# SOIL SURVEY OF

# Mayes 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 1961 to 1970. 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 Mayes County Soil and Water Conservation District.

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 Mayes 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 pasture and hayland suitability group, the woodland suitability group, and the range site in which the soil has been placed.

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

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

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

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

Ranchers and others can fine, under "Use of the Soils as Rangeland," 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 "Use of the Soils for Recreational Development."

Engineers and builders can find, under "Engineering Uses of the Soils," 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 Mayes County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

CONTENTS

# SOIL SURVEY OF MAYES COUNTY, OKLAHOMA

BY DOCK J. POLONE, CLAUDE T. NEWLAND, AND BILL G. SWAFFORD

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

MAYES COUNTY is in the northeastern part of Oklahoma (fig. 1). It is bounded on the

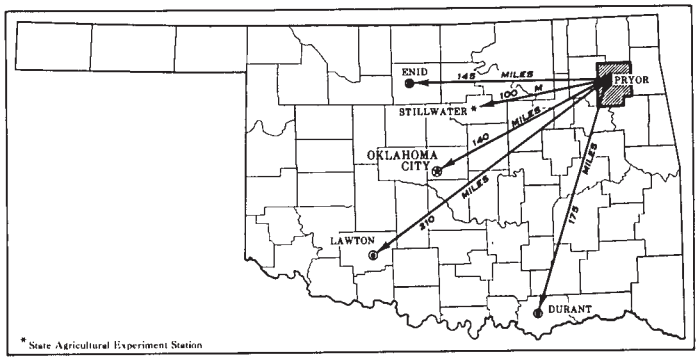



Figure 1.--Location of Mayes County in Oklahoma.

west by Rogers County, on the north by Craig and Rogers Counties, on the east by Delaware and Cherokee Counties, and on the south by Wagoner and Cherokee Counties. Pryor Creek, the county seat, is located in the west-central part of the county.

The county has an area of 414,720 acres, or 648 square miles. It lies within two physiographic regions, the Cherokee Prairies and the Ozark Highland. The western two-thirds of the county is mostly prairie. This area is used mainly for raising livestock and growing livestock products. The main crops are small grains, corn, grain sorghum, and soybeans. Improved grasses and legumes for hay are grown as feed for livestock. Industrial developments are also important in the western part of the county. The eastern part of the county, much of it rugged, is part of the Ozark Highland. The soils in the eastern part of the county are used for grazing livestock and for growing timber. Some of the more nearly level areas have been cleared of trees and are used for growing tame pasture plants, field crops, and grasses. Recreation development in this area is progressing rapidly, particularly around the lakes and streams.

## HOW THIS SURVEY WAS MADE

Soil scientists made this survey to learn what kinds of soil are in Mayes 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. Choteau and Collinsville, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided

into phases. The name of a soil phase indicates a feature that affects management. For example, Dennis silt loam, 1 to 3 percent slopes, is one of several phases within the Dennis 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 Mayes 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. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Hector-Enders complex, 1 to 5 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 there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils joined by "and." Verdigris soils, channeled, is an example of an undifferentiated group in Mayes County.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. In this survey, Rock outcrop is a land type that was mapped in a complex with Lenapah soils.

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.

The soil scientists also 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 in Mayes County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The nine soil associations in this survey are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 1, the term loamy soils refers to the texture of the surface layer in the major soils of this association.

Not all soil names on the general soil map of Mayes County are the same as those in adjoining Cherokee, Delaware, Rogers, Craig, and Wagoner Counties. Most of the differences in names result from refinements in the system of soil classification during the period these counties were surveyed.

### 1. Dennis-Parsons-Taloka Association

*Deep, nearly level to moderately steep, moderately well drained to somewhat poorly drained, loamy soils that have a loamy or clayey subsoil; over loamy or clayey sediment or shale; on uplands*

This association makes up about 33 percent of the survey area. It is mainly in the western part of the county. About 42 percent of this association is Dennis soils; 29 percent is Parsons soils; 14 percent is Taloka soils; and 15 percent is Bates, Choteau, Collinsville, Kanima, Okemah, Verdigris, and other less extensive soils.

Dennis soils are deep, very gently sloping to moderately steep, moderately well drained, and loamy. They have a loamy and clayey subsoil over shaley or clayey sediment.

Parsons soils are deep, nearly level, somewhat poorly drained, and loamy. They have a clayey and loamy subsoil over loamy or clayey sediment.

Taloka soils are deep, nearly level, somewhat poorly drained, and loamy. They have a clayey and loamy subsoil over loamy and clayey sediment.

About 65 percent of this association is tame pasture and cultivated crops, such as soybeans, corn, grain sorghum, and small grains. The rest is used as range.

The principal concerns of management are maintaining soil structure and fertility and controlling erosion. The soils in this association respond favorably to good management.

### 2. Collinsville-Bates Association

*Very shallow to moderately deep, very gently sloping to steep, well drained and somewhat excessively drained soils that are loamy throughout; over sandstone; on uplands*

This association makes up about 9 percent of the survey area and is in the western part. About 70 percent of this association is Collinsville soils, and 30 percent is Bates soils.

Collinsville soils are very shallow or shallow, very gently sloping to steep, and well drained to somewhat excessively drained. They are loamy throughout and overlie sandstone.

Bates soils are moderately deep, very gently sloping or gently sloping, and well drained. They are loamy throughout and overlie soft sandstone.

Most of this association is used as range. Some areas are used for tame pasture and such cultivated crops as small grains and grain sorghum.

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

### 3. Summit-Lenapah-Mayes Association

*Deep or shallow, nearly level to sloping, somewhat poorly drained or well-drained loamy soils that have a loamy or clayey subsoil; over limestone, shale, or loamy or clayey sediment; on uplands*

This association makes up about 12 percent of the survey area. It is in the central part of the county. About 31 percent of this association is Summit soils; 24 percent is Lenapah soils; 13 percent is Mayes soils; and 32 percent is Choteau, Lula, Parsons, and Dennis soils and Rock outcrop.

Summit soils are deep, nearly level to gently sloping, somewhat poorly drained, and loamy. They have a loamy and clayey subsoil over limestone or shale.

Lenapah soils are shallow, nearly level to sloping, well drained, and loamy. They have a loamy and clayey subsoil over limestone.

Mayes soils are deep, nearly level, somewhat poorly drained, and loamy. They have a loamy and clayey subsoil over loamy or clayey sediment.

About 50 percent of this association is cultivated, and the rest is used mainly as range. Commonly grown crops on the deep Summit and Mayes soils are small grains, grain sorghum, soybeans, and tame pasture. Most of the acreage of Lenapah soils is used as range.

The principal concerns of management on these soils are maintaining fertility and soil structure and controlling erosion. Returning residue to the soil, using fertilizer, and using terraces on the sloping soils are good management practices. When properly managed, these soils produce good range and pasture.

## 4. Riverton-Craig-Eldorado Association

*Deep, very gently sloping to sloping, well-drained, loamy soils that have a loamy or clayey subsoil; over limestone or gravelly sediment; on uplands*

This association makes up 7 percent of the survey area and is mainly in the central part, adjacent to the Neosho River. About 25 percent of this association is Riverton soils; 24 percent is Craig soils; 20 percent is Eldorado soils; and 31 percent is small areas of mainly Bates, Clarksville, and Dennis soils.

Riverton soils are deep, very gently sloping or gently sloping, and well drained. They are loamy throughout and overlie gravelly sediment.

Craig soils are deep, very gently sloping or gently sloping, well drained, and loamy. They have a cherty, loamy, and clayey subsoil that overlies cherty limestone.

Eldorado soils are deep, very gently sloping to sloping, well drained, and cherty. They are loamy throughout, have chert in their subsoil, and overlie cherty limestone.

About 60 percent of this association is used for small grains, grain sorghum, tame pasture, and other cultivated crops. The rest is used as range.

The principal concerns of management on these soils are maintaining fertility and structure and controlling erosion.

## 5. Hector-Enders Association

*Shallow to deep, very gently sloping to very steep, well-drained, loamy soils that have a loamy or clayey subsoil; over sandstone or shale; on uplands*

This association makes up about 7 percent of the survey area. It is in the northwestern and southern parts of the county. About 54 percent of this association is Hector soils; 26 percent is Enders soils; and 20 percent is small areas of mainly Verdigris, Bates, and Collinsville soils.

Hector soils are shallow, very gently sloping to very steep, and well drained. They are loamy throughout and overlie hard, massive sandstone.

Enders soils are deep, very gently sloping to moderately steep, well drained, and loamy. They have a loamy and clayey subsoil that overlies shale.

Most of this association is used as woodland range or tame pasture.

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

## 6. Clarksville Association

*Deep, steep and very steep, somewhat excessively drained soils that are loamy throughout; over cherty limestone; on uplands*

This association makes up about 8 percent of the survey area and is in the eastern part. About 98 percent of this association is Clarksville soils and 2 percent is small areas of mainly Nixa soils.

Clarksville soils are deep, steep or very steep, somewhat excessively drained, and stony. They are loamy throughout, have chert in their subsoil, and overlie cherty limestone.

About 85 percent of this association is wooded and is used as woodland range. The rest has been cleared and is used as tame pasture.

The steep slopes and the content of chert and other stones are the principal concerns

of management on these soils. The soils in this association respond favorably to good management.

### 7. Clarksville-Nixa Association

*Deep, nearly level to moderately steep, somewhat excessively drained and moderately well drained soils that are loamy throughout; over cherty limestone; on uplands*

This association makes up about 15 percent of the survey area, and is mainly in the eastern part of the county. About 80 percent of this association is Clarksville soils, 19 percent is Nixa soils, and 1 percent is small areas of mainly Captina soils.

Clarksville soils are deep, very gently sloping to moderately steep, somewhat excessively drained, and stony or very cherty. They have a very cherty subsoil that is loamy throughout, and they overlie cherty limestone.

Nixa soils are deep, nearly level or very gently sloping, moderately well drained, and cherty. They have a very cherty subsoil that is loamy throughout and overlies cherty limestone.

About 70 percent of this association is used for tame pasture and such cultivated crops as small grains and grain sorghum. The rest is wooded and is used as range.

The principal concerns of management are maintaining soil structure and fertility and controlling erosion. The soils in this association respond favorably to good management.

### 8. Verdigris-Quarles Association

*Deep, nearly level or very gently sloping, moderately well drained and poorly drained soils that are loamy throughout; over loamy or clayey sediment; on flood plains*

This association makes up about 5 percent of the survey area. It is mainly on the flood plains of Pryor Creek. About 52 percent of this association is Verdigris soils; 46 percent is Quarles soils; and 2 percent is small areas mainly of Osage soils.

Verdigris soils are deep, nearly level or very gently sloping, and moderately well drained. They are loamy throughout and overlie loamy sediment. These soils are subject to flooding.

Quarles soils are deep, nearly level, poorly drained, and loamy. They have a clayey subsoil over loamy or clayey sediment. These soils are on flood plains and are subject to flooding.

Most of this association is cultivated to soybeans, corn, grain sorghum, small grains, and tame pasture.

The principal concerns of management are maintaining soil structure and fertility and protecting the soils from damaging floods. Wetness is a concern on the Quarles soils. The soils in this association respond favorably to good management.

### 9. Sallisaw-Cannon Association

*Deep, nearly level or very gently sloping, well-drained soils that are loamy throughout; over cherty or loamy sediment; on terraces and flood plains*

This association makes up about 4 percent of the survey area. It is in the eastern part of the county adjacent to the Neosho River. About 35 percent of this association is Sallisaw soils; 25 percent is Cannon soils; and 40 percent is small areas mainly of Elsah, Clarksville, Nixa, and Riverton soils.

Sallisaw soils are deep, very gently sloping, and well drained. They have a cherty subsoil that is loamy throughout and that overlies cherty loamy sediment.

Cannon soils are deep, nearly level, well drained, and gravelly. They are loamy throughout and overlie loamy sediment. These soils are subject to flooding.

Most of the soils in this association are cultivated to soybeans, small grains, grain sorghum, corn, and tame pasture.

The principal concerns of management are maintaining soil structure and fertility and protecting the Cannon soils from flooding. The soils in this association respond favorably to good management.

## DESCRIPTIONS OF THE SOILS

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

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second 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 describing 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, hayland suitability group, range site, and woodland group in which the mapping unit has been placed. The page for the description of each capability unit, range site, woodland group, or other interpretative group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

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

### Bates Series

The Bates series consists of moderately deep, well-drained, very gently sloping or gently sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from sandstone.

In a representative profile the surface layer is 11 inches of very dark grayish-brown loam. The upper part of the subsoil extends to a depth of 16 inches and is dark-brown loam. The lower part, extending to a depth of 30 inches, is yellowish-brown clay loam. The subsoil is underlain by partly weathered sandstone (pl. I).

Bates soils have moderate permeability. Available water capacity is moderate to high.

Representative profile of Bates loam, 1 to 3 percent slopes, 600 feet north of the SW. corner of sec. 27, T. 19 N., R. 18 E.:

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; slightly acid; clear, smooth boundary.

A1--6 to 11 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, granular structure; friable; slightly acid; gradual, smooth boundary.

B1--11 to 16 inches, dark-brown (10YR 4/3) loam; weak, fine, subangular blocky structure; friable; medium acid; gradual, smooth boundary.

B2t--16 to 26 inches, yellowish-brown (10YR 5/6) clay loam; few, fine, prominent, red (2.5YR 5/6) mottles and few, fine, faint, yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; firm; patchy clay films on faces of peds; few, fine, black concretions; strongly acid; gradual, smooth boundary.

B3--26 to 30 inches, yellowish-brown (10YR 5/4) clay loam; few, fine, faint, strong-brown mottles and few, medium, distinct, red (2.5YR 4/6), yellowish-red (5YR 5/6), and yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; firm; strongly acid; abrupt, wavy boundary.

C--30 to 34 inches, soft partially weathered sandstone.

The A1 or Ap horizon is very dark grayish brown or very dark brown. It is slightly acid or medium acid. The B1 horizon is dark-brown, brown, yellowish-brown, or dark yellowish-brown loam or clay loam. It has a weak, fine, subangular blocky structure or a weak, medium, granular structure. It is slightly acid to strongly acid. The B2t horizon is yellowish-brown, dark yellowish-brown, dark-brown or brown clay loam or sandy clay loam mottled with shades of brown and red. It has a weak, fine, subangular blocky structure or weak, medium,

1/ Italic numbers in parentheses refer to Literature Cited, p.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

| Soil | Acres | Percent |
|---|---|---|
| Bates loam, 1 to 3 percent slopes | 3,088 | 0.7 |
| Bates loam, 3 to 5 percent slopes | 3,325 | .8 |
| Bates-Collinsville complex, 1 to 5 percent slopes | 18,407 | 4.4 |
| Cannon gravelly loam | 5,991 | 1.5 |
| Captina silt loam, 1 to 3 percent slopes | 864 | .2 |
| Choteau silt loam, 0 to 1 percent slopes | 7,438 | 1.8 |
| Choteau silt loam, 1 to 3 percent slopes | 5,502 | 1.3 |
| Clarksville cherty silt loam, 1 to 8 percent slopes | 38,550 | 9.3 |
| Clarksville stony silt loam, 5 to 20 percent slopes | 6,780 | 1.6 |
| Clarksville stony silt loam, 20 to 50 percent slopes | 33,500 | 8.1 |
| Collinsville soils, 5 to 30 percent slopes | 19,291 | 4.7 |
| Craig silt loam, 1 to 3 percent slopes | 5,445 | 1.3 |
| Craig silt loam, 3 to 5 percent slopes | 2,499 | .6 |
| Dennis silt loam, 1 to 3 percent slopes | 43,224 | 10.4 |
| Dennis silt loam, 3 to 5 percent slopes | 5,604 | 1.4 |
| Dennis silt loam, 2 to 5 percent slopes, eroded | 7,803 | 1.9 |
| Dennis-Verdigris complex, 0 to 15 percent slopes | 13,699 | 3.3 |
| Eldorado soils, 1 to 8 percent slopes | 5,660 | 1.4 |
| Elsah soils, frequently flooded | 2,000 | .5 |
| Hector-Enders complex, 1 to 5 percent slopes | 6,619 | 1.6 |
| Hector-Enders complex, 5 to 20 percent slopes | 19,753 | 4.8 |
| Hector soils, 20 to 50 percent slopes | 3,346 | .8 |
| Kanima soils, 1 to 30 percent slopes | 97 | (1/) |
| Lenapah silty clay loam, 0 to 3 percent slopes | 5,059 | 1.2 |
| Lenapah-Rock outcrop complex, 1 to 8 percent slopes | 10,637 | 2.6 |
| Lula silt loam, 1 to 3 percent slopes | 4,732 | 1.1 |
| Mayes silty clay loam | 6,616 | 1.6 |
| Nixa cherty silt loam, 0 to 3 percent slopes | 12,684 | 3.1 |
| Okemah silt loam, 0 to 1 percent slopes | 936 | .2 |
| Osage silty clay loam | 536 | .1 |
| Parsons silt loam, 0 to 1 percent slopes | 38,997 | 9.4 |
| Quarles silt loam | 10,436 | 2.5 |
| Riverton loam, 1 to 3 percent slopes | 3,421 | .8 |
| Riverton gravelly loam, 1 to 5 percent slopes | 5,679 | 1.4 |
| Sallisaw silt loam, 1 to 3 percent slopes | 8,340 | 2.0 |
| Summit silty clay loam, 0 to 1 percent slopes | 3,431 | .8 |
| Summit silty clay loam, 1 to 3 percent slopes | 9,091 | 2.2 |
| Summit silty clay loam, 3 to 5 percent slopes | 3,792 | .9 |
| Taloka silt loam, 0 to 1 percent slopes | 19,979 | 4.8 |
| Verdigris silty clay loam | 7,453 | 1.8 |
| Verdigris soils, channeled | 4,011 | 1.0 |
| Borrow pits, gravel pits, and limestone quarries | 405 | .1 |
| Total | 414,720 | 100.0 |

1/ Less than 0.1 percent.

subangular blocky structure. Reaction is medium acid or strongly acid. This horizon is 0 to 1 percent dark concretions. The B3 horizon is dark yellowish-brown or yellowish-brown clay loam or sandy clay loam mottled with shades of red and brown. Some profiles have no B3 horizon.

The depth to sandstone is 20 to 40 inches. The ground water table is at a depth of more than 72 inches.

In some areas of the county, the annual temperature of these soils is a few degrees cooler than defined in the range for the series. This difference does not alter the usefulness and behavior of the soils.

Bates soils are associated with Collinsville and Dennis soils. They are deeper than the Collinsville soils and have a Bt horizon that is lacking in the Collinsville soils. Bates soils are not so deep as Dennis soils and are coarser textured.

Bates loam, 1 to 3 percent slopes (BaB) --This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Dennis and Collinsville soils. Also included are a few small areas of soils that are similar to this soil except that they are more than 40 inches deep over sandstone.

This Bates soil is used mostly for growing small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture plants. Some areas are in prairie grasses and are used as range or for hay.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grown if the soil is well managed. Returning residue to the soil and using fertilizer are good management practices. If row crops are grown, terraces having protected outlets, contour farming, and no tillage or minimum tillage are needed. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Bates loam, 3 to 5 percent slopes (BaC). -This soil has a profile similar to the one described as representative of the series except that the depth to sandstone is 4 inches less.

Included with this soil in mapping are small areas of Dennis and Collinsville soils. Also mapped are a few areas of soils that are similar to this soil except that they are more than 40 inches deep over sandstone.

This Bates soil is used largely for growing small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture plants. A sizable acreage is in prairie grasses and is used as range or for hay.

The main concerns of management are the hazard of erosion and the maintenance of soil fertility and structure. Terraces and contour farming are needed if row crops are grown. Large amounts of residue should be returned to the soil, and fertilizer should be used to help maintain the content of organic matter and the soil structure and to increase the intake rate of water. If terraces are not used, a cropping system is needed that consists only of soil-maintaining crops and that keeps biennial or perennial vegetation on the soil at least half the time. Capability unit IIIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Bates-Collinsville complex, 1 to 5 percent slopes (BcC).--This complex is about 55 percent Bates loam and 35 percent Collinsville loam. The Bates soil has a profile similar to the one described as representative of the series, but the depth over sandstone is 2 inches less. The Collinsville soil has a profile similar to the one described as representative of the series, but the depth over sandstone is 3 inches more.

Included with these soils in mapping are small areas of Dennis soils. Also mapped are a few areas of soils that are similar to Dennis soils but less than 60 inches deep.

Most of the acreage of this complex is used as tame pasture or range, but in places it is used for growing small grains and drilled sorghum.

The main concerns of management are controlling erosion and maintaining soil structure and fertility. The regular use of residue, green-manure crops, and fertilizer helps to control erosion and maintain soil structure and fertility. Because the Collinsville soils are shallow, terraces are difficult to construct and maintain. This complex is better suited to growing grass for livestock than to other uses. Both parts in capability unit IVe-1; Bates part in pasture and hayland suitability group 8A and Collinsville part in pasture and hayland suitability group 14A; Bates part in Loamy Prairie range site and Collinsville part in Shallow Prairie range site; not assigned to a woodland suitability group.

## Cannon Series

The Cannon series consists of deep, well-drained, nearly level soils on flood

plains. These soils formed under a cover of hardwoods in loamy sediment.

In a representative profile the surface layer is 12 inches of very dark grayish-brown gravelly loam (pl. I). The next layer, extending to a depth of 24 inches, is very dark grayish-brown gravelly silt loam. The underlying material, extending to a depth of 60 inches, is a dark yellowish-brown gravelly silty clay loam.

Cannon soils have moderately rapid permeability. Available water capacity is high.

Representative profile of Cannon gravelly loam, 2,000 feet south and 1,400 feet east of the NW. corner of sec. 36, T. 21 N., R. 20 E.:

A1--0 to 12 inches, very dark grayish-brown (10YR 3/2) gravelly loam; moderate, medium, granular structure; friable; about 25 percent gravel, by volume; slightly acid; gradual, smooth boundary.

AC--12 to 24 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam; moderate, fine, granular structure; friable; about 20 percent gravel, by volume; slightly acid; gradual, smooth boundary.

C--24 to 60 inches, dark yellowish-brown (10YR 3/4) gravelly silty clay loam; massive; friable; 30 percent gravel, by volume; medium acid; gradual, wavy boundary.

The A1 or Ap horizon is very dark grayish brown, dark brown, or very dark brown. It is slightly acid or medium acid. The AC horizon is very dark grayish-brown or dark-brown gravelly silt loam or gravelly silty clay loam. It is medium acid to neutral. The C horizon is dark-brown, brown, dark yellowish-brown, yellowish-brown, or light yellowish-brown gravelly silt loam or gravelly silty clay loam. It is medium acid to neutral.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Cannon soils are associated with Sallisaw and Elsah soils. They lack the Bt horizon that is in the Sallisaw soils. They differ from Elsah soils in containing less than 35 percent rock fragments, by volume.

Cannon gravelly loam (Ca).--This nearly level soil has the profile described as representative of the series. This soil is subject to occasional flooding.

Included with this soil in mapping are small areas of Elsah and Sallisaw soils. About 10 percent of the individual mapped areas is made up of soils that have a silt loam surface layer. Another 10 percent consists of soils that have a thinner surface layer but that are otherwise similar to this soil.

This Cannon soil is used mostly for growing small grains, grain sorghum, soybeans, corn, alfalfa, tame pasture plants, and hardwood trees.

The main concerns of management are occasional flooding and the maintenance of soil structure and fertility. Most of the crops generally grown on this soil produce large amounts of residue and can be grown continuously if fertilizer is used and the residue is returned to the soil. Capability unit IIw-1; pasture and hayland suitability group 2A; not assigned to a range site; woodland suitability group 2o7.

## Captina Series

The Captina series consists of deep, moderately well drained, very gently sloping soils on uplands. These soils formed under a cover of hardwoods and pine and an understory of native grasses in material weathered from cherty limestone.

In a representative profile the surface layer is 11 inches of dark-brown and brown silt loam. The upper part of the subsoil, to a depth of 27 inches, is strong-brown silty clay loam. The lower part, extending to a depth of 42 inches, is yellowish-red, brittle silty clay loam. The subsoil is underlain by cherty limestone.

Captina soils have slow permeability. Available water capacity is high.

Representative profile of Captina silt loam, 1 to 3 percent slopes, 2,000 feet north of the SW. corner of sec. 36, T. 19 N., R. 20 E.:

Ap--0 to 6 inches, dark-brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; few chert fragments; slightly acid; clear, smooth boundary.

A1--6 to 11 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; friable; few chert fragments; few clean sand grains; medium acid; gradual, smooth boundary.

B1--11 to 17 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, fine, subangular blocky structure; friable; few chert fragments; common clean sand grains; medium acid; gradual, smooth boundary.

