severe: restrictive permeability; stones; slope.	Severe: slope	Severe: restrictive permeability; slope; stones.	Severe: slope; stones.
Guyton: Gu	Severe: wetness; restrictive permeability; subject to flooding.	Severe: wetness	Severe: wetness; subject to flooding; restrictive permeability.	Severe: wetness.
Hector:				
HcD, Hector part of Ehd.	Moderate: slope; stones.	Moderate: slope; stones.	Severe: slope; rock at depth of 10 to 20 inches.	Moderate: stones.
Hector part of EhE	Severe: slope	Severe: slope	Severe: slope; rock at depth of 10 to 20 inches.	Moderate: slope; stones.
HlC For Linker part, see Linker series.	Slight	Slight	Severe: rock at depth of 10 to 20 inches.	Slight.

TABLE 8.—*Limitations of the soils for recreational development*—Continued

Soil series and map symbols	Degree and kind of soil limitations for—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Kanima: KaE	Moderate to severe: coarse fragments.	Moderate to severe: slope; coarse fragments.	Severe: slope; coarse fragments.	Moderate: coarse fragments.
Kiomatia: Ko	Severe: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Liberal: LbC, LcC For Spiro part of LcC, see Spiro series.	Moderate: restrictive permeability.	Moderate: wetness; too clayey.	Moderate: wetness; slope; restrictive permeability.	Moderate: wetness; too clayey.
LdE For Collinsville part, see Collinsville series.	Moderate: restrictive permeability; slope.	Moderate: too clayey; slope; wetness.	Severe: slope	Slight.
Linker: LkB, LkC, LkC2	Slight	Slight	Moderate: slope; rock at depth of 10 to 20 inches.	Slight.
LnD3 For Hector part, see Hector series.	Slight	Slight	Severe: slope	Slight.
Mhoon variant: Mv	Severe: subject to flooding; wetness; restrictive permeability; too clayey.	Severe: subject to flooding; wetness; too clayey.	Severe: subject to flooding; wetness; restrictive permeability; too clayey.	Severe: subject to flooding; wetness; too clayey.
Naldo: NaB, NaC, NaC2	Slight	Slight	Moderate: slope	Slight.
Norwood: No	Moderate: subject to flooding; too clayey.	Moderate: too clayey	Moderate: subject to flooding; too clayey.	Moderate: too clayey.
Oklared: Ok	Moderate: subject to flooding.	Slight	Moderate: subject to flooding.	Slight.
Porum: PoC, PoC2	Severe: restrictive permeability.	Moderate: wetness	Severe: restrictive permeability; wetness.	Slight.
Rexor: Re	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.
Rf	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; slope.	Severe: subject to flooding.
Sallisaw: SfB	Slight	Slight	Moderate: slope	Slight.
Spiro: SnB, SnC, SnC2	Slight	Slight	Moderate: rock at depth of 20 to 40 inches; slope.	Slight.
Stigler: SrA, SrB	Severe: restrictive permeability; wetness.	Moderate: wetness	Severe: restrictive permeability; wetness.	Moderate: wetness.
Tamaha: TmB, TmC, TmC2, TnC3.	Severe: restrictive permeability; wetness.	Moderate: wetness	Severe: restrictive permeability; wetness.	Moderate: wetness.
Vian: VaB	Moderate: wetness; restrictive permeability.	Slight	Moderate: restrictive permeability; slope.	Slight.
Whakana: WhD, WkD3	Slight	Slight	Moderate: slope	Slight.
Wing Mapped only with Counts soils.	Severe: wetness; restrictive permeability; sodium.	Severe: wetness; sodium.	Severe: wetness; restrictive permeability; sodium.	Moderate: wetness; sodium.

special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use and do not have slopes or stones that greatly increase cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation and Classification of the Soils

This section describes the major factors of soil formation as they relate to the soils of Haskell County, the processes of soil formation, and the system of classifying soils into categories broader than the series.

Factors of Soil Formation

Soil is the product of five major factors of soil formation—parent material, climate, plants and animals (especially plants), relief, and time. If a factor, such as climate or vegetation, differs in one area from the same factor in another area but the other four factors are the same, the soil formed in the one area also differs from that formed in the other.