B2t--17 to 27 inches, strong-brown (7.5YR 5/6) silty clay loam; few, fine, distinct, pale-brown mottles; moderate,

medium, blocky structure; firm; clay films on faces of peds and in pores; few chert fragments; strongly acid; gradual, smooth boundary.

Bx--27 to 42 inches, yellowish-red (5YR 4/6) silty clay loam; many, medium and coarse, prominent, reddish-brown (5YR 5/3), light brownish-gray (10YR 6/2), and pale-brown (10YR 6/3) mottles; many nearly vertical streaks of gray (10YR 6/1); moderate, medium, blocky structure; firm, brittle; few chert fragments; strongly acid; abrupt, irregular boundary.

R--42 to 60 inches, slightly weathered chert; yellowish-red (5YR 4/6) silty clay loam in the fractures; red, brown, and gray mottles; massive; hard; very strongly acid.

The A1 or Ap horizon is dark grayish brown, dark brown, brown or grayish brown. It is slightly acid to strongly acid and is 0 to 5 percent chert fragments. The B1 horizon is brown, strong-brown, or yellowish-brown silt loam or silty clay loam. It is medium acid or strongly acid and is 0 to 5 percent chert fragments. The B2t horizon is brown, strong brown, or yellowish brown. It is very strongly acid or strongly acid and is 0 to 5 percent chert fragments. The Bx horizon is yellowish-red cherty silty clay loam or silty clay loam. It is mottled red, brown, or gray. It is strongly acid or very strongly acid and is 0 to 45 percent chert fragments.

The depth to bedrock is 40 to 60 inches. A perched water table is at a depth of 24 to 36 inches.

Captina soils are associated with Nixa and Sallisaw soils. They have fewer chert fragments in the Bt horizon than the Nixa soils. They differ from the Sallisaw soils in having a Bx horizon.

Captina silt loam, 1 to 3 percent slopes (CcB).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Nixa soils and a few small areas of soils that are similar to Captina soils but do not have a Bx horizon.

This Captina soil is used mostly for small grains, grain sorghum, soybeans, corn, alfalfa, tame pasture, native range, and woodland (pl. III).

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grown if the soil is well managed. Returning residue to the soil and using fertilizer are good management practices. Terraces that have protected outlets, contour farming, and minimum tillage or no tillage are needed if row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Smooth Chert Savannah range site; woodland suitability group 4o7.

## Choteau Series

The Choteau series consists of deep, moderately well drained, nearly level or very gently sloping soils on uplands. These soils formed under a cover of native grasses in clayey or loamy sediment.

In a representative profile the surface layer is 14 inches of very dark grayish-brown silt loam. The subsurface layer, extending to a depth of 22 inches, is brown silt loam. The upper part of the subsoil extends to a depth of 26 inches and is yellowish-brown silty clay loam. The middle part, extending to a depth of 40 inches, is dark yellowish-brown and yellowish-brown clay. The lower part, extending to a depth of 65 inches, is coarsely mottled yellowish-brown, brownish-yellow, and grayish-brown clay.

Choteau soils have slow permeability. Available water capacity is high.

Representative profile of Choteau silt loam, 1 to 3 percent slopes, 2,500 feet south and 1,300 feet west of the NE. corner of sec. 23, T. 22 N., R. 19 E.:

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; slightly acid; clear, smooth boundary.

A1--6 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium and fine, granular structure; friable; medium acid; clear, smooth boundary.

A2--14 to 22 inches, brown (10YR 5/3) silt loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.

B1--22 to 26 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine, faint, brownish-yellow and grayish-brown mottles; weak, fine, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.

B21t--26 to 34 inches, dark yellowish-brown (10YR 4/4) clay; many, medium, distinct, grayish-brown (10YR 5/2) mottles and common, fine and medium, prominent, red (2.5YR 4/6) mottles; moderate, medium, blocky structure; very firm; clay films on faces of peds; strongly acid; gradual, smooth boundary.

B22t--34 to 40 inches, yellowish-brown (10YR 5/4) clay; many, medium, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/6) mottles; moderate, medium, blocky structure; very firm; patchy clay films on faces of peds; slightly acid; gradual, smooth boundary.

B3--40 to 65 inches, coarsely mottled yellowish-brown (10YR 5/6), brownish-yellow (10YR 6/6), and grayish-brown (10YR 5/2) clay; weak, coarse, blocky structure; very firm; patchy clay films on faces of peds; neutral.

The solum is more than 60 inches deep.

The A1 or Ap horizon is very dark grayish brown, very dark brown, or dark brown. It is slightly acid to strongly acid.

The A2 horizon is dark grayish brown, light brownish gray, brown, pale brown, or grayish brown. It is medium acid to very strongly acid.

The B1 horizon is very dark grayish-brown, dark yellowish-brown, yellowish-brown, dark-brown, or brown silty clay loam or clay loam. Mottles are brown, gray, red, or yellow. Reaction is medium acid to very strongly acid.

The B21t horizon is dark yellowish-brown or yellowish-brown silty clay loam, silty clay or clay. Mottles are red, gray, and brown. Reaction is slightly acid to strongly acid.

The B22t horizon is dark yellowish-brown or yellowish-brown silty clay loam, silty clay, or clay that has mottles in shades of gray and red. This horizon is slightly acid to strongly acid.

The B3 horizon is silty clay loam, silty clay, or clay coarsely mottled in shades of brown, yellow, or gray. It is neutral to medium acid. In places it contains iron-manganese concretions and fragments of shale and sandstone.

A perched water table is at a depth of 24 to 36 inches.

Choteau soils are associated with Dennis, Choteau, and Taloka soils. They have a thicker A horizon than the Dennis soils. They differ from the Okemah soils in having an A2 horizon, and from the Taloka soils in having a B1 horizon.

Choteau silt loam, 0 to 1 percent slopes (ChA).--This soil has a profile similar to the one described as representative of the series, but the surface layer is 4 inches thinner.

Included with this soil in mapping are small areas of Dennis, Parsons, and Taloka soils. Also, in about 10 percent of the individual mapped areas there are soils that have a dark A horizon less than 10 inches thick but that are otherwise similar to this soil.

This soil is used mostly for small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture. Some areas are in native grasses and are used as range or for hay.

The main concern of management is the maintenance of soil structure and fertility. Most crops that produce large amounts of residue can be grown continuously if the soil is well managed and most of the residue is returned to the soil. These measures, and the addition of fertilizer, help to maintain the content of organic matter and good soil structure and fertility. Capability unit I-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Choteau silt loam, 1 to 3 percent slopes (ChB).--This soil has the profile described as representative of the series.

Included with this soil in mapping are spots of Dennis, Parsons, and Taloka soils. Also, in about 12 percent of the mapped area, there are soils having a surface layer less than 10 inches thick.

This soil is used mainly for small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture. Small areas are in native grasses used for range or hay.

The main concerns of management are control of erosion and maintenance of soil structure and fertility. Most of the adapted crops can be grown if the soil is well managed, which includes returning most of the crop residue to the soil. Contour farming and terraces help to control erosion if row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

## Clarksville Series

The Clarksville series consists of deep, somewhat excessively drained, very gently sloping to very steep soils on uplands. These soils formed under a cover of hardwoods and pine and an understory of native grasses in material weathered from cherty limestone.

In a representative profile the surface layer is 4 inches of very dark grayish-brown, cherty silt loam. The subsurface layer, extending to a depth of 16 inches, is brown, very cherty silt loam. The upper part of the subsoil extends to a depth of 30 inches and is brown, very cherty silty clay loam. The lower part extends to a depth of 60

inches and is yellowish-red, very cherty silty clay loam (pl. II)

Clarksville soils have moderately rapid permeability and moderate available water capacity.

Representative profile of Clarksville cherty silt loam in an area of Clarksville stony silt loam, 20 to 50 percent slopes, 1,320 feet west and 1,320 feet south of the NE. corner of sec. 36, T. 21 N., R. 20 E.

A1--0 to 4 inches, very dark grayish-brown (10YR 3/2) cherty silt loam; moderate, medium, granular structure; very friable; 40 percent chert fragments and 10 percent stones; very strongly acid; clear, smooth boundary.

A2--4 to 16 inches, brown (10YR 5/3), very cherty silt loam; weak, fine, granular structure; very friable; 50 percent chert fragments; very strongly acid; gradual, wavy boundary.

B1--16 to 30 inches, brown (7.5YR 5/4) very cherty silty clay loam; weak, fine, subangular blocky structure; friable; 80 percent chert fragments; very strongly acid; gradual, smooth boundary.

B2t--30 to 60 inches, yellowish-red (5YR 5/6), very cherty silty clay loam; few, medium, distinct, red (2.5YR 4/6) mottles; moderate, fine, blocky structure; firm; clay films on faces of peds and on chert fragments; 90 percent chert fragments; very strongly acid.

The A1 horizon is very dark grayish-brown, dark grayish-brown, and dark-brown cherty silt loam. It is stony in places. Chert fragments range from 20 to 50 percent, by volume, and stones range from 0 to 15 percent.

The A2 horizon is brown, yellowish-brown, pale-brown, or light yellowish-brown very cherty or cherty silt loam. It is stony in places. Chert fragments make up 50 to 80 percent of this horizon, by volume.

The B1 horizon is brown or strong brown. Content of chert fragments ranges from 50 to 80 percent, by volume.

The B2t horizon is brown, light brown, strong brown, red, reddish brown, light reddish brown, light red, yellowish red, or reddish yellow. It has mottles in shades of red and brown. Content of chert fragments ranges from 60 to 90 percent, by volume.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Clarksville soils are associated with Nixa soils and are similar to Eldorado soils. They lack the Bx horizon that is in the associated Nixa soils. They have a thinner A1 horizon than the Eldorado soils and have an A2 horizon that is lacking in those soils.

Clarksville cherty silt loam, 1 to 8 percent slopes (CkD).--This soil is less stony, but otherwise it has a profile similar to the one described as representative of the series.

Included with this soil in mapping are spots of Nixa soils. Also included are a few small areas of Clarksville stony silt loam.

Most of this soil is wooded and is used for grazing livestock. Some small areas have been cleared and are used for growing tame pasture and sorghums.

The main concerns of management are low fertility, droughtiness, and the large number of chert fragments that make tillage difficult. Sorghum or other crops that produce a large amount of residue can be grown if fertilizer is applied and residue is returned to the soil. Areas of tame pasture need to be fertilized and to have the brush controlled. Capability unit IVs-1; pasture and hayland suitability group 8B; Smooth Chert Savannah range site; woodland suitability group 4f8.

Clarksville stony silt loam, 5 to 20 percent slopes (ClE).--This soil has a profile similar to the one described as representative of the series.

Included with this soil in mapping are small areas of Sallisaw soils. About 15 percent of the individual mapped areas is made up of Clarksville cherty silt loam. Also included are small areas of soils that are similar to this soil except that they have mottles of low chroma in the upper part of the B2t horizon. There are also a few small areas of a soil that is more clayey in the B2t horizon than this soil.

Most of this soil is wooded and is used for grazing livestock. A small percentage has been cleared and is used as tame pasture (pl. III).

The main concerns of management are low fertility, droughtiness, steep slopes, and stoniness. If this soil is not properly managed, the vegetation becomes brushy and intensive management is needed for woodland or range. This soil is not suitable for cultivation. If it is properly managed and fertilized, and if brush is controlled, it is fairly well suited to tame pasture. The quality of the native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and

protecting against fire. Capability unit VIs-1; pasture and hayland suitability group 8B, Smooth Chert Savannah range site; woodland suitability group 4f8.

Clarksville stony silt loam, 20 to 50 percent slopes (ClF).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Nixa and Sallisaw soils. About 10 percent of the individual mapped areas is made up of soils that are similar to this soil, though they contain few stones and slopes are less than 20 percent. Also included are small areas of soils that are similar to this soil but have mottles of low chroma in the upper part of the B2t horizon. There are also small areas of a soil that is more clayey in the B2t horizon than Clarksville soils.

Most of this soil is wooded and is used for grazing livestock.

The main concerns of management are low fertility, droughtiness, steep slopes, and stoniness. If this soil is not properly managed, the vegetation becomes brushy, and intensive management is needed for woodland or range. This soil is not suitable for cultivation. The quality of the native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and protecting against fire. Capability unit VIIs-1; not assigned to a pasture and hayland suitability group; Steep Chert Savannah range site; woodland suitability group 4f8.

## Collinsville Series

The Collinsville series consists of well-drained to somewhat excessively drained, very shallow or shallow, very gently sloping to steep soils on uplands. These soils formed under a cover of native grasses in material weathered from sandstone.

In a representative profile the surface layer is 9 inches of very dark brown loam. The underlying material is hard sandstone.

Collinsville soils have moderately rapid permeability. Available water capacity is low.

Representative profile of Collinsville loam in an area of Collinsville soils, 5 to 30 percent slopes, 2,140 feet north and 1,320 feet east of the SW. corner of sec. 30, T. 20 N., R. 19 E.:

A1--0 to 9 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; slightly hard, friable; few sandstone fragments 3 to 10 inches in diameter; stones cover 15 percent of surface; medium acid; abrupt, wavy boundary.

R--9 to 12 inches, hard sandstone.

The A1 horizon is very dark grayish-brown or very dark brown fine sandy loam or loam. It is slightly acid or medium acid. It is 2 to 35 percent sandstone fragments.

The depth to hard sandstone is 4 to 20 inches. The ground water table is at a depth of more than 72 inches.

Collinsville soils are associated with Bates and Hector soils. They are shallower than the Bates soils and lack the B2t horizon of the Bates soils. They differ from the Hector soils in having a thicker A1 horizon and in lacking an A2 horizon.

Collinsville soils, 5 to 30 percent slopes (CoE).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Bates and Dennis soils. Also included are small areas of rock outcrop and of soils shallow over shale but otherwise similar to this soil.

Most of this soil is in native grasses and is used for grazing livestock.

The main concerns of management are low fertility, droughtiness, steep slopes, and stoniness. If this soil is not properly managed, the vegetation becomes brushy, and intensive management is needed for woodland or range. This soil is not suitable for cultivation. The quality of the native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and protecting against fire. Capability unit VIIs-2; not assigned to a pasture and hayland suitability group; Shallow Prairie range site; not assigned to a woodland suitability group.

## Craig Series

The Craig series consists of deep, very gently sloping or gently sloping soils on uplands. These soils formed in material weathered from cherty limestone under a cover of native grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam to a depth of 15 inches. The subsurface layer, to a depth of 24 inches, is brown cherty silt loam. The next layer, extending to a depth of 36 inches, is brown cherty silt loam. The upper part of the subsoil extends to a depth of 50 inches and is yellowish-red cherty clay. The lower part,

extending to a depth of 64 inches, is yellish-red very cherty clay. The subsoil is underlain by cherty limestone.

The Craig soils are well drained and have moderately slow permeability. Available water capacity is moderate to high.

Representative profile of Craig silt loam, 1 to 3 percent slopes, 540 feet south and 200 feet west of the NE. corner of sec. 4, T. 23 N., R. 21 E.:

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; few chert fragments; medium acid; clear, smooth boundary.

A1--6 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; few chert fragments; medium acid; gradual, smooth boundary.

A2--15 to 24 inches, brown (10YR 5/3) cherty silt loam; weak, fine, subangular blocky structure; friable; about 20 percent, by volume, chert fragments; very strongly acid; gradual, smooth boundary.

AB--24 to 36 inches, brown (10YR 5/3) cherty silt loam; weak, fine subangular blocky structure; friable; about 45 percent, by volume, chert fragments; very strongly acid; gradual, smooth boundary.

B21t--36 to 50 inches, yellowish-red (5YR 4/6) cherty clay; moderate, medium, blocky structure; firm; clay films on faces of peds and on chert fragments; about 45 percent, by volume, chert fragments; very strongly acid; gradual, smooth boundary.

B22t--50 to 64 inches, yellowish-red (5YR 4/8) very cherty clay; common, fine, prominent, dark-red (2.5YR 3/6), light yellowish-brown (10YR 6/4), and light brownish-gray (10YR 6/2) mottles; weak, fine, blocky structure; firm; clay films on faces of ped and on chert fragments; 80 percent chert fragments; very strongly acid.

The A1 or Ap horizon is very dark grayish brown or very dark brown. It is medium acid or strongly acid. It is 4 to 12 percent chert fragments.

The A2 horizon is grayish-brown or brown silt loam or cherty silt loam. It is medium acid to very strongly acid. It is 8 to 25 percent chert fragments. The AB horizon is dark brown, dark yellowish brown, or brown. It is medium acid to very strongly acid. It is 15 to 45 percent, by volume, chert fragments less than 3 inches in diameter, and 0 to 5 percent chert fragments more than 3 inches in diameter. The B21t horizon is dark-brown, yellowish-brown, reddish-brown, or yellowish-red very cherty silty clay loam, cherty silty clay loam, or cherty clay loam. It is medium acid to very strongly acid. It is 30 to 60 percent, by volume, chert fragments less than 3 inches in diameter, and 5 to 10 percent chert fragments more than 3 inches in diameter. The B22t horizon is dark-brown, brown, yellowish-brown, reddish-brown, or yellowish-red cherty or very cherty silty clay loam or clay. It is 35 to 80 percent, by volume, chert fragments less than 3 inches in diameter, and 5 to 10 percent fragments more than 3 inches in diameter. It is medium acid to very strongly acid.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Craig soils are associated with Eldorado and Riverton soils. They differ from the Eldorado and Riverton soils in having more clay in the upper part of the B2t horizon.

Craig silt loam, 1 to 3 percent slopes (CrB).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Dennis and Eldorado soils. About 5 percent of the individual mapped areas is made up of soils that are similar to this soil, but that have a Bx horizon.

This Craig soil is used mostly for growing small grains, grain sorghum, soybeans, corn, alfalfa, and time pasture. Some areas are in native grasses and are used for range or hay.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grown if this soil is well managed, fertilizer is used, and large amounts of residue are returned to the soil. Terraces and contour farming are needed if row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5f2.

Craig silt loam, 3 to 5 percent slopes (CrC).--This soil has a profile similar to the one described as representative of the series but depth to the subsoil is 10 inches less.

Included with this soil in mapping are small areas of Dennis, Eldorado, and Riverton soils.

This Craig soil is used mostly for grain sorghum, small grains, soybeans, corn, and tame pasture. Some areas are in native grasses and are used as range or for hay.

The main concerns of management are the hazard of erosion and the maintenance of soil fertility and structure. If row crops are grown, terraces and contour farming are needed. Large amounts of residue should be returned to the soil and fertilizers used to help maintain the content of organic-matter and the soil structure and to increase the intake rate of water. If terraces are not used, a cropping system is needed that includes only soil-maintaining crops and that includes biennial or perennial vegetation at least half the time. Capability unit IIIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5f2.

## Dennis Series

The Dennis series consists of deep, moderately well drained, very gently sloping or gently sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from shale or clay.

In a representative profile the surface layer is 11 inches of very dark grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 23 inches, is dark-brown silty clay loam. The middle part extends to a depth of 29 inches and is dark-brown clay. The lower part, extending to a depth of 60 inches, is yellowish-brown clay.

Dennis soils have slow permeability. Available water capacity is high.

Representative profile of Dennis silt loam, 1 to 3 percent slopes, 50 feet south of the NW. corner of sec. 16, T. 23 N., R. 19 E.:

A1--0 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; medium acid; gradual, smooth boundary.

B1--11 to 16 inches, dark-brown (10YR 4/3) silty clay loam; few, fine, faint, dark grayish-brown mottles; compound weak, fine, subangular blocky structure and strong, medium, granular structure; firm; strongly acid; gradual, smooth boundary.

B21t--16 to 23 inches, dark-brown (10YR 4/3) silty clay loam; common, medium, faint, grayish-brown mottles (10YR 5/2) and prominent, red (2.5YR 4/6) mottles; moderate, medium, blocky structure; very firm; clay films on faces of peds; strongly acid; gradual, smooth boundary.

B22t--23 to 29 inches, dark-brown (10YR 4/3) clay; common, fine, prominent, red, yellowish-red, and dark-gray mottles; moderate, medium, blocky structure; very firm; clay films on faces of peds; strongly acid; gradual, smooth boundary.

B3--29 to 60 inches, yellowish-brown (10YR 5/8) clay; many, coarse, distinct, gray (10YR 5/1 and 10YR 6/1) mottles; weak, coarse, blocky structure; very firm; common iron-manganese concretions and streaks; few shale fragments; slightly acid.

The A1 horizon is very dark brown or very dark grayish brown. It is medium acid or strongly acid. In places there is an A2 horizon.

The B1 horizon is brown, dark-brown, or dark yellowish-brown silty clay loam or clay loam. It is medium acid to very strongly acid.

The B21t and B22t horizons are brown, dark-brown, dark-yellowish, or yellowish-brown silty clay loam, clay loam, or clay. They are medium acid or strongly acid. They have gray, brown, or red mottles.

The B3 horizon is yellowish-brown or coarsely mottled brown, yellow, or gray silty clay loam, clay loam, or clay. It is slightly acid or medium acid.

The depth to bedrock is more than 60 inches. A perched water table is at a depth of 24 to 36 inches.

Dennis soils are associated with Choteau, Okemah, Bates, Parsons, and Taloka soils. They have a thinner A horizon than the Choteau soils. Dennis soils have less gray B1 and B21t horizons than the similar Okemah soils. They are deeper and more clayey than the Bates soils. They have a thicker A1 horizon than the Parsons and Taloka soils.

Dennis silt loam, 1 to 3 percent slopes (DnB).--This soil has the profile described as representative of the series.

Included with this soil in mapping are spots of Choteau, Bates, Parsons, and Taloka soils. About 10 percent of the mapped area is made up of soils similar to Dennis soils less than 60 inches deep over bedrock.

This Dennis soil is used mostly for small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture. A sizable acreage is in native grasses used as range or for hay (pl. IV).

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most adapted crops can be grown continuously if the soil is well managed and residue is returned to the soil. Contour farming and terraces are needed if row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.



548-966 O - 75 - 2

Dennis silt loam, 3 to 5 percent slopes (DnC).--This soil has a profile similar to the one described as representative of the series.

Included with this soil in mapping are small areas of Bates and Collinsville soils. About 8 percent of the individual mapped areas consists of soils that are similar to Dennis soils but have a less clayey subsoil. An additional 5 percent is soils that have a thinner surface layer.

This Dennis soil is used mostly as range or for hay. Some areas are used for small grains, grain sorghum, soybeans, corn, and tame pasture.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. If row crops are grown, contour farming and terraces are needed. Crops that produce large amounts of residue should be kept on the soil at least one-third of the time, and the residue should be managed for soil improvement. If row crops are not grown and terraces are not used, all crops should be of the kind that produce large amounts of residue. Annual reseeding should be provided or biennial or perennial vegetation should be grown at least half the time. Capability unit IIIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Dennis silt loam, 2 to 5 percent slopes, eroded (DnC2).--Part of the original surface layer of this soil has been removed by erosion in about 70 percent of the mapped areas. In about 20 percent of the mapped areas the surface layer is material from the subsoil and from the original surface layer that have been mixed by tillage. A few gullies and rills about 6 to 48 inches deep are in the more eroded areas. The deeper gullies are not crossable with farm machinery.

Included with this soil in mapping are areas of Bates, Collinsville, and Okemah soils. In about 10 percent of the mapped areas the soils are similar to Dennis soils but have shale at a depth of less than 60 inches.

Most of this soil is cultivated, or has been cultivated. It is used mainly for tame pasture, but a limited acreage is used for small grains, grain sorghum, or soybeans. A sizable acreage has a poor, weedy growth of grasses grazed by livestock.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Erosion should be controlled by a permanent cover of perennial grasses. Contour farming and terraces are required in cultivated areas. Large amounts of residue should be returned to the soil. Using fertilizer helps to increase the amount of residue and to maintain fertility. Capability unit IIIe-3; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Dennis-Verdigris complex, 0 to 15 percent slopes (DvE).--This complex consists of Dennis and Verdigris soils in and around drainageways on prairie uplands. It is about 45 percent Dennis soils and 30 percent Verdigris soils. The profile of the Verdigris soil is similar to the one described as representative of the series, but the surface layer is a few inches thinner. The Dennis soil is very gently sloping or gently sloping and is on uplands. The sloped areas are 150 to 350 feet wide. The Verdigris soil is nearly level and is on flood plains that are frequently flooded. The areas are 50 to 150 feet wide.

Included with these soils in mapping are small areas of Collinsville, Parsons, Summit, and Taloka soils. Also included is a soil that is similar to the Verdigris soil but that has a lighter colored surface layer. About 20 percent of the individual mapped areas is stream channels and a soil that is similar to this Dennis soil but that has a thinner surface layer. The Dennis soil is very gently sloping or gently sloping and is on uplands. The sloped areas are 150 to 350 feet wide. The Verdigris soil is nearly level and is on flood plains that are frequently flooded. These areas are 50 to 150 feet wide.

Included with these soils in mapping are small areas of Collinsville, Parsons, Summit, and Taloka soils. Also included is a soil that is similar to the Verdigris soil but that has a lighter colored surface layer. About 20 percent of the individual mapped areas is stream channels and a soil that is similar to this Dennis soil but that has a thinner surface layer.

This complex is used mostly as range. Most of the acreage is in native grasses. Only a few small areas have been cultivated. The flooding and slopes make these soils unsuitable for cultivation. They are suited to range, tame pasture, or wildlife habitat. The quality of the native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and providing fire protection. Both parts in capability unit VIe-1; Dennis part in pasture and hayland suitability group 8A and Verdigris part in pasture and hayland suitability group 2A; Dennis part in Loamy Prairie range site and Verdigris part in Loamy

Bottomland range site; both parts not assigned to a woodland suitability group.

## Eldorado Series

The Eldorado series consists of deep, well-drained, very gently sloping to sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from cherty limestone.

In a representative profile (pl. IV) the surface layer is 10 to 21 inches of very dark grayish-brown cherty silt loam and very dark brown cherty silt loam. The upper part of the subsoil, extending to a depth of 37 inches, is reddish-brown very cherty silty clay loam. The lower part of the subsoil, extending to a depth of 60 inches, is a yellowish-red very cherty silty clay loam.

Eldorado soils have moderate permeability. Available water capacity is moderate.

Representative profile of Eldorado cherty silt loam in an area of Eldorado soils, 1 to 8 percent slopes, 750 feet west of the SE. corner of sec. 31, T. 23 N., R. 21 E.:

A11--0 to 12 inches, very dark grayish-brown (10YR 3/2) cherty silt loam; moderate, medium, granular structure; friable; about 15 percent, by volume, chert fragments 1 to 4 inches in diameter; medium acid; gradual, smooth boundary.

A12--12 to 21 inches, very dark brown (10YR 2/2) very cherty silt loam; moderate, medium, granular structure; friable; about 60 percent, by volume, chert fragments 1 to 8 inches in diameter; medium acid; gradual, smooth boundary.

B1--21 to 37 inches, reddish-brown (5YR 4/4) very cherty silty clay loam; weak, fine, granular structure; friable; about 75 percent, by volume, chert fragments 1 to 8 inches in diameter; strongly acid; gradual, smooth boundary.

B2t--37 to 60 inches, yellowish-red (5YR 7/6) very cherty silty clay loam; moderate, fine, blocky structure; firm; nearly continuous clay films on faces of peds and on chert fragments; about 80 percent, by volume, chert fragments 1 to 8 inches in diameter; strongly acid.

The A11 or Ap horizon is black, very dark gray, very dark grayish-brown, or very dark brown cherty silt loam or stony silt loam. It is slightly acid or medium acid. It is 15 to 45 percent, by volume, chert fragments less than 3 inches in diameter, and 0 to 5 percent fragments 3 to 12 inches in diameter.

The A12 horizon is very dark grayish-brown, very dark brown, or dark-brown cherty silt loam or very cherty silt loam. It is slightly acid or medium acid. It is 20 to 60 percent, by volume, cherty fragments less than 3 inches in diameter and 0 to 5 percent fragments more than 3 inches in diameter.

The B1 horizon is dark-brown, dark yellowish-brown, reddish-brown, or dark reddish-brown very cherty silty clay loam or very cherty clay loam. The B1 horizon is 45 to 55 percent, by volume, chert fragments less than 3 inches in diameter and 5 to 10 percent fragments more than 3 inches in diameter.

The B2t horizon is dark reddish-brown, yellowish-red, red, or dark-red very cherty silty clay loam or very cherty clay loam. In places it is mottled in the lower part. It is medium acid or strongly acid. It is 45 to 80 percent, by volume, chert fragments less than 3 inches in diameter and 10 to 25 percent fragments more than 3 inches in diameter.

The depth to cherty limestone is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Eldora soils are similar to Clarksville soils but have a thicker A1 horizon and lack an A2 horizon. They are associated with Craig soils but differ in having less clay in the upper part of the B2t horizon.

Eldorado soils, 1 to 8 percent slopes (ElD).--This soil has a profile similar to that described as representative of the series, but the texture of the surface layer is silt loam and contains stone fragments.

Included with this soil in mapping are small areas of Craig, Dennis, and Summit soils and a few areas of soils that have gray mottles in the upper part of the subsoil. Also included are a few areas where the subsoil is thin over chert fragments, but where the soils are otherwise similar to those of the Eldorado series.

Most areas of this soil have never been cultivated. The soil is not suitable for cultivated crops and is used as range or for hay. A small acreage is used as tame pasture.

This soil needs fertilizer and careful control of grazing. Where stones are not excessive, tame pasture can be grown. Quality native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and providing fire protection. Capability unit VIs-2; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5f2.

## Elsah Series

The Elsah series consists of deep, well-drained or somewhat excessively drained, nearly level or very gently sloping soils on flood plains. These soils formed under a cover of hardwoods in cherty loamy sediments.

In a representative profile the surface layer is 14 inches of dark-brown loam. The upper part of the underlying layer, extending to a depth of 18 inches, is dark-brown very gravelly loam. The lower part, extending to a depth of 60 inches, is dark yellowish-brown very gravelly loam.

Elsah soils have moderately rapid or moderate permeability. Available water capacity is high.

Representative profile of Elsah loam from an area of Elsah soils, frequently flooded, 1,300 feet north and 330 feet east of the SW. corner of sec. 20, T. 21 N., R. 21 E.:

A1--0 to 14 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable; few roots; about 5 percent, by volume, chert fragments less than 3 inches in diameter; slightly acid; gradual, smooth boundary.

C1--14 to 18 inches, dark-brown (10YR 4/3) very gravelly loam; massive; friable; few roots; few dark concretions; evident bedding planes; about 60 percent, by volume, chert fragments; slightly acid; gradual, smooth boundary.

C2--18 to 60 inches, dark yellowish-brown (10YR 4/4) very gravelly loam; massive; few roots; evident bedding places; 80 percent, by volume, chert fragments; slightly acid.

The A1 or Ap horizon is very dark grayish-brown or dark-brown loam, gravelly loam, silt loam, or gravelly silt loam. It is 5 to 30 percent, by volume, chert fragments. The C1 and C2 horizon is brown, dark-brown, dark yellowish-brown, or yellowish-brown very gravelly silt loam or very gravelly loam. It is neutral to medium acid. It is 50 to 80 percent, by volume, chert fragments.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

The dark-colored A horizon is thicker than is defined as within the range for the series, but this difference does not alter usefulness and behavior of these soils.

Elsah soils are associated with Cannon soils. They differ from the associated Cannon soils in having a C horizon that is, by volume, 35 percent or more rock fragments.

Elsah soils, frequently flooded (Es).--These nearly level or very gently sloping soils are subject to frequent flooding.

Included with these soils in mapping are small areas of Cannon soils. About 14 percent of the individual mapped areas is soils that have a thinner A1 horizon but that are otherwise similar to these Cannon soils. Gravel bars and stream channels make up 25 percent of the mapped areas (pl. V).

These soils are wooded and are used mostly for grazing livestock. Some areas have been cleared and are used as tame pasture.

The main concern of management is frequent flooding. These soils support high-quality hardwoods if the trees are thinned, weeded, and selectively harvested. A good sod is desirable on tame pasture to control erosion caused by flooding. Brush control is needed. Capability unit Vw-1; pasture and hayland suitability group 2A; not assigned to a range site; woodland group 2f4.

## Enders Series

The Enders series consists of deep, well-drained, very gently sloping through moderately steep soils on uplands. These soils formed under a cover of hardwoods and pines and an understory of native grasses in material weathered from shale.

In a representative profile the surface layer is 5 inches of dark-brown fine sandy loam and loam. The upper part of the subsoil, extending to a depth of 9 inches, is brown silty clay loam. The middle part extends to a depth of 28 inches and is yellowish-red silty clay and red clay. The lower part, extending to a depth of 42 inches, is variegated red and gray clay and variegated gray, yellowish-brown, and reddish-brown silty clay. The underlying material is light-gray, weathered, soft shale.

Enders soils have very slow permeability. Available water capacity is high.

Representative profile of Enders fine sandy loam in an area of Hector-Enders complex, 5 to 20 percent slopes, 170 feet west of the SE. corner of sec. 6, T. 21 N., R. 18 E.:

A11--0 to 2 inches, dark-brown (10YR 3/3) fine sandy loam; weak, fine, granular structure; very friable; common fine roots; few fine shale and sandstone

fragments; strongly acid; gradual, smooth boundary.

A12--2 to 5 inches, dark-brown (7.5YR 4/4) loam; weak, fine, granular structure; friable; common fine roots; common fine shale and sandstone fragments; strongly acid; gradual, smooth boundary.

B1--5 to 9 inches, brown (7.5YR 5/4) silty clay loam; weak, fine, subangular blocky structure; friable; few fine roots; patchy clay films on faces of peds; common fine sandstone and shale fragments 1/2 to 3 inches in diameter; strongly acid; clear, smooth boundary.

B21t--9 to 16 inches, yellowish-red (5YR 4/8) silty clay; few, medium, distinct, strong-brown mottles; moderate, fine, blocky structure; firm; few fine roots; nearly continuous clay films on faces of peds; common fine sandstone and shale fragments; very strongly acid; gradual, smooth boundary.

B22t--16 to 28 inches, red (2.5YR 4/8) clay; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; strong, coarse, blocky structure; extremely firm; few fine roots; nearly continuous clay films on faces of peds; common fine shale fragments; extremely acid; gradual, smooth boundary.

B23t--28 to 36 inches, variegated red (2.5YR 6/6) and gray (10YR 6/1) clay; strong, fine, blocky structure; very firm; few fine roots; nearly continuous clay films on faces of peds; common fine shale and sandstone fragments; very strongly acid; gradual, smooth boundary.

B3--36 to 42 inches, variegated gray (10YR 6/1), yellowish-brown (10YR 5/4), and reddish-brown (5YR 5/4) silty clay; strong, fine, subangular blocky structure; firm; few fine roots; patchy clay films on faces of peds; common fine shale and sandstone fragments; extremely acid; gradual, smooth boundary.

C--42 to 48 inches, light-gray (10YR 7/1), weathered, soft shale; common, medium, distinct, yellowish-red (5YR 5/6) mottles; few fine roots; very strongly acid.

The A1 or Ap horizon is very dark grayish brown, brown, dark brown, or dark yellowish brown. The B1 horizon is dark-brown, strong-brown, brown, reddish-brown, or yellowish-red clay loam, silty clay loam, or loam. The B21t horizon is yellowish-red or red silty clay or clay. It is strongly acid through extremely acid. The B22t horizon is yellowish-red or red silty clay or clay mottled in shades of brown or gray. The B23t horizon is silty clay or clay coarsely mottled in shades of red, gray, and brown. The B3 horizon is silty clay or clay coarsely mottled in shades of red, brown, and gray. The C horizon is mottled with shades of red and brown.

The depth to shale is 40 to 60 inches. The ground water table is at a depth of more than 72 inches.

Enders soils are associated with Hector soils. They are more clayey in the B horizon and are deeper over bedrock than those soils.

## Hector Series

The Hector series consists of shallow, well-drained, very gently sloping to very steep soils on uplands. These soils formed under a cover of hardwoods and an understory of native grasses, in material weathered from sandstone

In a representative profile the surface layer and subsurface layers are 6 inches of dark-brown fine sandy loam. The subsoil, extending to a depth of 18 inches, is yellowish-red sandy loam. It is underlain by hard sandstone.

Hector soils have moderately rapid permeability. Available water capacity is low.

Representative profile of Hector gravelly fine sandy loam in an area of Hector-Enders complex, 1 to 5 percent slopes, 1,700 feet south and 100 feet east of the NW. corner of sec. 6, T. 22 N., R. 18 E.:

A1--0 to 2 inches, very dark grayish-brown (10YR 3/2) gravelly fine sandy loam; weak, fine, granular structure; very friable; many medium roots; 15 percent, by volume, sandstone fragments; slightly acid; gradual, smooth boundary.

A2--2 to 6 inches, yellowish-brown (10YR 5/4) gravelly fine sandy loam; weak, fine, granular structure; friable; common medium roots; 20 percent, by volume, sandstone fragments; slightly acid; gradual, smooth boundary.

B--6 to 18 inches, yellowish-brown (10YR 5/6) gravelly fine sandy loam; weak, medium, subangular blocky structure; friable; common medium roots; 30 percent, by volume, sandstone fragments; strongly acid; abrupt, irregular boundary.

R--18 to 20 inches, sandstone bedrock; hard; massive.

The A1 horizon is dark grayish-brown, very dark grayish-brown, dark-brown, or

brown fine sandy loam or gravelly fine sandy loam. It is slightly acid to strongly acid. It is 0 to 25 percent, by volume, sandstone fragments. The A2 horizon is brown, dark-brown, yellowish-brown, or dark yellowish-brown fine sandy loam or gravelly fine sandy loam. It is slightly acid to strongly acid. It is 0 to 25 percent, by volume, sandstone fragments. The B horizon is yellowish-brown or yellowish-red sandy loam or gravelly sandy loam. It is 0 to 25 percent, by volume, sandstone fragments.

The depth to hard sandstone is 10 to 20 inches. The water table is at a depth of more than 72 inches.

Hector soils are similar to Collinsville soils but have a thinner A1 horizon and an A2 horizon. They are associated with Enders soils but are less clayey in the B horizon and are shallower over bedrock than those soils.

Hector-Enders complex, 1 to 5 percent slopes (HeC).--This complex is about 35 percent Hector soils and about 25 percent Enders soils. The Hector soil has the profile described as representative of the series. The Enders soil has a profile similar to the one described as representative of the series.

Included with these soils in mapping and making up about 3 percent of the acreage are small areas of Dennis soils. About 16 percent of the mapped area is a soil similar to Hector soil but having bedrock at a depth of 20 to 40 inches. Bedrock is at a depth of 10 inches in 15 percent of this acreage. About 6 percent of the acreage mapped has a dark surface layer more than 10 inches thick.

Most of the acreage in this complex is used as range. A small acreage has been cleared of trees and is used for small grains, grain sorghum, and tame pasture.

The main concerns of management are the hazard of erosion, the shallowness to bedrock, and the maintenance of soil structure and fertility. Small grains or other high residue crops can be grown continuously if fertilizer is used and all residue is returned to the soil. If residue is not returned to the soil, terraces and contour farming are needed to control erosion. Terraces are difficult to build and maintain on these soils. Both parts in capability unit IVe-2; Hector part in pasture and hayland suitability group 14A and Enders part in pasture and hayland suitability group 8B; Hector part in Shallow Savannah range site and Enders part in Sandy Savannah range site; Hector part in woodland suitability group 5d2 and Enders part in woodland suitability group 4o1.

Hector-Enders complex, 5 to 20 percent slopes (HeE).--This complex is about 53 percent Hector soils, and about 32 percent Enders soils. The Hector soil has a profile similar to the one described as representative of the series but 3 inches deeper over bedrock. The Enders soil has the profile described as representative of the series.

Included areas of soils that are less than 10 inches deep over sandstone bedrock make up about 8 percent of this complex. About 5 percent of the acreage is made up of soils that are 20 to 40 inches deep over sandstone bedrock. An additional 2 percent is soils that are dark colored throughout.

Most of this mapping unit is used as range. A small acreage has been cleared of trees and is used as pasture.

This mapping unit is not suitable for cultivation. It is suitable for growing trees, native grasses, and food and cover for wildlife. The quality of the native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and providing protection from fire. Both parts in capability unit VIIs-3; not assigned to a pasture and hayland suitability group; Hector part in Shallow Savannah range site and Enders part in Sandy Savannah range site; Hector part in woodland suitability group 5d2 and Enders part in woodland suitability group 4o1.

Hector soils, 20 to 50 percent slopes (HsF).--This soil has a surface layer that is partly fine sandy loam. Otherwise it has a profile similar to the one described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage are areas of a soil that is similar to this soil but that is less than 10 inches deep over sandstone bedrock, and areas of a soil that is similar to this soil but 20 to 40 inches deep over sandstone bedrock. An additional 10 percent is a soil similar to Hector soils but 20 to 40 inches deep over shale. About 15 percent is a soil that is similar to Hector soils but 10 to 20 inches deep over limestone bedrock. About 13 percent of this acreage is small areas of rock outcrop.

Most of this soil is woodland. The understory of native grasses is used for grazing livestock and for wildlife.

This soil is not suitable for cultivation. It is suitable for growing trees, native grasses, and food and cover for wildlife. The quality of native grasses can be maintained or improved by controlling brush, using suitable growing practices, and providing protection from fire. Capability unit VIIs-4; not assigned to a pasture and

hayland suitability group; Savannah Breaks range site; woodland suitability group 5d2.

## Kanima Series

The Kanima series consists of deep, well-drained, gently sloping through steep soils on uplands. These soils formed under a cover of native grasses or hardwoods and pines in material weathered from shale.

In a representative profile the surface layer is 4 inches of dark-brown, shaly silty clay loam. The underlying material, extending to a depth of 72 inches, is brown, very shaly silty clay loam.

Kanima soils have moderate permeability Available water capacity is moderate.

Representative profile of Kanima shaly silty clay loam in an area of Kanima soils, 1 to 30 percent slopes, 1,320 feet east and 1,320 feet south of the NW. corner of sec. 7, T. 23 N., R. 18 E.:

A--0 to 4 inches, dark-brown (10YR 4/3) shaly silty clay loam; weak, fine, granular structure; friable; common fine roots; 15 percent shale fragments; slightly acid; clear, wavy boundary.
C--4 to 72 inches, brown (10YR 5/3) very shaly silty clay loam; massive; 60 percent light-gray (10YR 6/1) and yellowish-brown (10YR 5/6) shale fragments; neutral.

The A horizon is dark grayish-brown, very dark grayish-brown, or dark-brown shaly silty clay loam or shaly clay loam. It is about 20 to 50 percent shale fragments that are less than 3 inches in diameter, and less than 5 percent fragments larger than 3 inches. It is medium acid to moderately alkaline.

The C horizon is very dark grayish brown, dark grayish brown, brown, or olive gray. It is 50 to 90 percent shale fragments that are less than 3 inches in diameter, and 5 to 30 percent fragments larger than 3 inches. It is medium acid to moderately alkaline.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Kanima soils lack the B2t horizons of the associated Dennis and Okemah soils.

Kanima soils, 1 to 30 percent slopes (KaE).--This soil has the profile described as representative of the Kanima series.

Included with this soil are deep strip pits that are generally filled with water and make up about 3 percent of this area.

Management is needed that establishes, improves, or maintains stands of vegetation. Practices that may be needed are leveling, establishing desired vegetation, controlling grazing, and using fertilizer. Capability unit VIIe-1; not assigned to a pasture and hayland suitability group; not assigned to a range site; not assigned to a woodland suitability group.

## Lenapah Series

The Lenapah series consists of shallow, well-drained, nearly level to sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from limestone.

In a representative profile the surface layer is 9 inches of black and very dark gray silty clay loam. The upper part of the subsoil extends to a depth of 14 inches and is black silty clay loam. The lower part, extending to a depth of 18 inches, is a black clay. The subsoil is underlain by hard limestone.

Lenapah soils have slow permeability. Available water capacity is moderate.

Representative profile of Lenapah silty clay loam, 0 to 3 percent slopes, 1,800 feet east of the SW. corner of sec. 24, T. 23 N., R. 19 E.:

Ap--0 to 6 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
A1--6 to 9 inches, black (10YR 2/1) silty clay loam; strong, medium, granular structure; friable; clean sand grains; slightly acid; gradual, smooth boundary.
B1--9 to 14 inches, black (10YR 2/1) silty clay loam; strong, fine, blocky structure; firm; neutral; gradual, smooth boundary.
B2t--14 to 18 inches, black (10YR 2/1) clay; few, fine, faint, dark-brown mottles; moderate, medium, blocky structure; firm; clay films or pressure faces on surfaces; few fine iron-manganese concretions; few limestone fragments; neutral; abrupt, wavy boundary.
R--18 to 20 inches, hard limestone bedrock.

The A1 or Ap horizon is black, very dark gray, very dark grayish brown, or very dark brown. It is slightly acid or medium acid. The B1 horizon is black, very dark gray, very dark grayish brown, or very dark brown. It is slightly acid or neutral. The B2t horizon is black, very dark gray, very dark

brown, or very dark grayish-brown silty clay loam or clay. It is slightly acid or neutral. Hard limestone bedrock is at a depth of 16 to 20 inches.

The ground water table is at a depth of more than 72 inches.

The Lenapah soils are associated with Summit, Mayes, and Lula soils. They differ from the Summit soils in being shallower over limestone bedrock. They differ from the Mayes soils in having a solum less than 20 inches thick and in being more permeable. They differ from the Lula soils in having a more clayey Bt horizon.

Lenapah silty clay loam, 0 to 3 percent slopes (LeB).--This soil has the profile described as representative of the series.

Included with this soil in mapping, and making up about 9 percent of the acreage, is a soil that is similar to this soil but deeper over limestone. About 10 percent of the acreage is a soil similar to this soil but 1 to 15 inches deep over limestone bedrock. About 5 percent of the acreage is a soil that is similar to this soil but dark grayish brown or brown.

This Lenapah soil is used mostly as range. Some areas are used for growing wheat, grain sorghum, soybeans, and tame pasture.

Droughtiness and the need to maintain good tilth and fertility are the main concerns of management. Most adapted crops can be grown continuously if the soil is well managed and most of the residue is returned to the soil. Crops respond well to fertilizer. Quality native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and providing protection against fire. Capability unit IIIe-2; pasture and hayland suitability group 14A; Shallow Prairie range site; not assigned to a woodland suitability group.

Lenapah-Rock outcrop complex, 1 to 8 percent slopes (LrD).--The Lenapah soil in this complex has a profile similar to the one described as representative of the Lenapah series. The Rock outcrop part of this complex is bare limestone bedrock mantled with less than 3 inches of soil material (pl. V).

This complex is about 65 percent Lenapah silty clay loam and 25 percent Rock outcrop. Areas of a soil that is less than 15 inches deep over limestone bedrock and that lacks a B horizon make up 5 percent of the acreage. About 3 percent of the acreage is a soil that is similar to the Lenapah soil but 20 to 40 inches deep over limestone bedrock. An additional 2 percent of this complex is Summit soils. This complex is used mainly as range. Capability unit VIIs-5, pasture and hayland suitability group 14A; Shallow Prairie range site; not assigned to a woodland suitability group.

## Lula Series

The Lula series consists of deep, well-drained, very gently sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from limestone.

In a representative profile the surface layer is 11 inches of very dark grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 17 inches is dark reddish-brown silty clay loam. The lower subsoil, extending to a depth of 42 inches, is dark-brown and red silty clay loam. It is underlain by hard limestone.

Lula soils have moderate permeability. Available water capacity is high.

Representative profile of Lula silt loam, 1 to 3 percent slopes, 1,200 feet east of the SW. corner of sec. 9, T. 22 N., R. 20 E.:

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.

A1--6 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam; strong, medium, granular structure; friable; medium acid; gradual, smooth boundary.

B1--11 to 17 inches, dark reddish-brown (5YR 3/3) silty clay loam; strong, medium, granular structure; friable; medium acid; gradual, smooth boundary.

B21t--17 to 27 inches, dark-brown (7.5YR 4/4) silty clay loam; common, fine, prominent, red mottles; moderate, medium, blocky structure; firm; clay films on faces of peds; few, fine, black concretions; slightly acid; gradual, smooth boundary.

B22t--27 to 42 inches, red (2.5YR 4/6) silty clay loam; common, fine, prominent, dark-brown mottles; moderate, medium, blocky structure; firm; clay films on faces of peds; few, fine, black concretions; slightly acid; gradual, smooth boundary.

R--42 to 44 inches, hard limestone.

The Ap and A1 horizons are very dark grayish brown or dark reddish brown. They are slightly acid or medium acid. The B1 horizon is dark-brown, dark reddish-brown, or reddish-brown silty clay loam or clay loam. It is slightly acid or medium acid.

The B21t horizon is dark-brown, dark reddish-brown, reddish-brown, or yellowish-red clay loam or silty clay loam. It is slightly acid to strongly acid. The B22t horizon is dark reddish-brown, reddish-brown, yellowish-red, or red clay loam or silty clay loam. It is neutral to medium acid.

The depth to hard limestone bedrock is 40 to 60 inches. The ground water table is at a depth of more than 72 inches.

Lula soils are associated with Summit and Lenapah soils. They differ from Summit soils in having less clay in the Bt horizon. They differ from Lenapah soils in having less clay in the Bt horizon and in being more than 40 inches deep over limestone bedrock.

Lula silt loam, 1 to 3 percent slopes (LuB).--This soil has the profile described as representative of the Lula series.