Parent material.—Parent material is the unconsolidated material from which soil is formed. It influences the rate of soil formation; the chemical, physical, and mineralogical composition of the soil; and the color of the soil.

Soils on the uplands of Haskell County formed from material weathered from sandstone and shale laid down during the Pennsylvanian geologic period and from clayey, loamy, or sandy sediment. Soils of the Collinsville, Hector, and Linker series are examples of soils that formed in material weathered from sandstone. Soils of the Porum, Naldo, Vian, and Whakana series are examples of soils that formed in clayey, loamy, and sandy sediment. Counts and Enders soils are examples of soils that formed in material weathered from shale.

Alluvial sediment is extensive along the streams and rivers of the county. The kind of sediment deposited and the kinds of soil that formed in it depend largely on the source of the sediment and the velocity of floodwaters. Crevasse soils formed from the sandy sediment dropped near streambeds when the streams overflowed. Norwood soils formed in loamy sediment dropped from slow-moving water at the outer edges of flood plains.

Climate.—Haskell County has a warm, temperate climate. Precipitation is adequate for rapid leaching and plant growth. The climate is fairly uniform throughout the county, and differences among the soils cannot be attributed to differences in climate.

Plants and animals.—Plants, burrowing animals, insects, and soil micro-organisms have a direct influence on the formation of soils. The native grasses and the trees in the county have had different effects on the losses and gains of organic matter and plant nutrients and on soil structure and porosity. Soils that formed under prairie vegetation, such as those of the Liberal series, have a dark-colored surface layer and moderately high organic-matter content. Soils that formed under trees, such as soils of the Linker series, have a lighter colored surface layer and moderate organic-matter content.

Relief.—Relief has influenced the formation of soils mainly through its effect on the movement of water, erosion, soil temperature, and the kind of plant cover. In Haskell County relief is determined largely by the resistance of underlying formations to weathering and geologic erosion. About 12 percent of the acreage in Haskell County is nearly level or very gently sloping soils on flood plains, and about 88 percent is nearly level to steep soils on uplands.

Hector and Linker soils formed from similar sandstone parent material, but their development has been controlled to a large extent by relief. The moderately deep Linker soils are less sloping than the shallow Hector soils.

Time.—Time as a factor in soil formation cannot be measured strictly in years. The length of time needed for the development of genetic horizons depends on the intensity and interactions of soil-forming factors in promoting the losses, gains, transfers, or transformations of soil constituents that are necessary for forming soil horizons. Soils that have no definite genetic horizons are young, or immature, soils. Mature, or older, soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils of Haskell County range from young to old. Some of the old, mature soils are Counts and Stig-

ler soils on uplands. Linker soils are younger, but they have well-expressed soil horizons. The Collinsville and Hector soils are considered young soils. They have had sufficient time to develop well-expressed horizons, but because they are sloping, geologic erosion has taken away soil material almost as fast as it formed. The Crevasse, Norwood, and Oklared soils are on flood plains and have been forming for such a short time that they show little horizon development.

Processes of Soil Formation

Several processes were involved in the formation of the soils of Haskell County. These processes are the accumulation of organic matter, the leaching of calcium carbonates and bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. The results of these processes are not evident to the same degree in all the soils of the county.

Most of the older soils in the county have three major horizons. Some of the properties in which the major horizons differ are color, texture, structure, consistence, reaction, organic-matter content, and thickness. Subdivisions of the major horizons are based on minor differences.

The A horizon is the surface layer. The A1 horizon is a division of the surface layer in which there is an accumulation of organic matter. The A2 horizon is a division that is lighter colored and strongly leached of bases. Many of the soils of this county, such as those of the Stiegler series, have both A1 and A2 horizons.

The B horizon is the mineral horizon below the A horizon, generally called the subsoil. In the older soils of the county, such as those of the Counts series, this is the horizon of maximum accumulation of silicate clay. The younger soils of the county, such as those of the Crevasse series, do not have a B horizon.