Included with this soil in mapping are small areas of Dennis, Okemah, and Summit soils. About 10 percent of the individual mapped areas is made up of soils that are similar to Lula soils but either shallower or deeper over limestone. An additional 10 percent is areas of a soil that has slopes of less than 1 percent.

This soil is used mostly for wheat, grain sorghum, soybeans, corn, and alfalfa. A sizable acreage is used as tame pasture and range.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grown continuously if the soil is well managed. Most of the residue should be returned to the soil, and fertilizer should be used. Terraces and contour farming are needed where row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

## Mayes Series

The Mayes series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed under a cover of native grasses in material weathered from loamy or clayey sediment.

In a representative profile the surface layer is 14 inches of very dark gray silty clay loam. The upper part of the subsoil, extending to a depth of 34 inches, is very dark brown clay. The middle part of the subsoil, extending to a depth of 43 inches, is very dark grayish-brown clay. The lower part of the subsoil, extending to a depth of 60 inches, is dark grayish-brown clay.

Mayes soils have very slow permeability. Available water capacity is high.

Representative profile of Mayes silty clay loam, 800 feet east of the NW. corner of sec. 3, T. 21 N., R. 19 E.:

A1--0 to 9 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, granular structure; friable; neutral; gradual, smooth boundary.

A3--9 to 14 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, granular structure; friable; neutral; gradual, smooth boundary.

B21tg--14 to 34 inches, very dark brown (10YR 2/2) clay; few, fine, distinct, yellowish-brown mottles; moderate, medium, blocky structure; very firm; common shiny surfaces on faces of peds; few fine iron-manganese concretions; medium acid; gradual, smooth boundary.

B22tg--34 to 43 inches, very dark grayish-brown (2.5Y 3/2) clay; few, medium, distinct, dark-gray (10YR 4/1) mottles; moderate, medium, blocky structure; very firm; common shiny surfaces on faces of peds; few iron-manganese concretions; few fine gypsum crystals; neutral; diffuse, smooth boundary.

B3g--43 to 60 inches, dark grayish-brown (2.5Y 4/2) clay; few, fine, distinct, yellowish-brown mottles and few, medium, distinct, gray (10YR 5/1) mottles; weak, medium, blocky structure; very firm; few fine calcium carbonate concretions; few iron-manganese concretions; few fine gypsum crystals; mildly alkaline.

The A1 or Ap horizon is very dark gray or black. It is slightly acid or neutral.

The A3 horizon is very dark gray or black and neutral to strongly acid. In some areas this horizon is lacking.

The B21tg horizon is black, very dark gray, very dark grayish-brown, or very dark brown clay loam, silty clay loam, or clay. It is slightly acid or medium acid. Mottles are shades of gray or brown.

The B22tg horizon is very dark grayish-brown, very dark gray, dark grayish-brown, or dark-gray clay loam, silty clay loam, or clay. It is neutral or slightly acid. Mottles are shades of gray or brown.

The B3g horizon is dark gray or dark grayish brown. It is neutral or mildly alkaline. It contains few to common fine concretions of iron manganese and calcium

carbonate. In places it contains gypsum crystals.

The depth to bedrock is more than 60 inches. A perched water table is at a depth of 12 to 24 inches.

Mayes soils are associated with Lenapah, Parsons, and Summit soils. They differ from the Lenapah soils in having a solum that is more than 60 inches thick. They differ from the Parsons soils in having a gradual boundary between the A and B horizons. They differ from the Summit soils in being shallower over a perched water table.

Mayes silty clay loam (Ma).--This nearly level soil has the profile described as representative of the Mayes series.

Included with this soil in mapping are small areas of Okemah, Parsons, and Summit soils.

This soil is suitable for small grains, grain sorghum, corn, soybeans, tame pasture, and native grasses.

The main concerns of management are maintenance of soil structure and fertility, slow intake of water, and wetness. This soil can be maintained by growing crops that produce residue and by returning the residue, with fertilizer, to the soil. Drainage benefits most crops. Capability unit IIw-2; pasture and hayland suitability group 8C; Claypan Prairie range site; not assigned to a woodland suitability group.

## Nixa Series

The Nixa series consists of deep, moderately well drained, nearly level and very gently sloping soils on uplands. These soils formed under a cover of pine and oak and an understory of native grasses, in material weathered from cherty limestone.

In a representative profile the surface layer is 4 inches of dark grayish-brown cherty silt loam. The subsurface layer, extending to a depth of 12 inches, is brown cherty silt loam. The upper part of the subsoil, extending to a depth of 19 inches, is yellowish-brown very cherty silty clay loam. Below this, and extending to a depth of 23 inches, it is pale-brown very cherty silt loam. The lower subsoil extends to a depth of 42 inches and is strong-brown, brittle, very cherty silt loam. The underlying material, extending to a depth of 60 inches, is red very cherty clay loam.

Nixa soils have very slow permeability. Available water capacity is moderate.

Representative profile of Nixa cherty silt loam, 0 to 3 percent slopes, 2,200 feet east of the NW. corner of sec. 18, T. 21 N., R. 21 E.:

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) cherty silt loam; weak, fine, granular structure; friable; about 17 percent chert gravel; strongly acid; clear, smooth boundary.

A2--4 to 12 inches, brown (10YR 5/3) cherty silt loam; weak, fine, granular structure; friable; about 18 percent chert gravel; strongly acid; clear, smooth boundary.

B2--12 to 19 inches, yellowish-brown (10YR 5/4) very cherty silty clay loam; common fine, faint, brown mottles and prominent, red mottles; moderate, fine, blocky structure; firm; about 50 percent chert gravel; very strongly acid; gradual, smooth boundary.

A'2--19 to 23 inches, pale-brown (10YR 6/3) very cherty silt loam; weak, medium, subangular blocky structure; firm; few roots; many pores; about 55 percent chert fragments 1/4 to 3 inches in diameter; few dark concretions; strongly acid; abrupt, wavy boundary.

B'x--23 to 42 inches, strong-brown (7.5YR 5/6) very cherty silt loam; many, coarse, prominent, gray (10YR 6/1), light brownish-gray (10YR 6/2), grayish-brown (10YR 5/2), and dark-red (2.5YR 3/6) mottles and streaks; weak, fine, blocky structure; brittle when moist; thin patchy clay films; about 60 to 70 percent chert gravel; few black concretions; very strongly acid; gradual, smooth boundary.

C--42 to 60 inches, red (2.5YR 4/6) very cherty clay loam; common, medium, prominent, gray (10YR 5/1 and 10YR 6/1) and faint dark-red (2.5YR 3/6) mottles; massive; firm; about 80 percent chert gravel; strongly acid.

The A1 horizon is very dark grayish brown or dark grayish brown. It is about 15 to 20 percent chert fragments. The A2 horizon is grayish brown, brown, or pale brown. It contains 15 to 20 percent chert fragments.

The B2 horizon is brown, brownish-yellow, or yellowish-brown cherty silty clay loam or very cherty silty clay loam. It is mottled in shades of red and brown. This horizon is 35 to 60 percent chert fragments. It is strongly acid or very strongly acid.

The A'2 horizon is light brownish gray, grayish brown, pale brown, or brown. It is strongly acid or very strongly acid.

The B'x horizon is strong-brown, yellowish-brown, or brownish-yellow very cherty silty clay loam or very cherty silt loam. It is mottled in shades of brown and red. This horizon is strongly acid or very strongly acid.

The C horizon is strong-brown or red very cherty clay loam or very cherty silty clay loam. It is strongly acid or very strongly acid.

The depth to hard, massive chert beds is 40 to 60 inches. The ground water table is at a depth of more than 72 inches.

Nixa soils are associated with Clarksville and Captina soils. They have less chert in the upper horizons than the Clarksville soils. They have a B'x horizon that is lacking in Clarksville soils. They differ from Captina soils in having an A'2 horizon below the B2 horizon.

Nixa cherty silt loam, 0 to 3 percent slopes (NxB).--This soil has the profile described as representative of the series (pl. II).

Included with this soil in mapping are small areas of Clarksville very cherty silt loam and small areas of Captina soils.

This soil is used mostly for tame pasture. A small acreage is used for growing small grains, grain sorghum, sorghum, corn, wooded pasture plants, and food and cover plants for wildlife.

The main concerns of management are droughtiness and the maintenance of soil structure and fertility. Returning large amounts of residue to the soil helps to maintain the content of organic matter and the soil structure. The natural fertility of this soil is low, and fertilizer is needed for crops and tame pasture. Capability unit IIIs-1; pasture and hayland suitability group 8A; Smooth Chert Savannah range site; woodland suitability group 4f8.

## Okemah Series

The Okemah series consists of deep, moderately well drained, nearly level soils on uplands. These soils formed under a cover of native grasses in material weathered from clayey sediment or shale.

In a representative profile the surface layer is 13 inches of very dark gray and very dark brown silt loam and silty clay loam. The upper part of the subsoil, extending to a depth of 18 inches, is very dark grayish-brown silty clay loam. The middle part of the subsoil, extending to a depth of 39 inches, is dark grayish-brown and yellowish-brown clay. The lower subsoil, extending to a depth of 60 inches, is coarsely mottled, light-gray, gray, yellowish-brown, and brownish-yellow clay. The subsoil is underlain by hard limestone.

Okemah soils have slow permeability. Available water capacity is high.

Representative profile of Okemah silt loam, 0 to 1 percent slopes, 1,400 feet north of the SW. corner of sec. 19, T. 23 N., R. 18 E.:

Ap--0 to 8 inches, very dark gray (10YR 3/1) silt loam; weak, medium, granular structure; friable; medium acid; clear, smooth boundary.

A1--8 to 11 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; medium acid; gradual, smooth boundary.

A3--11 to 13 inches, very dark brown (10YR 2/2) silty clay loam; few, fine, faint, dark yellowish-brown mottles; strong, medium, granular structure; friable; few black concretions; medium acid; gradual, smooth boundary.

B1--13 to 18 inches, very dark grayish-brown (10YR 3/2) silty clay loam; common, fine, faint, dark yellowish-brown and yellowish-brown mottles; strong, medium, granular structure; firm; few black concretions; medium acid; gradual, smooth boundary.

B21t--18 to 24 inches, dark grayish-brown (10YR 4/2) clay, many medium, distinct, dark yellowish-brown (10YR 4/4), light yellowish-brown (10YR 6/4), and dark-gray (10YR 4/1) mottles; moderate, medium, blocky structure; very firm; clay films and dark organic stains on surface of peds; medium acid; gradual, smooth boundary.

B22t--24 to 39 inches, yellowish-brown (10YR 5/6) clay; many medium, distinct, gray (10YR 5/1) and dark yellowish-brown (10YR 4/4) mottles; moderate, medium, blocky structure; very firm; clay films and dark organic stains on surface of peds; medium acid; gradual, smooth boundary.

B3--39 to 60 inches, coarsely mottled light-gray (10YR 7/1), gray (10YR 6/1), yellowish-brown (10YR 5/8), and brownish-yellow (10YR 6/8) clay; weak, coarse, blocky structure; very firm, few black concretions; many gypsum crystals; neutral.

The A1 or Ap horizon is black, very dark brown, very dark gray, or very dark grayish brown. It is slightly acid or medium acid.

The A3 horizon is black, very dark grayish brown, very dark brown, or very dark gray. It is slightly acid or medium acid.

In places the B1 horizon is absent.

The B2t horizons are very dark gray, very dark grayish-brown, dark-gray, yellowish-brown, or dark grayish-brown clay or silty clay. They are medium acid to

mildly alkaline. They are mottled in shades of gray, brown, or red.

The B3 horizon is very dark gray, very dark grayish-brown, dark-gray, or dark grayish-brown clay or silty clay. It is mottled in shades of gray, yellow, and brown. This horizon is neutral or mildly alkaline.

The depth to bedrock is more than 60 inches. A perched water table is at a depth of 24 to 36 inches.

Okemah soils are associated with Choteau, Dennis, and Summit soils. They differ from the Choteau and Dennis soils in having a low-chroma B2t horizon. Also, the Choteau soils lack an A2 horizon. Okemah soils differ from the Summit soils in having a thicker solum.

Okemah silt loam, 0 to 1 percent slopes (OkA).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Dennis and Summit soils. About 5 percent of the individual mapped areas is made up of soils that are similar to Okemah soils but are less than 60 inches deep over shale.

This Okemah soil is used mostly for small grains, grain sorghum, soybeans, alfalfa, corn, and tame pasture. A small acreage is in native grasses used as range.

The main concern of management is maintenance of soil structure and fertility. If the soil is well managed and most of the residue is returned to the soil, crops can be grown continuously. Returning residue to the soil helps to maintain the content of organic matter and to improve soil structure. Capability unit I-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

## Osage Series

The Osage series consists of deep, poorly drained, nearly level soils on flood plains. These soils formed under a cover of hardwoods and an understory of native grasses, in clayey sediment.

In a representative profile the surface layer is 19 inches of very dark gray and black silty clay loam. The subsoil, extending to a depth of 37 inches, is dark-gray and very dark gray clay. The underlying material, extending to a depth of 60 inches, is gray clay.

Osage soils have very slow permeability. Available water capacity is high.

Representative profile of Osage silty clay loam, 1,400 feet west of the NE. corner of sec. 5, T. 21 N., R. 20 E.:

Ap--0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; weak, medium, granular structure; firm; slightly acid; clear, smooth boundary.

A11--7 to 13 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; firm; slightly acid; gradual, smooth boundary.

A12--13 to 19 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; very firm; neutral; gradual, smooth boundary.

B21g--19 to 27 inches, very dark gray (10YR 3/1) clay; common, fine, faint, gray mottles; massive; extremely firm; neutral; diffuse, smooth boundary.

B22g--27 to 37 inches, dark-gray (10YR 4/1) clay; few, fine, faint, black and gray mottles; massive; extremely firm; few fine chert pebbles; mildly alkaline; diffuse, smooth boundary.

B3g--37 to 60 inches, gray (10YR 5/1) clay; many, medium, distinct, gray (10YR 6/1), black (10YR 2/1), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/8) mottles; massive; extremely firm; few chert pebbles; few calcium concretions; mildly alkaline.

The A1 horizons are black or very dark gray. They are neutral to medium acid.

The B21g horizon is clay or silty clay mottled shades of gray and brown.

The B22g horizon is very dark gray, dark-gray, or gray clay or silty clay. It is neutral or mildly alkaline. Mottles are shades of gray and brown.

The B3g horizon is dark-gray or gray clay or silty clay. It is neutral or mildly alkaline. Mottles are shades of gray and brown.

The depth to bedrock is more than 60 inches. A perched water table is at a depth of 12 to 24 inches.

Osage soils are associated with Verdigris and Quarles soils. They are more clayey in the lower part of the subsoil than are Verdigris soils. They differ from Quarles soils in having a more clayey, thicker, and darker surface layer.

Osage silty clay loam (Os).--This nearly level soil is on flood plains and is subject to occasional flooding.

Included with this soil in mapping are small areas of Quarles and Verdigris soils.

This soil is used for corn, grain sorghum, alfalfa, small grains, tame pasture, and native grasses.

The main concerns of management in cultivated areas are surface wetness, flooding, surface crusting, slow water intake, and maintenance of soil structure. Most of the adapted crops can be grown continuously if residue is returned to the soil and the soil is well managed. When this soil is wet, tillage and grazing break down the soil structure and increase puddling. A drainage system that includes arranging row direction is beneficial to most crops. Capability unit IIw-1; pasture and hayland suitability group 2B; Heavy Bottomland range site; woodland suitability group 5w6.

## Parsons Series

The Parsons series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed under a cover of native grasses in material weathered from loamy and clayey sediment.

In a representative profile the surface layer is 9 inches of very dark grayish-brown silt loam. The subsurface layer, extending to a depth of 15 inches, is dark grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 32 inches, is very dark grayish-brown and dark grayish-brown clay. The middle subsoil, extending to a depth of 44 inches, is grayish-brown clay. The lower part extends to a depth of 64 inches and is dark-brown clay.

Parsons soils have very slow permeability. Available water capacity is high.

Representative profile of Parsons silt loam, 0 to 1 percent slopes, 2,100 feet north of the SE. corner of sec. 8, T. 23 N., R. 19 E.:

A1--0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; medium acid; gradual, smooth boundary.

A2--9 to 15 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, dark yellowish-brown mottles; weak, fine, subangular blocky structure; friable; few clean sand grains and silt coatings; strongly acid; abrupt, wavy boundary.

B21tg--15 to 25 inches, very dark grayish-brown (10YR 3/2) clay; many, medium, prominent, dark-red (2.5YR 3/6) mottles; moderate, medium, blocky structure; very firm; pressure faces and clay films on faces of peds; strongly acid; gradual, smooth boundary.

B22tg--25 to 32 inches, dark grayish-brown (10YR 4/2) clay; many, medium, prominent, red (2.5YR 4/6) mottles and few, fine, faint, dark yellowish-brown mottles; moderate, medium blocky, structure; very firm; pressure faces and clay films on faces of peds; strongly acid; gradual, smooth boundary.

B23t--32 to 44 inches, grayish-brown (10YR 5/2) clay; many, medium, prominent, red (2.5YR 4/6) mottles; and faint, yellowish-brown (10YR 5/4) and gray (10YR 5/1) mottles; weak, medium, blocky structure; very firm; pressure faces and thin clay films on faces of peds; strongly acid; gradual, smooth boundary.

B3--44 to 64 inches, dark-brown (10YR 4/3) clay; many, coarse, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; black (10YR 2/1) and very dark brown (10YR 2/2) organic stains in root channels; weak, coarse, blocky structure; very firm; many black streaks and soft bodies of iron-manganese; medium acid.

The A1 horizon is slightly acid or medium acid.

The A2 horizon is grayish brown or dark grayish brown. It is medium acid or strongly acid. Mottles are shades of brown and yellow.

The B21tg horizon is very dark gray, very dark grayish brown, dark gray, dark grayish brown, gray, or grayish brown. It is medium acid or strongly acid. Mottles are shades of gray, brown, or red.

The B22tg horizon is grayish brown, dark grayish brown, brown, dark yellowish brown, or yellowish brown. It is medium acid or strongly acid. Mottles are shades of red, brown, or gray.

The B23t horizon is dark grayish brown, grayish brown, brown, dark yellowish brown, or yellowish brown. It is medium acid or strongly acid. Mottles are shades of red, brown, or gray.

The B3 horizon is dark-brown, dark grayish-brown, or grayish-brown clay or silty clay loam. It is medium acid to neutral. Mottles are shades of red, brown, or gray.

The depth to bedrock is more than 60 inches. A perched water table is at a depth of 0 to 12 inches.

Parsons soils have a thinner A horizon than the associated Taloka soils. They have a coarser textured A horizon than the Mayes soils.

Parsons silt loam, 0 to 1 percent slopes (PaA).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Choteau, Dennis, and Taloka soils. About 27 percent of the individual mapped areas is made up of soils that are similar to Parsons soils but have a dark grayish-brown surface. In about 3 percent of the individual mapped areas the soils are similar to Parsons soils but the B2t horizon contains more than 15 percent exchangeable sodium.

This soil is used mostly for growing small grains, alfalfa, corn, grain sorghum, soybeans, and tame pasture plants (pl. VI). Some acreage is native grassland and is used as range or for hay.

The main concerns of management are maintenance of soil structure and fertility, surface crusting, slow intake of water, and seasonal wetness or droughtiness. Growing crops that produce residue and returning the residue and adding fertilizer help to maintain this soil. Drainage benefits most crops. Capability unit IIs-1; pasture and hayland suitability group 8C; Claypan Prairie range site; not assigned to a woodland suitability group.

## Quarles Series

The Quarles series consits of deep, poorly drained, nearly level soils on flood plains. These soils formed under a cover of hardwoods and an understory of native grasses, in material weathered from loamy or clayey sediment.

In a representative profile the surface layer is 7 inches of very dark grayish-brown silt loam. The subsurface layer, extending to a depth of 20 inches, is gray silt loam. The upper part of the subsoil, extending to a depth of 36 inches, is gray silty clay. The lower part of the subsoil, extending to a depth of 60 inches, is coarsely mottled, gray, dark-gray, and dark yellowish-brown silty clay (pl. VI).

Quarles soils have slow permeability. Available water capacity is high.

Representative profile of Quarles silt loam, NE. corner of sec. 11, T. 21 N., R. 18 E.:

A1--0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; strongly acid; gradual, smooth boundary.

A2--7 to 20 inches, gray (10YR 5/1) silt loam; common, fine, distinct, dark yellowish-brown mottles; weak, fine, granular structure; friable; strongly acid; gradual, smooth boundary.

B2t--20 to 36 inches, gray (10YR 5/1) silty clay; many, medium, faint, dark-gray (10YR 4/1) mottles and distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, blocky structure; firm; patchy clay films on faces of peds; few iron-manganese concretions; strongly acid; gradual, smooth boundary.

B3--36 to 60 inches, coarsely mottled, gray (10YR 5/1 and 10YR 6/1), dark-gray (10YR 4/1), and dark yellowish-brown (10YR 4/4) silty clay; weak, fine, blocky structure; firm; medium acid.

The A1 horizon is very dark grayish brown, black, very dark gray or very dark brown.

The A2 horizon is gray light brownish gray.

The B2t horizon is gray or dark gray silty clay or clay. It is strongly acid or very strongly acid.

The B3 horizon is silty clay or clay. It is medium acid to very strongly acid.

The depth to rippable bedrock is more than 60 inches. A perched water table is at a depth of 0 to 12 inches.

Quarles soils differ from the associated Osage and Verdigris soils in having a thinner A1 horizon. In addition, the Verdigris soils lack a B horizon.

Quarles silt loam (Qu).--This nearly level soil is subject to occasional flooding (pl. VII).

Included with this soil in mapping are spots of Osage and Verdigris soils. Included areas of soils that are similar to Quarles soils, except that they are less clayey in the lower part of the B horizons, make up about 10 percent of this acreage.

This soil is used for small grains, grain sorghum, corn, soybeans, tame pasture, native grasses, and hardwoods.

The main concerns of management in cultivated areas are surface wetness, flooding, surface crusting, slow water intake, and maintenance of soil structure. Most of the adapted crops can be grown continuously if crop residue is returned to the soil and the soil is well managed. When this soil is wet, tilling and grazing break down its structure and increase puddling. Use of a drainage system that includes arranging row direction is beneficial to most crops (pl. VII). Capability unit IIIw-1; pasture and hayland suitability group 2B; Heavy Bottomland range site; woodland suitability group 3w2.

## Riverton Series

The Riverton series consists of deep, well-drained, very gently sloping or sloping soil on uplands. These soils formed under

a cover of native grasses in material weathered from gravelly loamy sediment.

In a representative profile the surface layer is 7 inches of dark-brown gravelly loam. The upper part of the subsoil, extending to a depth of 34 inches, is reddish-brown gravelly clay loam. The middle part of the subsoil, extending to a depth of 64 inches, is dark-red and yellowish-red very gravelly clay loam. The lower part of the subsoil, extending to a depth of 70 inches, is yellowish-brown very gravelly clay.

Riverton soils have moderate permeability. Available water capacity is high.

Representative profile of Riverton gravelly loam, 1 to 5 percent slopes, 1,320 feet north and 1,220 feet west of the SE. corner of sec. 4, T. 22 N., R. 20 E.:

A1--0 to 7 inches, dark-brown (10YR 3/3) gravelly loam; moderate, medium, granular structure; about 20 percent pebbles 2 millimeters to 25 millimeters in diameter; medium acid; gradual, smooth boundary.

B1--7 to 18 inches, reddish-brown (5YR 4/4) gravelly clay loam; moderate, fine, subangular blocky structure; friable; about 30 percent pebbles 2 millimeters to 25 millimeters in diameter; medium acid; gradual, smooth boundary.

B21t--18 to 34 inches, reddish-brown (5YR 4/4) gravelly clay loam; moderate, fine, subangular blocky structure; firm; patchy clay films on faces of peds and surfaces of pebbles; about 40 percent pebbles 2 millimeters to 50 millimeters in diameter; strongly acid; gradual, wavy boundary.

B22t--34 to 44 inches, dark-red (2.5YR 3/6) very gravelly clay loam, moderate, fine, blocky structure; firm; patchy clay films on faces of peds and surfaces of pebbles; about 50 percent pebbles 2 millimeters to 50 millimeters in diameter; strongly acid; gradual, smooth boundary.

B31t--44 to 64 inches, yellowish-red (5YR 4/6) very gravelly clay loam; weak, fine, blocky structure; firm; about 75 percent pebbles 2 millimeters to 50 millimeters in diameter; strongly acid; gradual, smooth boundary.

B32t--64 to 70 inches, yellowish-brown (10YR 5/6) very gravelly clay; many medium, prominent, red (2.5YR 5/6) mottles and distinct, gray (10YR 5/1) mottles; weak, fine, blocky structure; firm; about 80 percent pebbles 2 millimeters to 50 millimeters in diameter; strongly acid.

The A1 horizon is dark-brown, dark reddish-brown, or dark yellowish-brown loam. It is 6 to 30 percent chert fragments. It is slightly acid to strongly acid.

The B1 horizon is dark-brown, dark yellowish-brown, dark reddish-brown, reddish-brown, yellowish-red, dark-red, or red gravelly loam or gravelly clay loam. It is 6 to 30 percent chert fragments. This horizon is medium acid to very strongly acid.

The B21t horizon is dark-brown, brown, dark yellowish-brown, reddish-brown, yellowish-red, dark reddish-brown, dark-red, or red gravelly clay loam or very gravelly clay loam. Mottles are in shades of brown, red, or yellow. This horizon is 35 to 60 percent chert fragments. It is medium acid to very strongly acid.

The B22t horizon is dark-brown, brown, reddish-brown, yellowish-red, dark-red, or red very gravelly clay loam or very gravelly silty clay loam. Mottles are shades of brown, gray, or red. This horizon is 50 to 85 percent chert fragments. It is strongly acid or very strongly acid.

The B3t horizon is brown, dark-brown, strong-brown, red, yellowish-brown, yellowish-red, or reddish-brown very gravelly clay loam or very gravelly clay. In places it is 65 to 90 percent chert fragments and black concretions. It is strongly acid or very strongly acid.

The depth to rippable bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Riverton soils are similar to Craig and Sallisaw soils. They differ from the Craig soils in having no A2 horizon and in having less clay in the B2t horizon. They have a greater percentage of gravel in the B2t horizon than Sallisaw soils.

Riverton loam, 1 to 3 percent slopes (ReB).--This soil has a profile similar to the one described as representative of the series, but it has a few pebbles in the surface layer (pl. IX).

Included with this soil in mapping are small areas of Craig and Sallisaw soils. An additional 10 percent of this acreage is Riverton gravelly loam.

This soil is used for small grains, grain sorghum, corn, soybeans, tame pasture, and native range grasses.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grwon if the soil is well managed. Returning residue to the soil and using fertilizer are good management practices. Terraces having protected

outlets, contour farming, and no tillage or minimum tillage are needed if row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5f2.

Riverton gravelly loam, 1 to 5 percent slopes (RvC).--This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Craig, Eldorado, Sallisaw soils and Riverton loam. About 10 percent is soils having slopes of 6 to 8 percent.

This soil is used largely for growing tame pasture plants and native grasses. Cultivated crops grown on this soil are small grains, grain sorghum, and soybeans.

The main concerns of management are the hazard of erosion and the maintenance of soil fertility and structure. If row crops are grown, terraces and contour farming are needed. Large amounts of residue should be returned to the soil, and fertilizer should be added to help maintain the content of organic matter and the soil structure and to increase intake of water. If terraces are not used, a cropping system is needed that includes only soil-maintaining crops and that includes biennial or perennial vegetation at least half the time. Capability unit IIIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5f2.

## Rock Outcrop

Rock outcrop consists of limestone bedrock exposed at the surface. Included with this land type in mapping are areas of bedrock mantled with less than 3 inches of soil. Rock outcrop is mapped as part of Lenapah-Rock outcrop complex, 1 to 8 percent slopes (LrD).

## Sallisaw Series

The Sallisaw series consists of deep, well-drained, very gently sloping soils on terraces. These soils formed in cherty, loamy sediment under a cover of pine and hardwoods and an understory of native grasses.

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 20 inches, is dark-brown silty loam. The middle part of the subsoil extends to a depth of 40 inches and is yellowish-red gravelly clay loam and gravelly silty clay loam. The lower part of the subsoil, extending to a depth of 64 inches, is yellowish-red very gravelly clay loam.

Sallisaw soils have moderate permeability. Available water capacity is high.

Representative profile of Sallisaw silt loam, 1 to 3 percent slopes, 1,400 feet north of the SW. corner of sec. 23, T. 21 N., R. 20 E.:

A1--0 to 10 inches, dark-brown (10YR 4/3) silt loam; granular structure; friable; common roots; about 3 percent rounded chert gravel; slightly acid; gradual, smooth boundary.

B1--10 to 20 inches, dark-brown (7.5YR 4/4) silt loam; medium granular structure; friable; about 5 percent rounded chert gravel; strongly acid; gradual, wavy boundary.

B21t--20 to 36 inches, yellowish-red (5YR 4/6) gravelly clay loam; moderate, medium, blocky structure; firm; patchy clay films on faces of peds and gravel; 25 percent rounded chert gravel; strongly acid; gradual, wavy boundary.

B22t--36 to 40 inches, yellowish-red (5YR 4/60 gravelly silty clay loam; weak, fine, subangular blocky structure; clay films on faces of peds and gravel; about 40 percent rounded chert gravel; strongly acid; gradual, wavy boundary.

IIB3--40 to 64 inches, yellowish-red (5YR 4/8) very gravelly clay loam; common, medium, prominent, dark grayish-brown (10YR 4/2) mottles; weak, fine, subangular blocky structure; firm; about 80 percent rounded chert fragments 2 to 8 inches in diameter; medium acid.

The A1 horizon is dark grayish brown, dark brown, or brown. It is 3 to 12 percent chert fragments and is slightly acid or medium acid.

The B1 horizon is reddish brown, dark brown, strong brown, or brown. It is 5 to 15 percent chert fragments and is medium acid or strongly acid.

The B21t horizon is reddish-brown, yellowish-red, brown, dark-brown, or strong-brown gravelly clay loam or gravelly silty clay loam. It is 15 to 35 percent chert fragments. This horizon is medium acid or strongly acid.

The B22t horizon is red, yellowish red, reddish brown, brown, dark brown, or strong brown. It is 30 to 50 percent chert fragments. This horizon is medium acid or strongly acid.

The IIB3 horizon is reddish-brown, red, or yellowish-red very gravelly silty clay loam or very gravelly clay loam. It is 50 to 80 percent chert fragments. It is medium acid or strongly acid.

The depth to rippable bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

The Sallisaw soils are associated with Riverton, Cannon, and Captina soils. They have less gravel and more clayey material in the B2t horizon than the Riverton soils. They differ from the Cannon soils in having a Bt horizon. They differ from the Captina soils in lacking a brittle Bx horizon.

Sallisaw silt loam, 1 to 3 percent slopes (SaB).--This soil has the profile described as representative of the series (pl. VIII).

Included with this soil in mapping are small areas of Cannon, Clarksville, and Riverton soils. Also included are a few areas of soils that are similar to Sallisaw soils but have a very gravelly layer at a depth of less than 30 inches.

This soil is used mostly as tame pasture, but some areas are used for small grains, corn, soybeans, alfalfa, grain sorghum, trees, and a source of food and cover for wildlife.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the adapted crops can be grown continuously if the soil is well managed and large amounts of residue are returned to the soil. Terraces and contour farming are needed if row crops are grown. Brush control and fertilizer are needed on tame pasture. Capability unit IIe-1; pasture and hayland suitability group 8A; Smooth Chert Savannah range site; woodland suitability group 3o7.

## Summit Series

The Summit series consists of deep, somewhat poorly drained, nearly level to gently sloping soils on uplands. These soils formed under a cover of native grasses in material weathered from limestone or shale.

In a representative profile the surface layer is 9 inches of black silty clay loam. The upper part of the subsoil, extending to a depth of 18 inches, is very dark gray silty clay loam. The middle part of the subsoil, extending to a depth of 28 inches, is very dark grayish-brown clay. The lower part of the subsoil extends to a depth of 40 inches is dark-gray clay. The underlying material, extending to a depth of 60 inches, is clay mottled with gray, yellowish brown, dark grayish brown, or light olive brown.

Summit soils have slow permeability. Available water capacity is high.

Representative profile of Summit silty clay loam, 1 to 3 percent slopes, 1,100 feet south of the NE. corner of sec. 19, T. 22 N., R. 20 E.:

A1--0 to 9 inches, black (10YR 2/1) silty clay loam; strong, medium, granular structure; friable; slightly acid; gradual, smooth boundary.

B1--9 to 18 inches, very dark gray (10YR 3/1) silty clay loam; strong, medium, granular structure and weak, fine, subangular blocky structure; firm; slightly acid; gradual, smooth boundary.

B21t--18 to 28 inches, very dark grayish-brown (2.5Y 3/2) clay; common, fine, faint, olive-brown mottles; moderate, medium, blocky structure; very firm; clay films on faces of peds; neutral; diffuse, smooth boundary.

B22t--28 to 40 inches, dark grayish-brown (2.5Y 4/2) clay; many, fine, faint, olive-brown, light olive-brown, and yellowish-brown mottles; moderate, medium, blocky structure; very firm; clay films on faces of peds; few large limestone fragments coated with calcium carbonate; moderately alkaline; diffuse, smooth boundary.

C--40 to 60 inches, mottled gray (10YR 5/1), yellowish-brown (10YR 5/6), dark grayish-brown (2.5Y 4/2), and light olive brown (2.5Y 5/4) clay; massive; very firm; limestone fragments coated with calcium carbonate; mildly alkaline.

The A1 horizon is black, very dark brown, very dark gray, or very dark grayish brown. It is slightly acid or medium acid.

The B1 horizon is black, very dark brown, very dark gray, or very dark grayish-brown silty clay loam or silty clay. It is slightly acid or medium acid. Mottles are shades of gray or brown. This horizon contains a few iron-manganese concretions in some areas.

The B21t horizon is black, very dark brown, very dark gray, dark gray, very dark grayish brown, dark grayish brown, dark brown, or olive brown. It is slightly acid or neutral. It has mottles in shades of gray or brown. In places, this horizon contains iron-manganese concretions and limestone fragments.

The B22t horizon is dark-brown, brown, very dark grayish-brown, dark yellowish-brown, dark grayish-brown or very dark gray



548-966 O - 75 - 3

clay or silty clay. It is slightly acid to moderately alkaline. Mottles are in shades of black or brown.

The C horizon is mottled dark brown, brown, very dark grayish brown, dark yellowish brown, dark grayish brown, olive brown, very dark gray, gray, yellowish brown, or light olive brown. It is mildly alkaline. In places, this horizon contains calcium carbonate concretions and gypsum crystals.

The depth to hard limestone or shale bedrock is more than 60 inches. A perched water table is at a depth of 24 to 36 inches.

Summit soils are associated with Dennis, Okemah, Lula, Mayes, and Lenapah soils. They have a thinner solum than the Dennis and Okemah soils. They are more clayey in the upper B horizon than the Lula soils. Summit soils differ from the Mayes soils in being deeper over a perched water table. They differ from the Lenapah soils in being deeper over limestone bedrock.

Summit silty clay loam, 0 to 1 percent slopes (SuA).--Included with this soil in mapping are small areas of Lenapah, Lula, Okemah, and Mayes soils. An additional 3 percent of the individual mapped areas is made up of soils that are similar to Summit soils but shallower over limestone.

This soil is used mostly for small grains, grain sorghum, soybeans, alfalfa, corn, tame pasture, and native range. The main concerns of management are surface crusting and the maintenance of soil structure and fertility Crops that produce large amounts of residue can be grown continuously if the soil is well managed and if most of the residue is returned to the soil and fertilizer is used. Capability unit I-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Summit silty clay loam, 1 to 3 percent slopes (SuB).--This soil has the profile described as representative of the series.

Included with this soil in mapping are spots of Lenapah, Lula, and Okemah soils.

This soil is used mostly for growing small grains, grain sorghum, soybeans, alfalfa, corn, and tame pasture. A sizable acreage is native grassland and is used as range or for hay.

The main concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. Most of the crops that produce large amounts of residue can be grown continuously if the soil is well managed and the residue is returned to the soil. If row crops are grown, terraces and contour farming are needed to break up concentrations of water and reduce the hazard of erosion. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

Summit silty clay loam, 3 to 5 percent slopes (SuC).--This soil is gently sloping. Included with it in mapping are small areas of Lenapah and Lula soils. About 15 percent of the individual mapped areas is made up of soils that are similar to Summit soils but shallower over limestone.

This soil is used mostly as range or for hay. A fair percentage of the acreage is used for small grains, grain sorghum, soybeans, and corn.

The principal concerns of management are the hazard of erosion and the maintenance of soil structure and fertility. If row crops are grown, terraces and contour farming are needed. Large amounts of residue should be returned to the soil and fertilizer used to help maintain the content of organic matter and the soil structure and to increase intake of water. If terraces are not used, a cropping system is needed that includes only soil-maintaining crops and that keeps biennial or perennial vegetation on the soil at least half the time. Capability unit IIIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; not assigned to a woodland suitability group.

## Taloka Series

The Taloka series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed under a cover of native grasses in loamy or clayey sediment.

In a representative profile the surface layer is 9 inches of very dark grayish-brown silt loam. The subsurface layer, extending to a depth of 21 inches, is grayish-brown silt loam. The upper part of the subsoil, extending to a depth of 28 inches, is dark grayish-brown clay. The middle subsoil extends to a depth of 38 inches and is dark yellowish-brown silty clay loam. The lower part of the subsoil, extending to a depth of 65 inches, is gray clay. Mottles are shades of brown and gray.

Taloka soils have very slow permeability. Available water capacity is high.

Representative profile of Taloka silt loam, 0 to 1 percent slopes, 2,000 feet west of the NE. corner of sec. 32, T. 23 N., R. 19 E.:

A1--0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; medium acid; gradual, smooth boundary.
A2--9 to 21 inches, grayish-brown (10YR 5/2) silt loam; common, fine, faint, dark-brown and light yellowish-brown mottles; weak, medium, granular structure; friable; strongly acid; abrupt, wavy boundary.
B21t--21 to 28 inches, dark grayish-brown (10YR 4/2) clay; many, medium, faint, dark yellowish-brown (10YR 4/4) mottles and fine, prominent, red and yellowish-red mottles; moderate, medium, blocky structure; very firm; clay films on ped surfaces; pressure faces; few silt coatings; slightly acid; gradual, smooth boundary.
B22t--28 to 38 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, medium, faint, dark grayish-brown (10YR 4/2) mottles; weak, medium, blocky structure; very firm; pressure faces; clay films on ped surfaces; slightly acid; gradual, smooth boundary.
B3--38 to 65 inches, gray (10YR 6/1) clay; many, medium, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; weak, fine, blocky structure; very firm; few soft black bodies; slightly acid.

The A1 horizon is very dark gray or very dark grayish brown. It is medium acid or strongly acid.

The A2 horizon is grayish brown, very dark grayish brown, or brown.

The B21t horizon is dark gray, dark grayish brown, or dark brown and is slightly acid to strongly acid. It is mottled shades of brown or gray.

The B22t horizon is dark gray, dark grayish brown, dark brown, or dark yellowish brown. This horizon is slightly acid to strongly acid. Mottles are in shades of brown or gray.

The B3 horizon is gray, grayish-brown, light brownish-gray, pale-brown, brown, or yellowish-brown clay or silty clay loam. It is slightly acid or neutral. Mottles are shades of brown or gray.

The depth to rippable bedrock is more than 60 inches. A perched water table is at a depth of 12 to 24 inches.

The Taloka soils are associated with Parsons and Choteau soils. They have a thicker A horizon than the Parsons soils. Taloka soils differ from Choteau soils in having an abrupt boundary between the A2 and B2t horizons and in having mottles that are of chroma 2 or less in upper part of the B2t horizon.

Taloka silt loam, 0 to 1 percent slopes (TaA).--This is a nearly level soil (pl. IX). Included with it in mapping are small areas of Choteau, Dennis, and Parsons soils. An additional 10 percent of the individual mapped areas is made up of soils that are similar to Taloka soil but that have a dark grayish-brown surface layer. About 9 percent of the mapped areas is made up of soils that are similar to Taloka soil but that have a chroma of 2 or more in the B21t horizon.

This soil is used mostly for small grains, grain sorghum, soybeans, corn, alfalfa, and tame pasture. Some areas are used as range or native hay.

The main concerns of management are the slow infiltration rate and the maintenance of soil structure. Returning large amounts of residue to the soil helps to maintain soil structure. Capability unit IIs-1; pasture and hayland suitability group 8C; Loamy Prairie range site; not assigned to a woodland suitability group.

## Verdigris Series

The Verdigris series consists of deep, moderately well drained, nearly level or very gently sloping soils on flood plains. These soils formed under a cover of hardwoods and an understory of native grasses, in loamy alluvium.

In a representative profile the surface layer is 25 inches of very dark grayish-brown silty clay loam. The subsoil, extending to a depth of 34 inches, is very dark grayish-brown silty clay loam. The underlying material is dark grayish-brown silty clay loam.

Verdigris soils have moderate permeability. Available water capacity is high.

Representative profile of Verdigris silty clay loam, 800 feet north and 100 feet west of the SE. corner of sec. 10, T. 21 N., R. 18 E.:

A11--0 to 11 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium, granular structure; friable; slightly acid; gradual, smooth boundary.
A12--11 to 25 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium, granular structure and weak, fine, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.
AC--25 to 34 inches, very dark grayish-brown (10YR 3/2) silty clay loam; few, fine, faint, dark yellowish-brown mottles;

weak, fine, subangular blocky structure; firm; clean silt grains; medium acid; gradual, smooth boundary.

C--34 to 60 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, medium, distinct, gray (10YR 5/1) mottles and common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; firm; few iron-manganese concretions; medium acid.

The A1 horizon is black, very dark gray, dark-brown, very dark grayish-brown, or very dark brown silty clay loam or silt loam. It is slightly acid or medium acid.

The AC horizon is black, very dark gray, very dark brown, very dark grayish-brown, or dark-brown silty clay loam or silt loam. It is slightly acid or medium acid. Mottles are shades of brown.

The C horizon is dark grayish brown, grayish brown, light brownish gray, dark brown, brown, pale brown, dark yellowish brown, or yellowish brown. It is slightly acid or medium acid. Mottles are shades of gray or brown.

The depth to bedrock is more than 60 inches. The ground water table is at a depth of more than 72 inches.

Verdigris soils are associated with Osage and Quarles soils. They have a thicker A horizon than either of the associated soils.

Verdigris silty clay loam (Ve).--This nearly level soil is subject to occasional flooding. It has the profile described as representative of the series.

Included with this soil in mapping are spots of Osage and Quarles soils. An additional 10 percent of the mapped area is made up of soils that are similar to Verdigris soils but are thinner or are dark grayish brown or brown. About 23 percent of this acreage is Verdigris silt loam.

This Verdigris soil is used mostly for growing corn, small grains, alfalfa, grain sorghum, soybeans, and tame pasture plants. Some areas are used as woodland or range.

The main concerns of management are the occasional flooding and the maintenance of soil structure and fertility. Most of the crops generally grown on this soil produce large amounts of residue and can be grown continuously if the residue is returned to the soil and fertilizer is used. Capability unit IIw-1; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 3w5.

Verdigris soils, channeled (Vs).--This is a nearly level or very gently sloping soil. It is along stream channels and is subject to frequent flooding. Areas are about 150 to 500 feet wide. This soil has a profile similar to the one described as representative of the series, but the surface layer is silt loam or silty clay loam (pl. VIII).

Included with this soil in mapping are small areas of Quarles soils. Also included, and making up 18 percent of the individual mapped areas, are soils that are similar to Verdigris soils but that are thinner or that are dark grayish brown or brown. About 14 percent of the individual mapped areas is stream channels.

This soil is used mostly as tame pasture or woodland. It is not suitable for cultivation.

The main concern of management is the frequent flooding. This soil produces high-quality hardwoods if the trees are thinned, weeded, and selectively harvested. A good mulch is desirable on tame pasture to prevent erosion by flooding. Brush control is needed. Capability unit Vw-1; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 3w6.

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

This section also contains information about use of the soils as pasture and hayland; about the use of the soils as rangeland, woodland, wildlife habitat, and recreational development; and about the use of the soils for engineering purposes.

## General Management of the Soils for Cultivated Crops 2/

Cultivated soils in this county need management that conserves moisture, controls erosion, maintains fertility, supplies organic matter, and preserves good tilth. Some of the practices commonly required in the county are described in the following pages For suggested combinations of practices for specific soils, see the section "Descriptions of the Soils."

The information in this section can be used along with that in the descriptions of the mapping units to help farmers, ranchers, and others select appropriate practices for specific soils. Most good management practices accomplish more than one objective and can be used on nearly all the cropland in the county.

Minimum tillage.--If soils are to be cropped, they must be worked to prepare a seedbed, to control weeds, and to provide a variable place for the growth of plant roots. Excessive tillage breaks down the soil structure and speeds up the decomposition of organic matter. The soils then tend to puddle and crust at the surface, take in less water and air, and store less moisture for plant growth.

Minimum tillage is accomplished by (1) using a long-term cropping system of perennial grasses or deep-rooted legumes, (2) using herbicides instead of cultivation for weed control, and (3) reducing the number of operations used in preparing the seedbed, planting, and cultivating.

Crop residue management.--Leaving crop residue on the surface during winter and spring, or working it partly into the surface, protects soils from erosion. Organic matter, or humus, supplied in crop residue improves the tilth of the surface layer. The improved tilth then increases the infiltration and storage of water, reduces the hazard of erosion, and helps to prevent crusting.

Soil-maintaining crops.--The main objectives in using soil-maintaining crops are to maintain or improve the physical condition and the productivity of the soil and to control erosion, weeds, insects, and diseases. A cropping system that improves the soil includes crops that produce large amounts of residue.

The residue of crops and weeds is the largest source of organic material for the maintenance of soil fertility and soil structure. Nitrogen fertilizers should be added to this residue to prevent a shortage of nitrogen for the succeeding crop.

Soil-depleting crops.--Crops that do not help to control erosion, to improve soil structure, or to build up the content of organic matter are soil-depleting crops. Good cropping systems make minimum use of these crops. Crops that have the forage removed for silage or cut low for bundle feed or hay, and soybeans that are cut for hay, are soil depleting crops if most of the top growth is removed each year.

Cover crops.--Cover crops usually consist of small grains grown with vetch or annual lespedeza to improve the soil and protect it from erosion. An example of a warm-season cover crop is small grains overseeded with annual lespedeza. Small grains and vetch are suitable cool-season cover crops.

Grassed waterways.--These waterways are broad, flat-bottomed channels seeded to or sodded with perennial plants. Bermudagrass or native grasses are commonly used. These waterways are needed in terrace outlets, on diversion terraces, and in natural drains to provide for the safe disposal of excess water.

## 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

2/ By ERNEST O. HILL, agronomist, Soil Conservation Service.

not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

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

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

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

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. 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 Mayes County are described and suggestions for the use and management of the soils are given.

Class I. Soils that have few limitations that restrict their use. (No subclasses).
- Unit I-1. Deep, nearly level, moderately well drained or somewhat poorly drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.

Class II. Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Unit IIe-1. Deep and moderately deep, very gently sloping, somewhat poorly drained to well-drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.
- Subclass IIs. Soils that have moderate limitations because they are very slowly permeable or droughty.
  - Unit IIs-1. Deep, nearly level, somewhat poorly drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.
- Subclass IIw. Soils moderately limited by excess water or seasonal overflow.
  - Unit IIw-1. Deep, nearly level, well-drained to poorly drained, soils on flood plains that have a loamy surface layer and loamy or clayey subsoil.
  - Unit IIw-2. Deep, nearly level, somewhat poorly drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe. Soils subject to severe erosion if they are not protected.
  - Unit IIIe-1. Deep or moderately deep, very gently sloping or

gently sloping, well-drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.

Unit IIIe-2. Deep and shallow, nearly level to gently sloping, somewhat poorly drained to well-drained soils on uplands that have a loamy surface layer and a loamy or clayey subsoil.

Unit IIIe-3. Deep, very gently sloping or gently sloping, moderately well drained soils on uplands that have a loamy surface layer and loamy or clayey subsoil.

Subclass IIIs. Soils that have severe limitations because they are very slowly permeable.

Unit IIIs-1. Deep, nearly level or very gently sloping, moderately well drained soils on uplands that are loamy throughout.

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

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

Unit IVe-1. Very shallow to moderately deep, very gently sloping or gently sloping, well-drained to somewhat excessively drained soils of the uplands that are loamy throughout.

Unit IVe-2. Shallow or deep, very gently sloping and gently sloping, well-drained soils of the uplands that have a loamy surface layer and loamy or clayey subsoil.

Subclass IVs. Soils very severely limited by high content of sodium, low available water capacity, or other soil features.

Unit IVs-1. Deep, very gently sloping to sloping, somewhat excessively drained soils of the uplands that are loamy and cherty throughout.

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

Subclass Vw. Soils subject to flooding.

Unit Vw-1. Deep, nearly level to very gently sloping, moderately well drained or well drained soils of the flood plains that are loamy throughout.

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

Subclass VIe. Soils limited chiefly by risk of erosion and by steep slopes.