The C horizon is weathered rock material. It has been little affected by soil-forming processes but may have been modified by reduction of iron or accumulation of calcium carbonates.

The R layer is consolidated bedrock.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*4*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*) and adopted in 1965 (*6*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 9, the soil series of Haskell County are placed in categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. The five soil orders represented in Haskell County are Mollisols, Alfisols, Entisols, Ultisols, and Inceptisols.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborder narrows the broad climatic range permitted in the order. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences that result from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol).

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Haplaquents* (*Hapl*, meaning simple horizons; *aqu*, for wetness or water; and *ent*, from Entisols).

SUBGROUP: Great groups are divided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives

TABLE 9.—*Classification of the soil series in Haskell County*

Series	Family	Subgroup	Order
Caspiana [1]	Fine-silty, mixed, thermic	Typic Argiudolls	Mollisols.
Collinsville	Loamy, siliceous, thermic	Lithic Hapludolls	Mollisols.
Counts	Fine, mixed, thermic	Albaquic Paleudalfs	Alfisols.
Crevasse	Mixed, thermic	Typic Udipsamments	Entisols.
Dela	Coarse-loamy, siliceous, nonacid, thermic	Typic Udifluvents	Entisols.
Enders	Clayey, mixed, thermic	Typic Hapludults	Ultisols.
Guyton	Fine-silty, siliceous, thermic	Typic Glossaqualfs	Alfisols.
Hector	Loamy, siliceous, thermic	Lithic Dystrochrepts	Inceptisols.
Kanima	Loamy-skeletal, mixed, nonacid, thermic	Udalfic Arents	Entisols.
Kiomatia	Sandy, mixed, thermic	Typic Udifluvents	Entisols.
Liberal	Fine, mixed, thermic	Aquollic Hapludalfs	Alfisols.
Linker	Fine-loamy, siliceous, thermic	Typic Hapludults	Ultisols.
Mhoon variant [2]	Fine, mixed (calcareous), thermic	Typic Fluvaquents	Entisols.
Naldo	Fine-loamy, mixed, thermic	Glossic Paleudalfs	Alfisols.
Norwood	Fine-silty, mixed (calcareous), thermic	Typic Udifluvents	Entisols.
Oklared	Coarse-loamy, mixed, (calcareous), thermic	Typic Udifluvents	Entisols.
Porum	Fine, mixed, thermic	Glossaquic Paleudalfs	Alfisols.
Rexor	Fine-silty, siliceous, thermic	Ultic Hapludalfs	Alfisols.
Sallisaw	Fine-loamy, siliceous, thermic	Typic Paleudalfs	Alfisols.
Spiro	Fine-silty, siliceous, thermic	Ultic Hapludalfs	Alfisols.
Stigler	Fine, mixed, thermic	Aquic Paleudalfs	Alfisols.
Tamaha	Fine, mixed, thermic	Aquic Paleudalfs	Alfisols.
Vian	Fine-silty, siliceous, thermic	Aquic Paleudalfs	Alfisols.
Whakana	Fine-loamy, mixed, thermic	Glossic Paleudalfs	Alfisols.
Wing	Fine, mixed, thermic	Aquic Natrustalfs	Alfisols.

[1] These soils are taxadjuncts to the Caspiana series in that the thickness of the mollic epipedon ranges from 26 to 38 inches; otherwise they are similar in morphology, use, behavior, and management.

[2] The Mhoon variant in Haskell County has a more clayey control section than the Mhoon series. The acreage of this soil is not sufficient to warrant naming a new series.

before the name of the great group. An example is *Typic Haplaquents* (a typical Haplaquent).

FAMILY: Soil families are designated within a subgroup primarily on the basis of properties important to growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 9). An example is the coarse-loamy, siliceous, acid, thermic family of Typic Haplaquents.

SERIES: The series consists of a group of soils that formed in a particular kind of parent material and that have genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, consistence, reaction, and mineral and chemical composition.

General Nature of the County

Additional information about the county is given in this section. This information is most useful to people not familiar with Haskell County. Briefly described are the early history; climate; physiography, drainage, and relief; farming; transportation and industry; and natural resources of Haskell County.