Unit VIe-1. Deep, nearly level to moderately steep, moderately well drained soils of the uplands and flood plains that have a loamy surface layer and loamy or clayey subsoil.

Subclass VIs. Soils severely limited by depth over hard underlying material and by slope.

Unit VIs-1. Deep, sloping to moderately steep, somewhat excessively drained soils of the uplands that are loamy and stony throughout.

Unit VIs-2. Deep, very gently sloping to sloping, well-drained soils of the uplands that are loamy and cherty throughout.

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

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

Unit VIIe-1. Deep, very gently sloping to steep, well-drained soils of the uplands that are loamy and have shaly fragments throughout.

Subclass VIIs. Soils very severely limited by low available water capacity, shallowness, stones, or other characteristics.

Unit VIIs-1. Deep, steep to very steep, somewhat excessively drained soils of the uplands that are loamy and stony throughout.

Unit VIIs-2. Very shallow or shallow, sloping to steep soils of the uplands that are loamy and stony throughout.

Unit VIIs-3. Shallow or deep, sloping to moderately steep, well-drained soils of the uplands that have a loamy surface layer and loamy or clayey subsoil.

Unit VIIs-4. Shallow, steep or very steep, well-drained soils

of the uplands that are loamy throughout.

Unit VIIs-5. Deep, very gently sloping to sloping, well-drained, soils of the uplands that have a loamy surface layer and loamy or clayey subsoil, or that consist of areas of exposed Rock outcrop.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. (None in Mayes County.)

## Estimated Yields

Table 2 lists estimated yields of the principal crops grown in the county. The estimates were made by farmers, soil scientists, and others who have knowledge of yields in the county and who studied information derived from research data. They are for average yields per acre that can be expected on good commercial farms managed at a level that produces the highest economic returns.

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 because reliable data on yields are not available. Absence of a yield figure indicates the crop is not suited to the soil or is not commonly grown on the soil.

The yields given in table 2 can be expected if--

1. Rainfall is effectively used and conserved.
2. Surface and subsurface drainage systems are installed where needed.
3. Residue is managed to maintain soil tilth.
4. Minimum but timely tillage is used.
5. Insect-, disease-, and weed-control measures are consistently used.
6. Fertilizer is applied according to soil tests and needs of the crop grown.
7. Adapted crop varieties are used at the recommended seeding rates.

## Use of the Soils as Pasture and Hayland

General guidelines for managing soils for pasture and hay are described in this subsection. Then the soils are placed in six pasture and hayland suitability groups, and each group is described. Those who wish to know the pasture and hayland suitability group of a soil can refer to the "Guide to Mapping Units" at the back of this survey. Those desiring detailed information about the management of soils can refer to the section "Descriptions of the Soils."

Much of the acreage in Mayes County is in pasture. Pasture plants are grown on soils that range from class I through class VI. The trend is to convert cropland to pasture. Because of the high value of land, extensive acreages of class IV and VI woodland soils also are being cleared and planted to tame pasture.

The main base grasses are improved bermudagrass for warm-season pasture and fescue for cool-season pasture. The base grasses are usually overseeded in a mixture containing legumes; for example, a bermudagrass-legume mixture is the main vegetation of summer pasture. Improved varieties of bermudagrass under good management produce more forage than common bermudagrass. Bermudagrass is well suited to most of the soils in classes I through VI. Winter rye and vetch, if overseeded on bermudagrass, provide grazing late in fall and early in spring. Annual lespedeza is grown with bermudagrass primarily to provide more palatable forage in July and August. Sudan and sorghum hybrids are used for summer temporary pasture where perennial forages are in short supply. Fall-sown small grains, such as winter rye, are sometimes used for fall, winter, and spring grazing as a supplement to native and perennial tame-pasture plants.

Tall fescue also provides grazing early in spring and late in fall. Tall fescue is better suited to the wetter, more clayey soils. It can be grown successfully on soils of the uplands, but intensive management is required if it is to survive dry seasons. On soils of the bottom lands management does not need to be so intensive. Ladino clover and big hop clover are frequently grown with fescue.

## Management and Maintenance of Pasture and Hayland

Proper grazing helps to lengthen the life of most pastures. Fescue pasture should not be grazed in July and August. This rest permits the plants to grow enough to shade the ground and regain vigor.

Brush control is essential, especially on soils that grow trees. Applying moderate

amounts of fertilizer that contains the proper elements provides for more vigorous plants and more palatable forage. It also helps to increase the production of and lengthen the lifespan of pastures. Some legumes, such as Ladino clover, require more phosphate and lime than others, such as yellow hop clover and lespedeza. Commonly, larger amounts of nitrogen fertilizer are needed where grass is grown without legumes.

## Pasture and Hayland Suitability Groups

Pasture and hayland suitability groupings have been made in this county to assist farmers in selecting suitable forage plants for grazing livestock. These groups are described in the following pages. The soils of each group support similar pasture plants and require similar treatment and management. Forage production for one soil in the group is essentially the same as for the other soils if management and treatment are the same for all the soils. Soils that formed under woodland require brush control. Failure to control brush results in the regrowth of trees and the reduction of pasture forage.

Yields of pasture and hayland are given in the section "Estimated Yields." Grazing capacities are estimated in terms of animal-unit-months. An animal-unit-month (A.U.M.) is the amount of forage or feed required to maintain one animal unit--one cow, one horse, one mule, five sheep, or five goats --for a period of 30 days.

### Pasture and Hayland Suitability Group 2A

In this group are deep soils that are loamy throughout. These soils are moderately permeable to rapidly permeable and are well drained or moderately well drained. They are on flood plains and are subject to flooding. Control of brush is a needed management practice on these soils. These soils are well suited to tall fescue and bermudagrass.

### Pasture and Hayland Suitability Group 2B

In this group are deep soils that have a loamy surface layer and clayey subsoil. These soils are slowly permeable or very slowly permeable and are poorly drained. They are on flood plains and are subject to flooding. Controlling brush, using drainage practices and fertilizer, and preventing surface compaction are needed management practices on these soils. These soils are well suited to tall fescue and bermudagrass. Preparation of seedbeds is difficult because the soils are wet.

### Pasture and Hayland Suitability Group 8A

In this group are moderately deep and deep soils that have a loamy surface layer and loamy or clayey subsoil. They are moderately permeable to very slowly permeable. These soils are well-drained to somewhat poorly drained. They are on uplands and terraces. These soils are well suited to bermudagrass. Tall fescue is not so well adapted as bermudagrass but can be grown under good management.

### Pasture and Hayland Suitability Group 8B

In this group are deep soils that are loamy throughout or have a loamy and clayey subsoil. These soils are very slowly permeable or moderately rapidly permeable and are well drained or somewhat excessively drained. They are on uplands. Control of brush is a needed management practice on these soils. These soils are low in fertility and require split applications of fertilizer that is high in content of nitrogen. These soils are well suited to bermudagrass. Tall fescue is not so well adapted as bermudagrass but can be grown under good management.

### Pasture and Hayland Suitability Group 8C

In this group are deep soils that have a loamy surface layer and loamy and clayey subsoil. They are very slowly permeable and somewhat poorly drained. These soils are on uplands. The greatest crop growth can be expected in spring and early in summer. Using drainage practices and preventing surface compaction are good management practices on these soils. These soils are well suited to bermudagrass. Tall fescue is not so well adapted as bermudagrass but can be grown under good management.

### Pasture and Hayland Suitability Group 14A

In this group are very shallow to shallow soils that have a loamy surface layer and loamy or clayey subsoil. These soils are slowly permeable or moderately rapidly permeable and well drained to somewhat excessively drained. They are on uplands. Brush

TABLE 2.--ESTIMATED ACRE YIELDS OF CROPS AND PASTURE PLANTS

[All yields are those to be expected under a high level of management. Absence of a yield figure indicates that the crop is seldom grown or is not suited]

| Soil series and map symbol | Corn | Grain sorghum | Wheat | Soybeans | Alfalfa | Bermuda-grass | Fescue |
|---|---|---|---|---|---|---|---|
| | Bu | Bu | Bu | Bu | Tons | AUM 1/ | AUM 1/ |
| Bates: | | | | | | | |
| BaB------ | 50 | 55 | 35 | 25 | 3.0 | 6.0 | 5.5 |
| BaC------ | 40 | 45 | 25 | 20 | 2.5 | 5.5 | 4.5 |
| BcC------ | -- | 35 | 20 | -- | --- | 4.5 | --- |
| Cannon: Ca. | 70 | 60 | 30 | 30 | 4.0 | 6.5 | 5.5 |
| Captina: CcB. | 75 | 70 | 35 | 30 | 4.0 | 7.5 | 7.0 |
| Choteau: | | | | | | | |
| ChA------ | 60 | 65 | 35 | 30 | 4.0 | 7.0 | 6.0 |
| ChB------ | 50 | 60 | 30 | 25 | 3.5 | 7.0 | 5.5 |
| Clarksville: | | | | | | | |
| CkD------ | -- | 40 | -- | -- | --- | 4.5 | 4.0 |
| ClE------ | -- | -- | -- | -- | --- | 4.0 | 4.0 |
| ClF------ | -- | -- | -- | -- | --- | --- | --- |
| Collinsville: CoE. | -- | -- | -- | -- | --- | --- | --- |
| Craig: | | | | | | | |
| CrB------ | 45 | 50 | 25 | 20 | 3.0 | 5.5 | 4.5 |
| CrC------ | 40 | 40 | 25 | 20 | --- | 5.0 | 4.0 |
| Dennis: | | | | | | | |
| DnB------ | 60 | 70 | 40 | 35 | 4.0 | 7.0 | 6.0 |
| DnC------ | 55 | 65 | 35 | 30 | --- | 6.5 | 5.5 |
| DnC2----- | -- | 50 | 30 | 20 | --- | 5.0 | 5.0 |
| DvE------ | -- | -- | -- | -- | --- | 6.0 | 6.0 |
| Eldorado: ElD. | -- | -- | -- | -- | --- | 4.0 | 4.0 |
| Elsah: Es-- | -- | -- | -- | -- | --- | 4.5 | 5.0 |
| Hector: | | | | | | | |
| HeC------ | -- | 40 | 25 | -- | --- | 4.0 | 4.0 |
| HeE------ | -- | -- | -- | -- | --- | --- | --- |
| HsF------ | -- | -- | -- | -- | --- | --- | --- |
| Kanina: KaE. | -- | -- | -- | -- | --- | --- | --- |
| Lenapah: | | | | | | | |
| LeB------ | -- | 35 | 30 | 15 | --- | 4.5 | 4.5 |
| LrD------ | -- | -- | -- | -- | --- | --- | --- |

TABLE 2.--ESTIMATED ACRE YIELDS OF CROPS AND PASTURE PLANTS--Cont.

| Soil series and map symbol | Corn | Grain sorghum | Wheat | Soybeans | Alfalfa | Bermuda-grass | Fescue |
|---|---|---|---|---|---|---|---|
| | Bu | Bu | Bu | Bu | Tons | AUM 1/ | AUM 1/ |
| Lula: LuB-- | 55 | 60 | 35 | 25 | 3.5 | 6.0 | 5.5 |
| Mayes: Ma-- | 40 | 45 | 25 | 25 | --- | 5.5 | 5.0 |
| Nixa: NxB-- | 50 | 35 | 20 | -- | --- | 5.0 | 5.0 |
| Okemah: OkA. | 60 | 70 | 40 | 35 | 4.0 | 7.0 | 6.5 |
| Osage: Os-- | 55 | 70 | 35 | 25 | --- | 5.5 | 6.0 |
| Parsons: PaA. | 55 | 50 | 35 | 30 | --- | 6.0 | 6.0 |
| Quarles: Qu. | 50 | 45 | 20 | 25 | --- | 6.0 | 6.0 |
| Riverton: | | | | | | | |
| ReB------ | 45 | 50 | 30 | 25 | 3.5 | 6.0 | 5.5 |
| RvC------ | -- | 40 | 25 | 20 | --- | 5.5 | 5.0 |
| Sallisaw: SaB. | 50 | 50 | 30 | 25 | 3.5 | 7.5 | 6.0 |
| Summit: | | | | | | | |
| SuA------ | 65 | 70 | 40 | 35 | 4.0 | 6.5 | 6.5 |
| SuB------ | 60 | 65 | 35 | 30 | 3.5 | 6.0 | 6.0 |
| SuC------ | 55 | 60 | 30 | 25 | --- | 5.5 | 5.5 |
| Taloka: TaA. | 55 | 60 | 40 | 30 | 4.0 | 6.5 | 6.5 |
| Verdigris: | | | | | | | |
| Ve------- | 70 | 70 | 40 | 35 | 4.5 | 7.5 | 7.5 |
| Vs------- | -- | -- | -- | -- | --- | 6.0 | 6.0 |

1/ Animal-unit-month. The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

control is a needed management practice on these soils. The shallowness of the soils is a limitation to good plant growth during prolonged dry periods. These soils are suited to tall fescue and bermudagrass.

## Use of the Soils as Rangeland 3/

This section contains information about the use of the soils as rangeland. Areas of rangeland in Mayes County consist of native grassland prairies and savannah areas used primarily for grazing. The county is about 30 percent rangeland. Of this area, about 20 percent is prairie and 10 percent is mixed hardwoods and grasses.

Beef cattle are the main livestock in the county. About 65,000 to 85,000 head are grazed annually. The range is usually grazed year round and protein is used as a supplement. Most range in the county is used in conjunction with tame pastures and small grains, but there are a few large ranches.

### Range Sites and Condition Classes

Different kinds of soil vary in their capacity to produce grasses and other plants for grazing. Soils that produce about the same kinds and amounts of forage when 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 as long as the environment remains unchanged. Throughout the prairie and the plains, the climax vegetation consists of the plants that were growing in an area 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 amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in 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 are annual weeds, some are shrubs that have some grazing value, and others are plants that have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the climax vegetation that is brought about by grazing or other uses. The classes indicate 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 the same as that in the climax stand. 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.

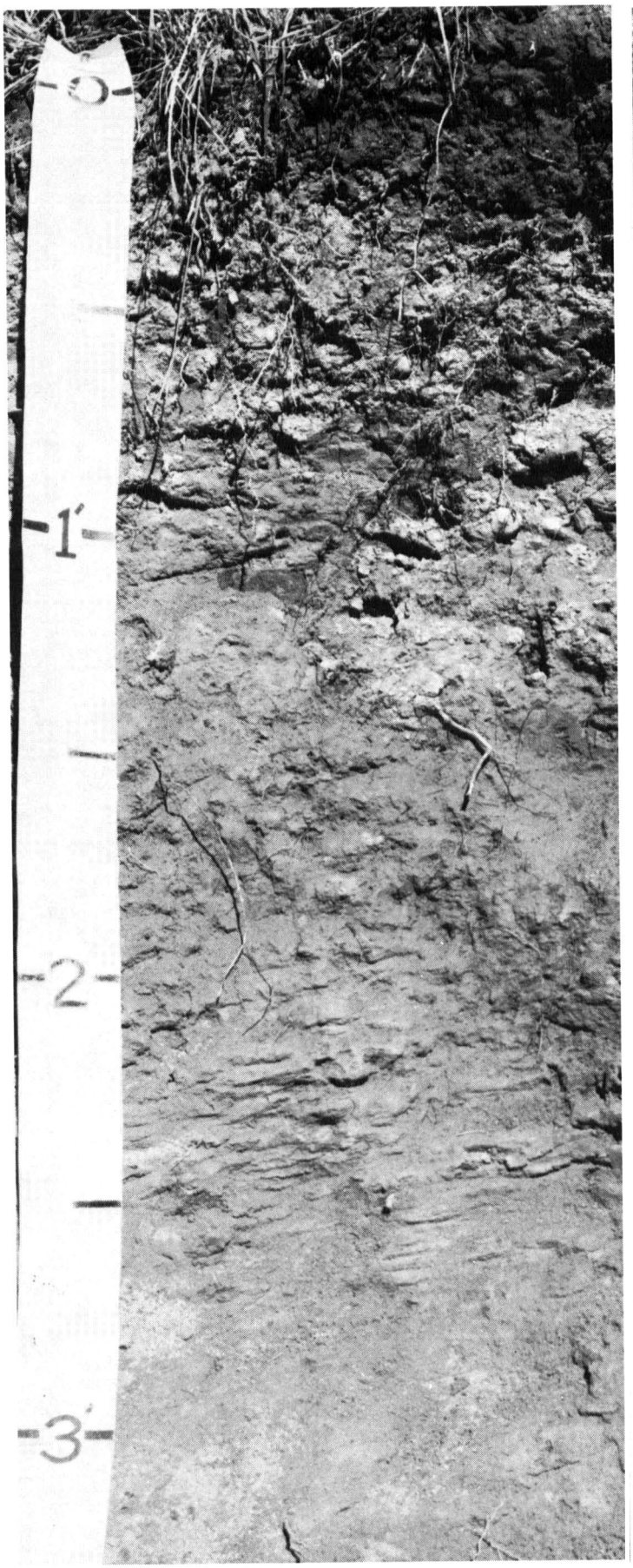
Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing seasons.

A primary objective of good range management is to keep rangeland in excellent or good condition. If this is done and the water is conserved, yields are improved, and the soils are protected. The main concern in management is recognizing 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 may 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, rangeland 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.

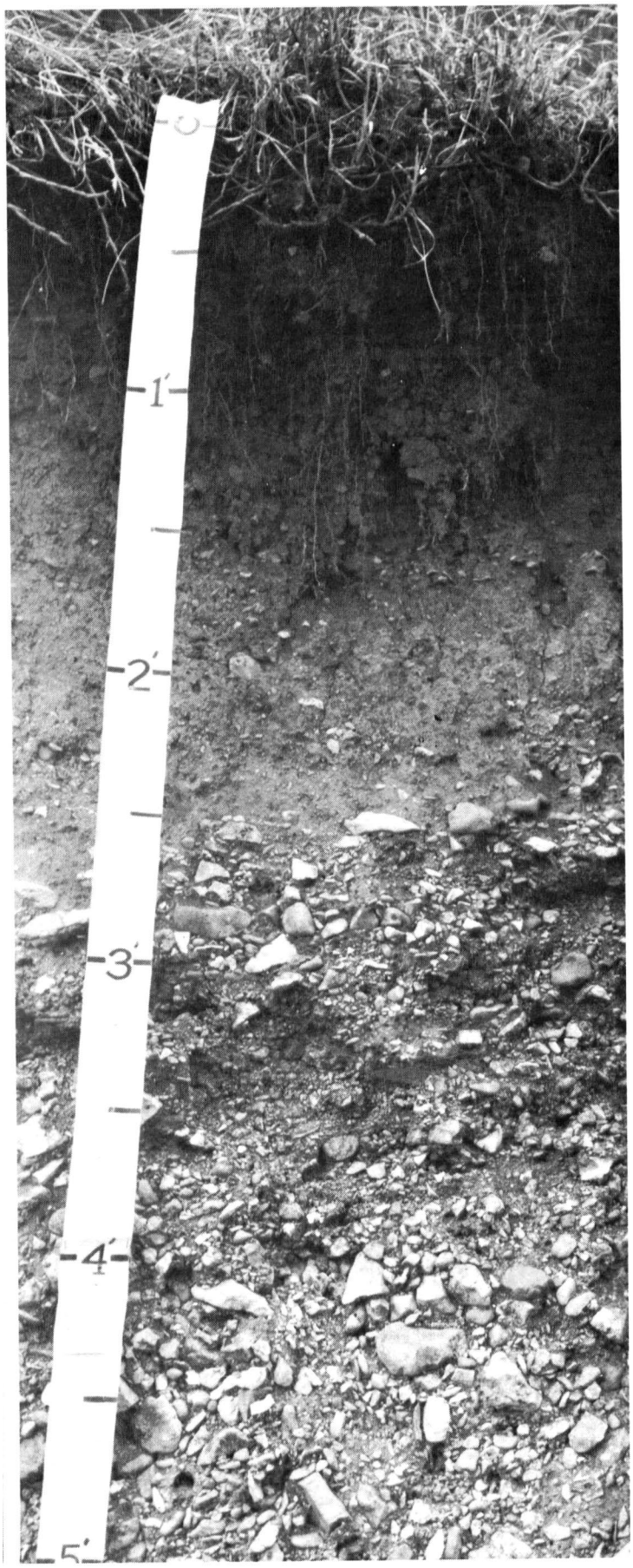
### Descriptions of Range Sites

In the following pages, the range sites and range management needs are described.

3/ By DAVID ANKLE, range conservationist, Soil Conservation Service.

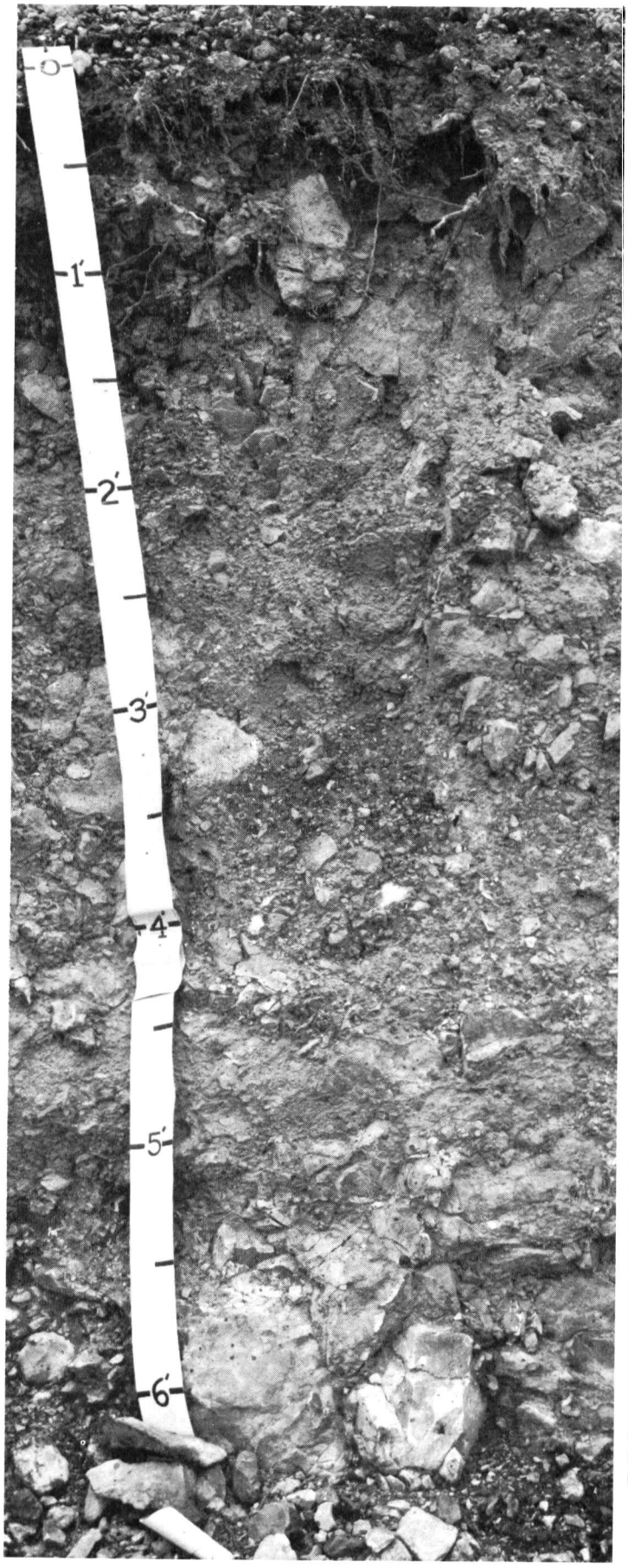



Profile of Bates loam showing sandstone at a depth of about 2 feet.




Profile of Cannon gravelly loam.

*PLATE II*




Profile of Clarksville cherty silt loam.


Profile of Nixa cherty silt loam.

Good stand of bermudagrass on Captina silt loam, 1 to 3 percent slopes. The sod was established after trees were cleared.

Clarksville stony silt loam, 5 to 20 percent slopes, used as a site for a modern rural home.

An area of Dennis silt loam, 1 to 3 percent slopes, used as range.