Early History

Haskell County was formed out of the Choctaw Nation of Indian Territory. The county was named for the first governor of Oklahoma, Charles N. Haskell.

J. S. Stigler, a Scotch youth, married Miss Mary Folsom, a well-educated Choctaw, in 1887. He plotted the town of Newman on part of their land in 1892, but confusion with the town of Norman caused trouble for the Post Office and the town was changed to Stigler.

During the Civil War (1862–1865) several skirmishes were fought in Haskell County, and troops crossed the area on many occasions.

The town of Tamaha is located in the northeastern part of the county on a bluff overlooking the Arkansas River. The original name was Pleasant (or Pheasant) Bluff. Early settlers loaded their crops and other products on steamboats at Tamaha and shipped them down the river to New Orleans. Boat traffic from Tamaha continued until the railroad came to Haskell County in about 1900. By the beginning of World War I very little, if any, boat traffic remained.

Before Statehood, Haskell County was part of the Sans Bois County of the Choctaw Nation. Green McCurtain, last governor of the Choctaw Nation, lived at the town of Sans Bois, 9 miles south of Stigler. Restoration of the home as a museum for visitors to the area is planned.

Climate [8]

Weather records for Haskell County sufficient to determine long-term averages and extremes of temperature and precipitation are not available. The weather data in this section are for Eufaula in McIntosh County. Average elevation and latitude of the two counties are approximately the same, and records for Eufaula are therefore considered representative of the climate of Haskell County.

Haskell County has a humid climate. Average annual precipitation is 43 inches and is fairly well distributed throughout the year, as indicated in table 10. On an average, 35 percent of the year's total moisture falls in spring, 27 percent in summer, 23 percent in fall, and 15 percent in winter. Much of the rainfall results from thunderstorms, which occur on an average of 53 days a year and are more numerous during April, May, and June. The greatest known 24-hour rainfall in Haskell County since 1941 was 5.56 inches at Whitefield in May 1960. It is estimated that a 24-hour rainfall of at least 6.6 inches will occur on an average of once every 10 years, and a 24-hour rainfall of at least 7.60 inches, once every 25 years. Measurable precipitation is observed on 95 days of an average year.

Summer is hot. Temperatures reach 100° F. approximately 12 days each year, mainly during July and August, although temperatures of 100° have occurred in June and September. During the usual hot summer afternoon, moderately low relative humidity and a good southerly breeze ease the discomfort of the high temperature. The record high temperature for Eufaula is 116°, which occurred on August 10, 1936.

Winter is generally comparatively mild, although an occasional outbreak of cold air keeps the temperature below freezing 7 days each year. In the past 25 years, Eufaula's temperature has dropped to zero or below on only 7 days. The record low temperature at Eufaula is −18°, which occurred on January 22, 1930.

Snowfall averages about 6 inches per year and is greatest in January. The average number of days each year that have snowfall of 1 inch or more is 3. Approximately 4 days each year have a snow depth of 1 inch or more; the average depth is 2 inches.

The growing season, or freeze-free period, in Haskell County is about 215 days. Data on probabilities of freezing temperatures are given in table 11. The average date of the last freeze in spring is March 30, and that of the first fall freeze, November 4. At Eufaula freezing temperatures have occurred as late as April 21 and as early as September 29.

Prevailing wind is southerly, although northerly wind predominates during December, January, February, and March. Average yearly windspeed is 9 miles per hour, ranging from 7 miles per hour in July to 12 miles per hour in April. Strong gusty winds are quite common during spring storms and winter "northers."

Average daily noontime relative humidity is 60 percent in January and 55 percent in July. When air is heated, it expands and can hold more moisture. For this reason, the relative humidity is usually lower during the warm afternoon and higher during the cool early morning hours. The average monthly percentage of possible sunshine in Haskell County is 53 percent in January, 57 percent in April, 72 percent in July, and 67 percent in October.

Haskell County, like all of Oklahoma, is susceptible to severe storms. The storms are more frequent during hot spring afternoons, but can and do occur every month of the year and at any hour of the day. At any one location within Haskell County, hail occurs on 3 days of an average year. Hail in Haskell County is not necessarily damaging.