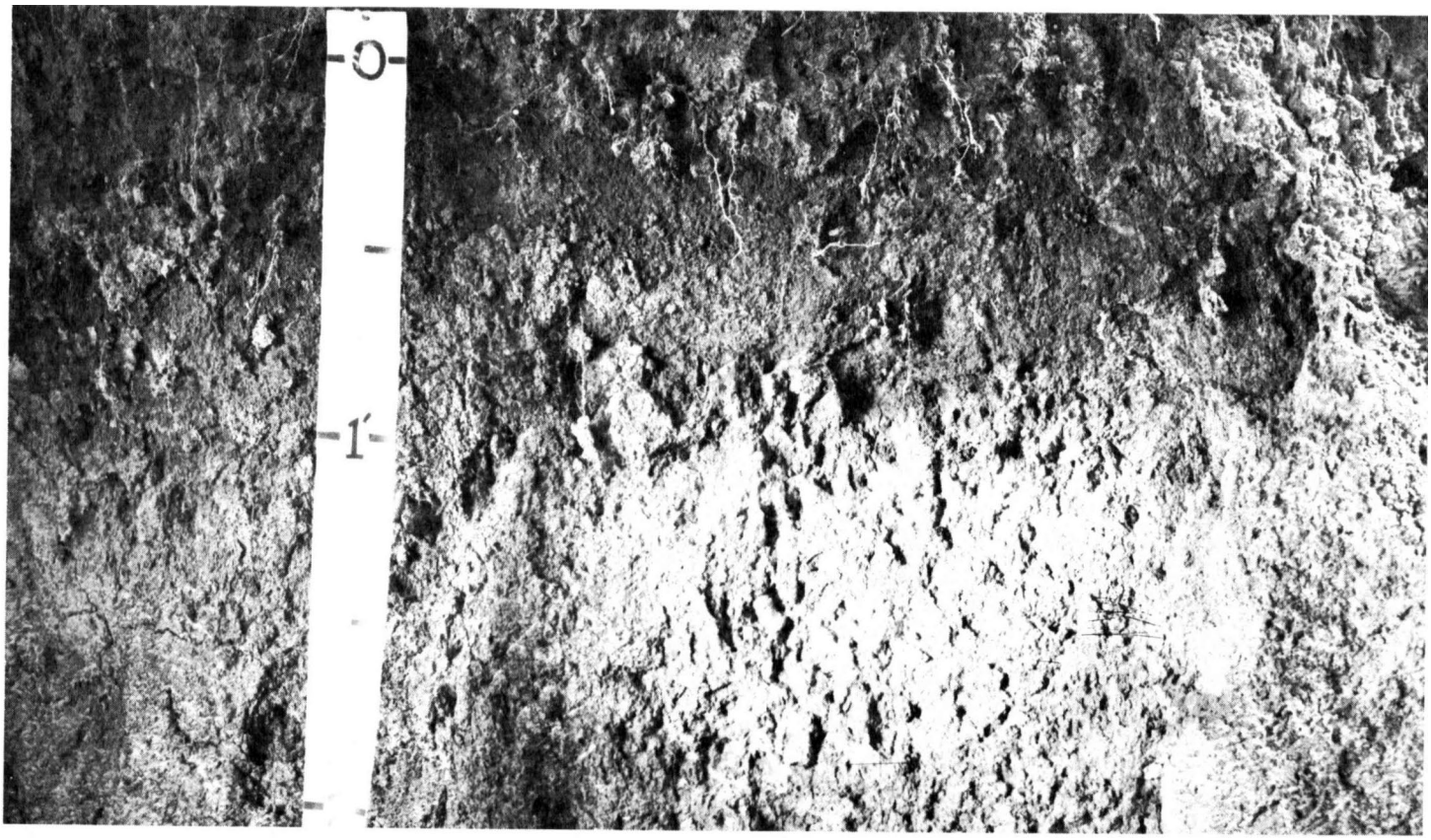

Profile of Eldorado cherty silt loam.

Area of Elsah soils, frequently flooded.

Lenepah-Rock outcrop complex, 1 to 8 percent slopes. Lenepah soils in foreground and bare limestone Rock outcrop in background.

548-966 O - 75 - 4

Tame pasture on Parsons silt loam, 0 to 1 percent slopes.



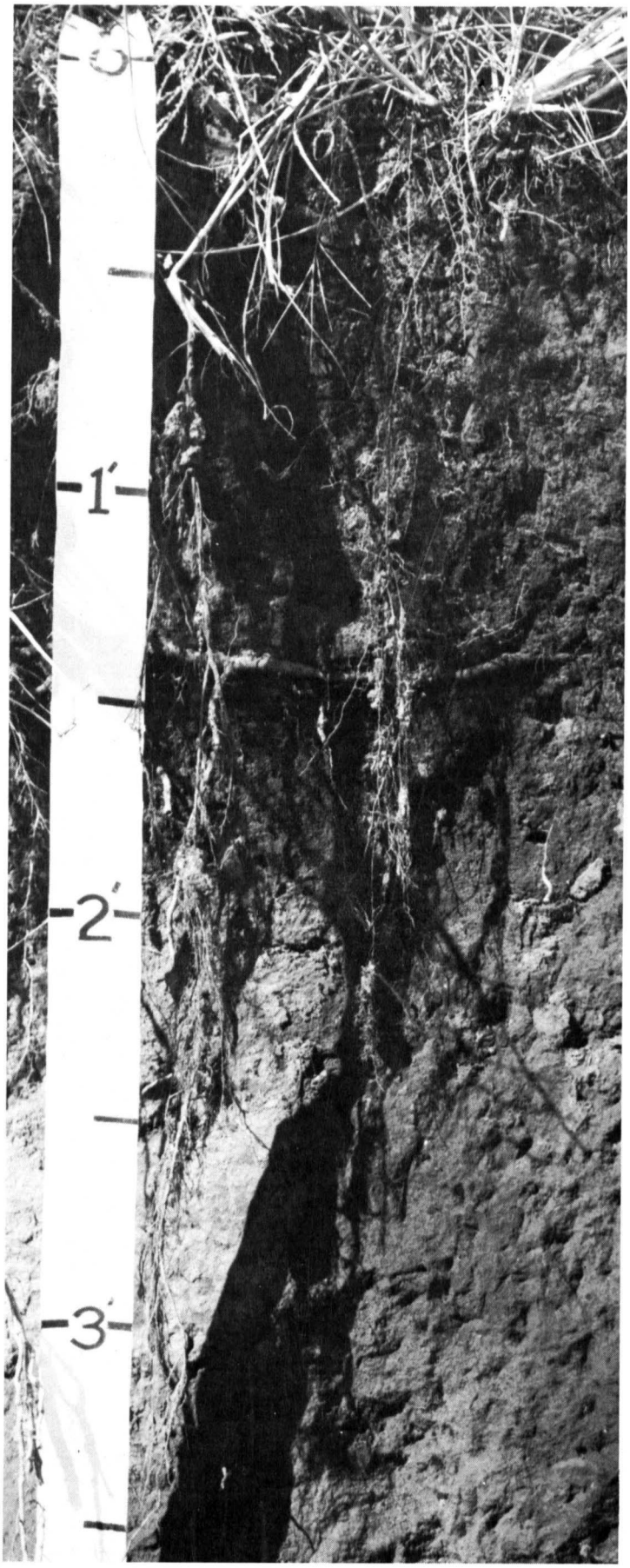

Profile of Quarles silt loam.

Flooding on Quarles silt loam.

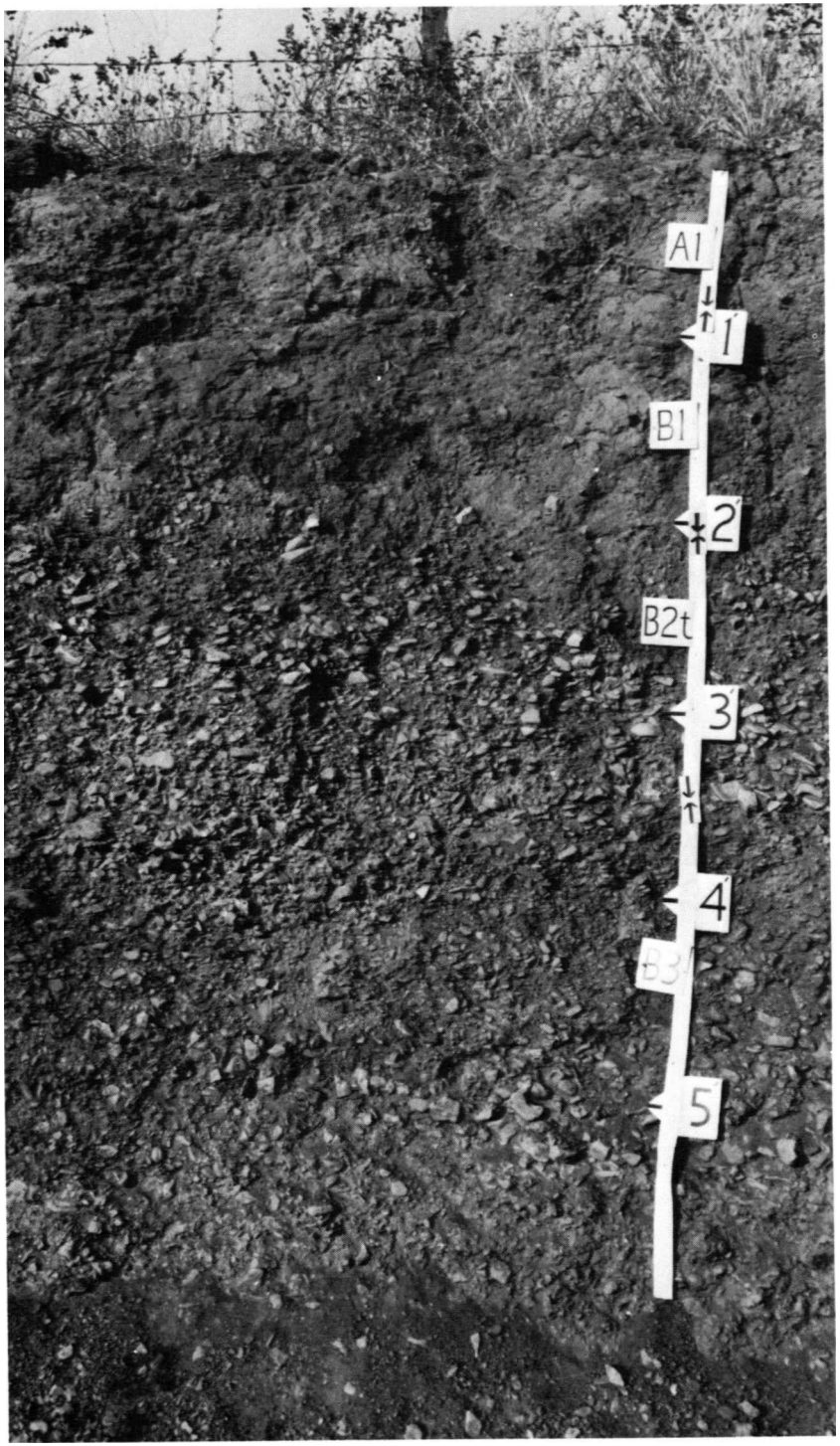
Cultivated field with surface drainage on Quarles silt loam.

*PLATE VIII*

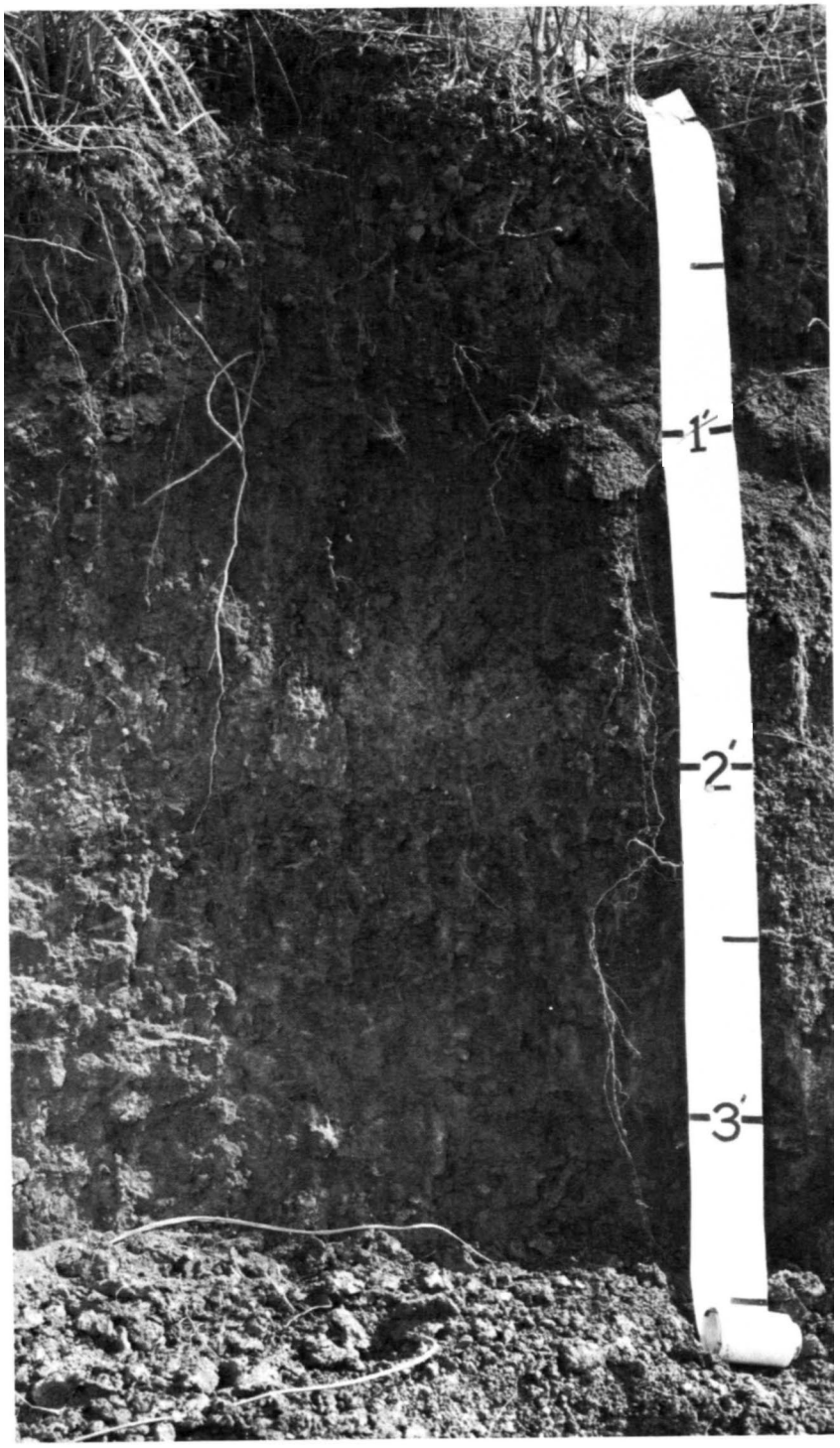

Profile of Sallisaw silt loam.




Profile of Verdigris silty clay loam.




Profile of Riverton loam.




Profile of Taloka silt loam.

PLATE IX

The potential plant community and the potential annual yield of air-dry herbage for each soil are shown in table 3. The range site of each soil is shown in table 3 and in the "Guide to Mapping Units" at the back of this survey.

## Claypan Prairie Range Site

This range site consists of deep, nearly level, loamy soils on uplands. These soils have a clayey and loamy subsoil that restricts the penetration of grass roots and water.

Under continued heavy grazing by cattle, big bluestem, little bluestem, switchgrass, indiangrass, and Illinois bundleflower decrease in the plant community. Such plants as tall dropseed, side-oats grama, scribner panicum, slimflower scurf-pea, winged elm, and hawthorn increase. If overgrazing is prolonged, ragweed, bitter sneezeweed, croton, splitbeard bluestem, broomsedge bluestem, annual bromes, and persimmon make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, deferred grazing, planned grazing systems, stockwater development, range seeding, fencing, brush control, and weed control.

## Heavy Bottomland Range Site

This site consists of deep, nearly level, loamy soils on flood plains. These soils have a clayey or loamy subsoil.

Under continued heavy grazing by cattle, prairie cordgrass, big bluestem, indiangrass, switchgrass, and perennial sunflowers decrease in the plant community. Such plants as little bluestem, tall dropseed, knotroot bristlegrass, sedges, ash, walnut, and pecan increase. If overgrazing is prolonged, giant ragweed, ironweed, white snakeroot, seacoast sumpweed, silver bluestem, windmillgrass, and hawthorns make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, deferred grazing, planned grazing systems, stockwater development, range seeding, fencing, brush control, and weed control.

## Loamy Bottomland Range Site

This site consists of deep, nearly level to very gently sloping soils on flood plains. These soils are loamy throughout.

Under continued heavy grazing by cattle, big bluestem, indiangrass, switchgrass, eastern gamagrass, florida paspalum, and compass plant decrease in the plant community. Such plants as little bluestem, beaked panicum, sedges, rushes, pecan, walnut, and greenbrier increase. If overgrazing is prolonged, broomsedge bluestem, annual bromes, giant ragweed, seacoast sumpweed, white snakeroot, persimmon, oak, and hawthorn make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, planned grazing systems, deferred grazing, stockwater development, cross fencing, range seeding, brush control, and weed control.

## Loamy Prairie Range Site

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

Under continued heavy grazing by cattle, big bluestem, little bluestem, switchgrass, indiangrass, and catclaw sensitivebrier decrease in the plant community. Such plants as purpletop, tall dropseed, scribner panicum, goldenrods, sumac, blackberry, coralberry, and indigobush increase. If overgrazing is prolonged, broomsedge and splitbeard bluestem, annual bromes, threeawns, common broomweed, ragweeds, ironweed, and persimmon make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, deferred grazing, planned grazing systems, stockwater development, brush control, fencing, weed control, and range seeding.

## Sandy Savannah Range Site

This site consists of deep, very gently sloping to moderately steep soils on uplands that have a loamy surface layer or loamy or clayey subsoil. These soils support an understory of tall and mid-grasses and an overstory of post oak and blackjack oak.

Under continued heavy grazing by cattle, little bluestem, big bluestem, indiangrass, switchgrass, wildryes, virginia tephrosia, and perennial sunflowers decrease in the plant community. Such plants as purple lovegrass, scribner panicum, purpletop, goldenrods, post oak, blackjack oak, red oak, and hickory increase. If overgrazing

is prolonged, fringeleaf paspalum, broomsedge bluestem, threeawns, showy partridgepea, ragweeds, crotons, persimmon, and hawthorns make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, planned grazing systems, deferred grazing, stockwater development, controlled burning, fencing, brush control, range seeding, and weed control.

## Savannah Breaks Range Site

This site consists of shallow, steep and very steep soils on uplands that are loamy throughout. The soils of this site support an understory of tall and mid-grasses and an overstory of post oak and blackjack oak.

Under continued heavy grazing by cattle, little bluestem, big bluestem, indiangrass, switchgrass, Canada wildrye, poison-ivy, and perennial lespedeza decrease in the plant community. Such plants as purpletop, side-oats grama, scribner panicum, post oak, blackjack oak, chittam, redbud, and greenbrier increase. If overgrazing is prolonged, broomsedge bluestem, annual bromes, threeawns, poverty oatgrass, ragweeds, croton, and winged elm make a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, planned grazing systems, deferred grazing, and controlled burning.

## Shallow Prairie Range Site

This site consists of very shallow or shallow, nearly level to steep soils on uplands that have a loamy surface layer and loamy or clayey subsoil. These soils are over sandstone or limestone.

Under continued heavy grazing by cattle, little bluestem, big bluestem, indiangrass, switchgrass, blacksamson, and prairie rose decrease in the plant community. Such plants as side-oats grama, longspike tridens, tall dropseed, heath aster, winged elm, sumac, and blackberry increase. If overgrazing is prolonged, broomsedge bluestem, windmillgrass, annual bromes, annual threeawn, showy partridgepea, common broomweed, persimmon, and hawthorn make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, planned grazing systems, deferred grazing, stockwater development, fencing, range seeding, and weed control.

## Shallow Savannah Range Site

This site consists of shallow, very gently sloping to moderately steep soils on uplands that are loamy throughout. These soils support an understory of tall and mid grasses and an overstory of post oak and blackjack oak.

Under continued heavy grazing by cattle, little bluestem, big bluestem, indiangrass, Canada wildrye, Virginia tephrosia, perennial sunflower, poison-ivy, and wild grapes decrease in the plant community. Such plants as tall dropseed, scribner panicum, heath aster, wild indigo, post oak, blackjack oak, red oak, hickory, and coralberry increase. If overgrazing is prolonged, splitbeard bluestem, broomsedge bluestem, poverty oatgrass, croton, ironweed, horseweed fleabane, persimmon, and winged elm make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, deferred grazing, planned grazing systems, stockwater development, fencing, controlled burning, brush control, and weed control.

## Smooth Chert Savannah Range Site

This site consists of deep, nearly level to moderately steep soils on uplands that are loamy throughout. These soils support an understory of tall and mid grasses and an overstory of blackjack oak and red oak.

Under continued heavy grazing by cattle, big bluestem, little bluestem, indiangrass, wildrye, slender lespedeza, and huckleberry decrease in the plant community. Such plants as tall dropseed, scribner panicum, goldenrods, red oak, post oak, blackjack oak, shortleaf pine, flowering dogwood, and coralberry increase. If overgrazing is prolonged, broomsedge bluestem, splitbeard bluestem, poverty oatgrass, copperleaf, horseweed fleabane, croton, ragweed, and winged elm make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, planned grazing systems, deferred grazing, stockwater development, fencing, controlled burning, brush control, range seeding, and weed control.

TABLE 3.--COMPOSITION OF THE POTENTIAL NATIVE PLANT COMMUNITY ON RANGELAND

[Soils not listed are not in a range site. Soils not listed can be used for grazing if grass cover is established]

| Soil series and map symbols | Common plant name | Composition | Potential production during-- | | Range site |
|---|---|---|---|---|---|
| | | | Favorable years | Unfavorable years | |
| | | Percent | Pounds per acre | Pounds per acre | |
| Bates: BaB, BaC, BcC 1/. | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Other---------------- | 30 | | | |
| Cannon: Ca---- | Little bluestem------ | 15 | 4,000 | 2,000 | (2/) |
| | Big bluestem--------- | 25 | | | |
| | Indiangrass---------- | 20 | | | |
| | Other---------------- | 40 | | | |
| Captina: CcB-- | Little bluestem------ | 20 | 5,000 | 2,000 | Smooth Chert Savannah. |
| | Big bluestem--------- | 15 | | | |
| | Low panicums--------- | 10 | | | |
| | Other---------------- | 55 | | | |
| Choteau: ChA, ChB. | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Other---------------- | 30 | | | |
| Clarksville: | | | | | |
| CkD, ClE----- | Little bluestem------ | 15 | 3,000 | 1,000 | Smooth Chert Savannah. |
| | Big bluestem--------- | 20 | | | |
| | Indiangrass---------- | 10 | | | |
| | Other---------------- | 55 | | | |
| ClF---------- | Little bluestem------ | 15 | 2,500 | 500 | Steep Chert Savannah. |
| | Big bluestem--------- | 10 | | | |
| | Indiangrass---------- | 10 | | | |
| | Other---------------- | 65 | | | |
| Collinsville: CoE. | Little bluestem------ | 30 | 3,500 | 1,500 | Shallow Prairie. |
| | Big bluestem--------- | 15 | | | |
| | Indiangrass---------- | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 35 | | | |
| Craig: CrB, CrC. | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 30 | | | |
| Dennis: DnB, DnC 1/, DnC2, DvE 1/. | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 30 | | | |

TABLE 3.--COMPOSITION OF THE POTENTIAL NATIVE PLANT COMMUNITY ON RANGELAND--Continued

| Soil series and map symbols | Common plant name | Composition | Potential production during-- | | Range site |
|---|---|---|---|---|---|
| | | | Favorable years | Unfavorable years | |
| | | Percent | Pounds per acre | Pounds per acre | |
| Eldorado: ElD- | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 30 | | | |
| Elsah: Es----- | Switchgrass---------- | 15 | 5,000 | 2,000 | (2/). |
| | Big bluestem--------- | 10 | | | |
| | Little bluestem------ | 10 | | | |
| | Gamagrass------------ | 10 | | | |
| | Low panicums--------- | 15 | | | |
| | Other---------------- | 40 | | | |
| Enders 3/------ | Little bluestem------ | 20 | 3,000 | 1,000 | Sandy Savannah. |
| | Indiangrass---------- | 10 | | | |
| | Big bluestem--------- | 15 | | | |
| | Switchgrass---------- | 5 | | | |
| | Other---------------- | 50 | | | |
| Hector: | | | | | |
| HeC 1/, HeE 1/. | Little bluestem------ | 25 | 4,800 | 2,000 | Shallow Savannah. |
| | Big bluestem--------- | 15 | | | |
| | Indiangrass---------- | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 40 | | | |
| HsF---------- | Little bluestem------ | 20 | 3,500 | 1,700 | Savannah Breaks. |
| | Big bluestem--------- | 10 | | | |
| | Indiangrass---------- | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 50 | | | |
| Lenapah: LeB, LrD. | Little bluestem------ | 30 | 5,000 | 2,500 | Shallow Prairie. |
| | Big bluestem--------- | 15 | | | |
| | Indiangrass---------- | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 35 | | | |
| Lula: LuB----- | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Switchgrass---------- | 10 | | | |
| | Indiangrass---------- | 25 | | | |
| | Other---------------- | 30 | | | |
| Mayes: Ma----- | Big bluestem--------- | 30 | 4,500 | 2,000 | Claypan Prairie. |
| | Little bluestem------ | 15 | | | |
| | Switchgrass---------- | 15 | | | |
| | Indiangrass---------- | 10 | | | |
| | Other---------------- | 30 | | | |
| Nixa: NxB----- | Little bluestem------ | 15 | 3,000 | 1,000 | Smooth Chert Savannah. |
| | Big bluestem--------- | 10 | | | |
| | Low panicums--------- | 20 | | | |
| | Other---------------- | 55 | | | |