Physiography, Drainage, and Relief

Haskell County consists of 366,470 acres of wooded areas and prairies. Topographic differences range from the level flood plains of the Arkansas and Canadian Rivers to the steep mountainous area of the Sans Bois Mountains in the southern part of the county. The general slope is toward the north and east. All drainage except that of small areas in the western and southern parts of the county reaches the Canadian and Arkansas Rivers within the county. Sans Bois Creek has the largest drainage system in the county. It enters the southwestern part and flows east and north into the Robert S. Kerr Lock and Dam Reservoir in the northeastern part of the county. Brooken, Emachaya, and Taloka Creeks are the three largest tributaries that drain the northwestern part of the county. Broken Creek flows into the Eufaula Lake. Emachaya Creek and Taloka Creek flow into the Canadian River below the Eufaula Dam. The Canadian and Arkansas Rivers form the northern boundary of Haskell County.

The average elevation is approximately 1,030 feet above sea level. The Sans Bois Mountains in the extreme southern part of the county reach a height of some 1,600 feet. The lowest point in the county is only about 460 feet above sea level. This is along the bank of the Robert S. Kerr Lock and Dam Reservoir in the extreme northeastern corner of the county. The approximate elevation of Stigler, the county seat, is 560 feet.

Haskell County has four general types of areas. These are the timbered sandstone and shale areas on steep parts of mountains and smooth crests and ridges, the prairie areas, the timbered terraces along the Canadian and Arkansas Rivers, and the floodplain areas of streams and rivers. The major part of the county is in the timbered sandstone and shale areas.

[8] By STANLEY HOLBROOK, climatologist for Oklahoma, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation data*

[All data from Eufaula in McIntosh County; period of record 1941–70]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average highest maximum	Average lowest minimum	Average total	One year in 10 will have—		Days that have snow cover of 1 inch or more	Average depth of snow on days that have snow cover
						Less than—	More than—		
January	51	29	72	1	1.8	0.3	4.0	2	2
February	56	34	75	16	2.2	1.0	3.7	1	2
March	63	40	83	19	3.5	1.5	5.7	(1)	2
April	75	52	88	34	4.9	1.8	8.5	(1)	----
May	81	60	91	44	6.7	2.3	10.6	(1)	----
June	88	67	96	57	4.0	1.5	8.6	(1)	----
July	96	72	103	62	4.5	0.7	9.3	(1)	----
August	94	70	104	58	2.9	0.2	5.6	(1)	----
September	87	62	98	47	4.1	0.5	7.5	(1)	----
October	77	52	91	34	3.3	0.3	8.1	(1)	----
November	64	40	80	22	2.5	0.2	5.3	(1)	----
December	54	33	72	13	2.6	0.5	4.7	1	2
Year	74	51	[2] 105	[3] 4	43.0	29.7	56.8	4	2

[1] Less than one-half day.
[2] Average annual maximum temperature.
[3] Average annual minimum temperature.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Eufaula in McIntosh County; period of record 1921–68]

Probability	Dates for given probability and temperature				
	16° F	20° F	24° F	28° F	32° F
Spring:					
1 year in 10 later than	March 12	March 20	April 1	April 8	April 17.
2 years in 10 later than	March 2	March 12	March 24	April 2	April 11.
5 years in 10 later than	February 12	February 24	March 9	March 22	March 30.
Fall:					
1 year in 10 earlier than	November 24	November 18	November 3	October 23	October 19.
2 years in 10 earlier than	December 2	November 29	November 10	October 29	October 23.
5 years in 10 earlier than	December 20	December 9	November 24	November 11	November 2.

Farming

About half the soils in Haskell County are suited to cultivation. In recent years more people who have a supplemental income from employment in industry have purchased farms.

The main farming enterprises are the raising of livestock and the production of crops. The main cash crops are cotton, soybeans, and alfalfa. A large acreage of bermudagrass and native grasses is cut for hay.

Trends for the future point to more acreages used for tame pasture and better range management to increase cattle production.

Transportation and Industry

Haskell County is served by a network of State highways. State Highway 9 crosses the county in an east-west direction through the towns of Keota, Stigler, Whitefield, and Enterprise. State Highway 31 crosses it in an east-west direction through the towns of McCurtain, Lequire, and Kinta. State Highway 2 crosses the county in a north-south direction through the towns of Kinta and Whitefield. State Highway 71 crosses the western part of the county in a north-south direction through the town of Enterprise. State Highway 82 connects State Highways 9 and 31 between Stigler and Lequire. State Highway 26 connects Highways 9 and 31 in the eastern part of the county. In farm areas all-weather roads provide access to the hard-surfaced highways from all parts of the county.

The Arkansas River navigation channel furnishes water transportation for Haskell County. Formal opening of the waterway was in 1971.

A railroad provides freight service to Stigler and Keota. No passenger service is available. A spur of another railroad serves the town of McCurtain, but its use is primarily for the shipping of coal. Bus service and freight trucking are available.

The main industries in Haskell County are coal mining, canning, and prefab home building.

Natural Resources

Important natural resources of the county include coal, gas, sandstone, and water.

Haskell County is underlain by vast beds of coal, both shallow beds and those that lie deep in the earth. Value of the coal produced amounts to more than $4 million a year. Coal is mined both by deep-shaft mining and by strip mining.

Haskell County is centrally located in the largest gas field in eastern Okalhoma. A large number of natural gas wells have been drilled.

Sandstone of uniform thickness and various colors is found in abundance throughout the county. Some has been quarried for building stone and crushed for gravel.

Haskell County has an abundant supply of water. It has two large lakes, Eufaula Lake and Robert S. Kerr Lock and Dam Reservoir. In addition, 17 smaller lakes cover from 10 to more than 200 acres. Ground water is the source of most domestic and stock water supplies. Streams and farm ponds furnish large amounts of stock water.

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Glossary

ABC soil. A soil that has a complete profile, including an A, B, and C horizon.

AC soil. A soil that has an A and a C horizon but no B horizon. Commonly such soils are immature, as those developing from alluvium or those on steep, rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, clocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Argillic horizon. An illuvial horizon in which layer-lattice silicate clays have accumulated through illuviation to a significant extent.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

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

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate 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.

Decreaser. Any of the climax range plants most heavily grazed. Because they are the most palatable, they are first to be destroyed by overgrazing.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specifiifed plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil orginates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the undconsolidated parent material, as conditioned by relief and age of landform.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Horizon, soil. A layer of soil approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer or 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. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Increasers. Species in the climax vegetation that increase in relative amount as the more desirable plants are reduced by close grazing; increasers commonly are shorter than decreasers, and some are less palatable to livestock.

Invaders. On range, plants that come in and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface. (Most weeds are "invaders").

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

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.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

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 the soil 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, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depths, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from acceleraged erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. If two sequa are present in a single soil profile, it is said to have a bisequum.

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.

Silica. Silica is a combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina plus iron oxide in a soil or the clay fraction of a soil. The more highly weathered materials in warm-temperate, humid regions, and especially those in the tropics, generally have low ratios. The clays in soils with low ratios normally are less active, physically and chemically, than those with high ratios.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Site index. A numerical means of expressing the quality of a forest site that is based on the height of the dominant stand at an arbitrarily chosen age; for example, the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Slope. Soil slope is expressed in words and in percentage of gradient. In this county they are: nearly level, 0 to 1 percent; very gently sloping, 1 to 3 percent; gently sloping, 3 to 5 percent; sloping, 5 to 8 percent; strongly sloping, 8 to 12 percent; moderately steep, 12 to 20 percent; steep, 20 to 50 percent.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than .002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics 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 aggreages longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Subsurface layer. An A2 horizon, below the surface layer in which the distinguishing characteristics are a loss of clay, iron, or aluminum.

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 surface 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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements found in soils in extremely small amounts, yet which are essential to plant growth. Some of the trace elements are zinc, cobalt, manganese, copper, and iron.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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