TABLE 3.--COMPOSITION OF THE POTENTIAL NATIVE PLANT COMMUNITY ON RANGELAND--Continued

| Soil series and map symbols | Common plant name | Composition | Potential production during-- | | Range site |
|---|---|---|---|---|---|
| | | | Favorable years | Unfavorable years | |
| | | Percent | Pounds per acre | Pounds per acre | |
| Okemah: OkA--- | Big bluestem-------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem----- | 10 | | | |
| | Indiangrass--------- | 15 | | | |
| | Switchgrass--------- | 10 | | | |
| | Other--------------- | 30 | | | |
| Osage: Os----- | Prairie cordgrass--- | 30 | 7,000 | 3,500 | Heavy Bottomland. |
| | Big bluestem-------- | 20 | | | |
| | Switchgrass--------- | 5 | | | |
| | Gramagrass---------- | 5 | | | |
| | Other--------------- | 40 | | | |
| Parsons: PaA-- | Big bluestem-------- | 30 | 4,500 | 2,000 | Claypan Prairie. |
| | Little bluestem----- | 15 | | | |
| | Indiangrass--------- | 10 | | | |
| | Switchgrass--------- | 15 | | | |
| | Other--------------- | 30 | | | |
| Quarles: Qu--- | Switchgrass--------- | 15 | 3,000 | 1,500 | Heavy Bottomland. |
| | Wildrye------------- | 15 | | | |
| | Beaked panicum------ | 20 | | | |
| | Redtop panicum------ | 15 | | | |
| | Other--------------- | 35 | | | |
| Riverton: ReB, RvC. | Big bluestem-------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem----- | 10 | | | |
| | Indiangrass--------- | 15 | | | |
| | Switchgrass--------- | 10 | | | |
| | Other--------------- | 30 | | | |
| Sallisaw: SaB- | Little bluestem----- | 20 | 4,000 | 1,500 | Smooth Chert Savannah. |
| | Big bluestem-------- | 15 | | | |
| | Indiangrass--------- | 5 | | | |
| | Low panicums-------- | 10 | | | |
| | Other--------------- | 50 | | | |
| Summit: SuA, SuB, SuC. | Big bluestem-------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem----- | 10 | | | |
| | Indiangrass--------- | 15 | | | |
| | Switchgrass--------- | 10 | | | |
| | Other--------------- | 30 | | | |

TABLE 3.--COMPOSITION OF THE POTENTIAL NATIVE PLANT COMMUNITY ON RANGELAND--Continued

| Soil series and map symbols | Common plant name | Composition | Potential production during-- | | Range site |
|---|---|---|---|---|---|
| | | | Favorable years | Unfavorable years | |
| | | Percent | Pounds per acre | Pounds per acre | |
| Taloka: TaA--- | Big bluestem--------- | 35 | 7,000 | 3,500 | Loamy Prairie. |
| | Little bluestem------ | 10 | | | |
| | Indiangrass---------- | 15 | | | |
| | Switchgrass---------- | 10 | | | |
| | Other---------------- | 30 | | | |
| Verdigris: Ve, Vs. | Big bluestem--------- | 25 | 10,000 | 6,000 | Loamy Bottomland. |
| | Little bluestem------ | 10 | | | |
| | Indiangrass---------- | 20 | | | |
| | Switchgrass---------- | 15 | | | |
| | Other---------------- | 30 | | | |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

2/ Not assigned to a range site. This soil is normally used as woodland but can be used for grazing if tree cover is reduced.

3/ Mapped only with Hector soils (HeC and HeE) in this survey area.

## Steep Chert Savannah Range Site

This site consists of deep, steep or very steep soils on uplands that are very loamy throughout. These soils support an understory of tall and mid grasses and an overstory of oak and hickory.

Under continued heavy grazing by cattle, big bluestem, little bluestem, indiangrass, wildryes, Virginia tephrosia, hairy sunflower, and huckleberry decrease in the plant community. Such plants as purpletop, scribner panicum, sumac, hickory, shortleaf pine, red oak, coralberry, flowering dogwood, and white oak increase. If overgrazing is prolonged, annual threeawn, broomsedge bluestem, poverty oatgrass, deervetch, ragweed, croton, ironweed, persimmon, and sassafras make up a substantial part of the range, and total production is greatly reduced.

Range management practices practical on this site are proper grazing, deferred grazing, planned grazing systems, and controlled burning.

## Use of the Soils as Woodland 4/

Originally 39 percent of Mayes County was mainly wooded. Now trees cover about 27 percent of the county. The areas of native woodland are on the flood plains and terraces along the major streams, on most of the cherty limestone areas of the uplands, and on a few areas of the sandstone and shale uplands.

The value of the wood products is substantial in this county, though below the potential. The woodland is also valuable for grazing livestock and for use as wildlife habitat, recreation areas, scenic areas, and soil and water conservation areas. This section explains how soils affect the growth of trees and the management of timber resources in the county. In table 4, potential productivity and

4/ By NORMAN E. SMOLA, forester, Soil Conservation Service.

management concerns are listed for soils of Mayes County. If a mapping unit contains the names of two series, as in a soil association, the component soils are evaluated separately under their respective series names.

The woodland ordination group, column 2 of table 4, tells much about the nature of soils in the group. All the soils in a given ordination group are suited to the same kinds of trees, need about the same kind of management to produce these trees, and have about the same potential productivity.

Each ordination group is identified by a three-part symbol. The first part of the symbol indicates the productivity of the soils: 1 for very high; 2, high; 3, moderately high; 4, moderate; and 5, low.

The second part of the symbol, a letter, indicates the important soil property that imposes a moderate or severe hazard or limitation in managing the soils for wood production. The letter x indicates that the main limitation is stoniness or rockiness; w, that excessive water in or on the soil is the chief limitation; t, that toxic substances in the soil are the chief limitation; d, that the rooting depth is restricted; c, that clay in the upper part of the soil is a limitation; s, that the soils are sandy; f, that the soils contain large amounts of coarse fragments; r, that the soils are steeply sloping; and o, that the soils have no significant restrictions or limitations for woodland use or management.

The third part of the symbol indicates degree of hazard, limitation, or general suitability of the soils for certain kinds of trees: 1 indicates the soils have no or only slight limitations and that they are best suited to needleleaf trees; 2, that the soils have one or more moderate limitations and are best suited to needleleaf trees; 3, that the soils have one or more severe limitations and are best suited to needleleaf trees; 4, that the soils have no limitations or only slight limitations and that they are best suited to broadleaf trees; 5, that the soils have one or more moderate limitations and are best suited to broadleaf trees; 6, that the soils have one or more severe limitations and are best suited to broadleaf trees; 7, that the soils have no limitations or only slight limitations and that they are suited to either needleleaf or broadleaf trees; 8, that the soils have one or more moderate limitations and are suited to either needleleaf or broadleaf trees; 9, that the soils have one or more severe limitations and are suited to either needleleaf or broadleaf trees; and 0 indicates that the soils are not suitable for producing commercial timber. The hazards or limitations that affect management of soils for woodland are windthrow hazard, erosion hazard, equipment limitations, seedling mortality, and plant competition.

Ratings of the hazard of erosion indicate the risk of loss of soil in well-managed woodland. The risk is slight if the expected loss of soil is small; moderate if some measures to control erosion are needed in logging and construction; and severe if intensive treatment or special equipment and methods are needed to prevent excessive soil losses.

Ratings of equipment limitations reflect the soil conditions that restrict the use of equipment normally used in woodland management or in harvesting. A rating of slight indicates that equipment use is not limited to a particular kind of equipment or time of year. A rating of moderate indicates a seasonal limitation or a need for modification in methods or equipment. A rating of severe indicates the need for specialized equipment or operations.

Seedling mortality ratings indicate degree of expected mortality of planted seedlings when plant competition is not a limiting factor. The ratings are for good planting stock that is properly planted during periods of normal rainfall. A rating of slight indicates that the expected mortality is less than 25 percent; moderate, 25 to 50 percent; and severe, more than 50 percent.

Table 4 also includes a list of potentially productive, commercially important trees that are adapted to the soils. These are the trees that woodland managers generally favor in intermediate or improvement cuttings.

The potential productivity of the trees is shown as a site-index value. The site-index value is the average height of the dominant trees, in feet, at age 30 for cottonwood, 35 for sycamore, 25 for planted pines, and 50 for all other species.

The last column of table 4 is a list of trees that are suitable for planting for commerical wood production.

## Use of the Soils as Wildlife Habitat 5/

Soils directly influence the kinds and amounts of vegetation and the amount of

5/ By GARY L. BULLARD, biologist, Soil Conservation Service.

TABLE 4.--WOODLAND SUITABILITY GROUPS AND FACTORS OF WOODLAND MANAGEMENT

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means that information was not available]

| Soil series and map symbols | Ordination group | Management concerns | | | Productivity | | Trees to favor in planting |
|---|---|---|---|---|---|---|---|
| | | Erosion hazard | Equipment limitation | Seedling mortality | Important trees | Site index | |
| Cannon: Ca----- | 2o7 | Slight---- | Slight----- | Slight. | Yellow-poplar---<br>Upland oaks-----<br>Loblolly pine---<br>Black walnut---- | 100<br>80<br>90<br>-- | Yellow-poplar, black walnut, loblolly pine. |
| Captina: CcB--- | 4o7 | Slight---- | Slight----- | Slight. | Shortleaf pine--<br>Red oak---------<br>Black locust----<br>Black walnut----<br>Redcedar-------- | 60<br>65<br>--<br>--<br>40 | Shortleaf pine, redcedar, black walnut, black locust, red oak. |
| Clarksville: | | | | | | | |
| CkD---------- | 4f8 | Slight---- | Slight----- | Slight. | Upland oak------<br>Shortleaf pine-- | 55<br>55 | Shortleaf pine. |
| ClE---------- | 4f8 | Moderate-- | Moderate--- | Moderate. | Upland oak------<br>Shortleaf pine-- | 55<br>55 | Shortleaf pine. |
| ClF---------- | 4f8 | Severe---- | Severe----- | Severe. | Upland oak------<br>Shortleaf pine-- | 55<br>55 | Shortleaf pine. |
| Craig: CrB, CrC. | 5f2 | Slight---- | Slight----- | Moderate. | Shortleaf pine--<br>Redcedar--------<br>Loblolly pine--- | 50<br>30<br>-- | Shortleaf pine, loblolly pine, redcedar. |
| Eldorado: ElD-- | 5f2 | Slight---- | Slight---- | Moderate. | Shortleaf pine--<br>Redcedar--------<br>Loblolly pine--- | 50<br>30<br>-- | Shortleaf pine, redcedar, loblolly pine. |
| Elsah: Es------ | 2f4 | Slight---- | Slight----- | Slight. | Cottonwood------ | 100 | Sycamore, red maple, sweet gum. |
| Enders 1/------- | 4o1 | Slight---- | Slight----- | Slight. | Red oak---------<br>White oak-------<br>Redcedar--------<br>Shortleaf pine-- | 60<br>55<br>40<br>60 | Loblolly pine, shortleaf pine, redcedar. |
| Hector: | | | | | | | |
| HeC 2/--------- | 5d2 | Slight---- | Moderate--- | Moderate. | Shortleaf pine--<br>Redcedar-------- | 50<br>30 | Shortleaf pine, loblolly pine, redcedar. |
| HeE 2/--------- | 5d2 | Moderate-- | Moderate--- | Moderate. | Shortleaf pine--<br>Redcedar-------- | 50<br>30 | Shortleaf pine, loblolly pine, redcedar. |
| HsF---------- | 5d2 | Severe---- | Severe----- | Severe. | Shortleaf pine--<br>Redcedar-------- | 50<br>30 | Shortleaf pine, loblolly pine, redcedar. |
| Nixa: NxB------ | 4f8 | Slight---- | Slight----- | Moderate. | Shortleaf pine--<br>Red oak---------<br>White oak-------<br>Redcedar--------<br>Black walnut----<br>Black locust---- | 60<br>60<br>60<br>40<br>--<br>-- | Shortleaf pine, loblolly pine, redcedar, black locust, red oak. |

TABLE 4.--WOODLAND SUITABILITY GROUPS AND FACTORS OF WOODLAND MANAGEMENT--Continued

| Soil series and map symbols | Ordination group | Management concerns | | | Productivity | | Trees to favor in planting |
|---|---|---|---|---|---|---|---|
| | | Erosion hazard | Equipment limitation | Seedling mortality | Important trees | Site index | |
| Osage: Os------ | 5w6 | Slight---- | Slight----- | Moderate. | Pin oak--------- | 50 | Pin oak, pecan. |
| | | | | | Pecan----------- | 40 | |
| | | | | | Cottonwood------ | 65 | |
| Quarles: Qu---- | 3w6 | Slight---- | Severe----- | Slight. | Pin oak--------- | 80 | Pin oak, pecan. |
| | | | | | Pecan----------- | 55 | |
| Riverton: ReB, RvC. | 5f2 | Slight---- | Slight----- | Moderate. | Shortleaf pine-- | 50 | Shortleaf pine, |
| | | | | | Redcedar-------- | 35 | redcedar, |
| | | | | | Loblolly pine--- | -- | loblolly pine. |
| Sallisaw: SaB-- | 3o7 | Slight---- | Slight----- | Slight. | Shortleaf pine-- | 70 | Shortleaf pine, |
| | | | | | Red oak--------- | -- | loblolly pine, |
| | | | | | White oak------- | -- | redcedar. |
| Verdigris: | | | | | | | |
| Ve---------- | 3w5 | Slight---- | Slight----- | Moderate. | Bur oak--------- | 70 | Black walnut, |
| | | | | | Black walnut---- | 75 | cottonwood. |
| Vs---------- | 3w6 | Severe---- | Severe----- | Moderate. | Red oak--------- | 65 | Sycamore, sweet |
| | | | | | Green ash------- | 75 | gum, green ash, |
| | | | | | Hickory--------- | 75 | red oak. |
| | | | | | Hackberry------- | 75 | |

1/ Mapped only with Hector soils (HeC and HeE) in this survey area.

2/ This mapping unit consists of more than one kind of soil. The soil series for the other soils in HeC and HeE is Enders.

water available in an area, and, in this way, indirectly influence the kinds of wildlife that can live in the area. Soil properties that affect the growth of wildlife habitat are (1) the thickness of the soil useful to crops, (2) the texture of the surface layer, (3) the available water capacity to a depth of 40 inches, (4) the wetness, (5) the stoniness or rockiness of the surface, (6) the hazard of flooding, (7) the slope, and (8) the permeability of the soil to air and water.

In table 5, the soils of this survey area are rated according to their ability to support kinds of wildlife. Each soil is also rated according to its suitability for producing various kinds of plants and other elements that make up wildlife habitat. The ratings take into account mainly the characteristics of the soils and the closely related natural factors of the environment. They do not take into account climate, present use of the soils, or present distribution of wildlife and people. For this reason, selection of a site for development as habitat for wildlife requires inspection of the site.

A rating of good means the element of wildlife habitat or the kind of habitat is easily created, improved, and maintained. Few or no limitations affect management in this category, and satisfactory results can be expected if the soil is used for the prescribed purpose. A rating of fair means the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention is required for satisfactory results. A rating of poor means the limitations for the designated element of wildlife habitat or kind of wildlife are 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 that restrictions on the use of the soil for the element of wildlife habitat or kind of wildlife are very severe and that unsatisfactory results can be expected. It is either impossible or impractical to create, improve, or maintain wildlife habitat on soils in this category.

The habitat elements rated in table 5 are each explained as follows.

Grain and seed plants are annual grain-producing plants, such as corn, sorghum, millet, and soybeans.

Grasses and legumes are those established by planting that provide food and cover for wildlife. They are such grasses as bahiagrass, ryegrass, and panicgrass and such legumes as 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 upland wildlife. Beggarweed, perennial lespedeza, wildbean, pokeweed, and cheatgrass are typical examples. On rangeland, typical plants are bluestem, grama, perennial forbs, and legumes.

Hardwood trees are nonconiferous trees, shrubs, and woody vines that produce food for wildlife. The food is in the form of fruits, nuts, buds, catkins, and browse. Such plants commonly grow in a natural environment, but they are also 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 plants are cone-bearing trees and shrubs that provide cover for wildlife and that furnish food in the form of browse, seeds, or fruitlike cones. They commonly grow in their natural environment, but they may be planted and managed. Typical plants in this category are pines, cedars, and ornamental trees and shrubs.

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

Shallow water areas are impoundments or excavations for controlling water, generally not more than 5 feet deep, for the purpose of creating a habitat that is suitable for waterfowl. Some areas are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submerged aquatic plants.

Table 5 also rates soils according to their potential as habitat for the three kinds of wildlife--openland, woodland, and wetland. These ratings are consistent with the ratings 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, dove, meadowlark, field sparrow, cottontail rabbit, and fox are typical examples of openland wildlife.

Woodland wildlife are birds and mammals that normally live in wooded areas consisting of hardwood trees, coniferous trees, and shrubs. Woodcock, thrush, wild turkey,

vireo, deer, squirrel, and raccoon are typical examples of woodland wildlife.

Wetland wildlife are birds and mammals that normally live in wet areas, marshes, and swamps. Duck, geese, rail, shore birds, heron, mink, and muskrat are typical examples of wetland wildlife.

## Use of Soils for Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 6, the soils of Mayes County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

The soils are rated as having slight, moderate, or severe limitations for 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 plans, designs, or 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 as sites for tents and small camp trailers and for 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 are gently sloping, are well drained, are free of rocks and coarse fragments on the surface, are not subject to flooding during periods of heavy use, have a surface that is firm after rains and not dusty when dry, and do not perc slowly (water does not percolate through the soil slowly).

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 and not dusty when dry, are not subject to flooding during the period of use, and do not have slopes and stones that greatly increase the 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 should be able to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops on the surface, are well drained, are not subject to flooding during periods of heavy use, are firm after rains, and are not dusty when dry. If grading and leveling are required, the depth over rock is an important consideration.

Paths and trails are used for local and cross-country travel on foot or horseback. The design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet, are not dusty when dry, are not subject to flooding more than once during the period of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

## Engineering Uses of the Soils 6/

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

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

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternative 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

6/ ROBERT F. HEIDLAGE, agricultural engineer, Soil Conservation Service, assisted in the preparation of this section.



548-966 O - 75 - 5

TABLE 5.--POTENTIAL OF THE SOILS FOR ELEMENTS OF WILDLIFE HABITAT AND KINDS OF WILDLIFE

| Soil series and map symbol | Potential for elements of wildlife habitat-- | | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed plants | Grasses and legumes | Wild herbaceous plants | Hardwood trees | Coniferous plants | Wetland plants | Shallow water areas | Openland wildlife | Woodland wildlife | Wetland wildlife |
| Bates: BaB, BaC, BcC 1/. | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Cannon: Ca---------- | Fair-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Poor--- | Good---- | Good---- | Poor. |
| Captina: CcB-------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Poor--- | Good---- | Good---- | Poor. |
| Choteau: | | | | | | | | | | |
| ChA---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Fair--- | Good---- | Good---- | Fair. |
| ChB---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Poor--- | Good---- | Good---- | Poor. |
| Clarksville: | | | | | | | | | | |
| CkD, ClE---------- | Poor-- | Fair--- | Fair-- | Good-- | Fair-- | Very poor. | Very poor. | Fair---- | Good---- | Very poor. |
| ClF---------- | Very poor. | Poor--- | Fair-- | Good-- | Fair-- | Very poor. | Very poor. | Poor | Good---- | Very poor. |
| Collinsville: CoE-- | Poor-- | Very poor. | Poor-- | Poor-- | Very poor. | Very poor. | Very poor. | Very poor. | Poor---- | Very poor. |
| Craig: | | | | | | | | | | |
| CrB---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Fair--- | Good---- | Good---- | Poor. |
| CrC---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Dennis: | | | | | | | | | | |
| DnB---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Poor--- | Good---- | Good---- | Poor. |
| DnC, DnC2, DvE 1/- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Eldorado: ElD------ | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Elsah: Es---------- | Poor-- | Fair--- | Fair-- | Good-- | Poor-- | Very poor. | Poor--- | Fair---- | Good---- | Very poor. |
| Enders 2/---------- | Fair-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Hector: HeC 1/, HeE 1/, HsF. | Very poor. | Poor--- | Poor-- | Fair-- | Very poor. | Very poor. | Very poor. | Poor---- | Fair---- | Very poor. |
| Kanima: KaE-------- | Poor-- | Fair--- | Fair-- | Fair-- | Poor-- | Very poor. | Very poor. | Fair---- | Fair---- | Very poor. |
| Lenapah: | | | | | | | | | | |
| LeB---------- | Fair-- | Good--- | Fair-- | Fair-- | Fair-- | Very poor. | Poor--- | Fair---- | Fair---- | Very poor. |
| LrD---------- | Fair-- | Good--- | Fair-- | Fair-- | Fair-- | Very poor. | Very poor. | Fair---- | Fair---- | Very poor. |
| Lula: LuB---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Poor--- | Good---- | Good---- | Very poor. |
| Mayes: Ma---------- | Fair-- | Fair--- | Good-- | Good-- | Good-- | Fair-- | Good--- | Fair---- | Good---- | Fair. |

TABLE 5.--POTENTIAL OF THE SOILS FOR ELEMENTS OF WILDLIFE HABITAT AND KINDS OF WILDLIFE--Cont.

| Soil series and map symbol | Potential for elements of wildlife habitat-- | | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed plants | Grasses and legumes | Wild herbaceous plants | Hardwood trees | Coniferous plants | Wetland plants | Shallow water areas | Openland wildlife | Woodland wildlife | Wetland wildlife |
| Nixa: NxB---------- | Poor-- | Fair--- | Fair-- | Fair-- | Fair-- | Very poor. | Poor--- | Fair---- | Fair---- | Very poor. |
| Okemah: OkA-------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Good--- | Good---- | Good---- | Fair. |
| Osage: Os---------- | Poor-- | Fair--- | Fair-- | Fair-- | Fair-- | Good-- | Good--- | Fair---- | Fair---- | Good. |
| Parsons: PaA------- | Fair-- | Fair--- | Good-- | Good-- | Good-- | Fair-- | Good--- | Fair---- | Good---- | Good. |
| Quarles: Qu-------- | Fair-- | Fair--- | Fair-- | Good-- | Fair-- | Fair-- | Fair--- | Fair---- | Good---- | Fair. |
| Riverton: ReB, RvC-- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Poor--- | Good---- | Good---- | Very poor. |
| Sallisaw: SaB------- | Good-- | Good--- | Good-- | Good-- | Good-- | Very poor. | Very poor. | Good---- | Good---- | Very poor. |
| Summit: | | | | | | | | | | |
| SuA---------- | Fair-- | Fair--- | Fair-- | Good-- | Good-- | Fair-- | Good--- | Fair---- | Good---- | Fair. |
| SuB---------- | Fair-- | Fair--- | Fair-- | Good-- | Good-- | Fair-- | Poor--- | Fair---- | Good---- | Poor. |
| SuC---------- | Fair-- | Fair--- | Fair-- | Good-- | Good-- | Very poor. | Very poor. | Fair---- | Good---- | Very poor. |
| Taloka: TaA-------- | Fair-- | Fair--- | Good-- | Good-- | Good-- | Fair-- | Good--- | Fair---- | Good---- | Fair. |
| Verdigris: | | | | | | | | | | |
| Ve---------- | Good-- | Good--- | Good-- | Good-- | Good-- | Poor-- | Fair--- | Good---- | Good---- | Poor. |
| Vs---------- | Poor-- | Poor--- | Fair-- | Good-- | Good-- | Poor-- | Fair--- | Poor---- | Poor---- | Poor. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map Symbol | Series |
|---|---|
| BcC---------- | Collinsville |
| DvE---------- | Verdigris |
| HeC---------- | Enders |
| HeE---------- | Enders |

2/ Mapped only with Hector soils (HeC and HeE) in this survey.

TABLE 6.--LIMITATIONS OF THE SOILS FOR RECREATIONAL DEVELOPMENT

[Soil characteristics in this table are expressed in computer-adapted terms differing from those in the Soil Survey Manual. Refer to Explanation of Key Phrases following the Glossary for definition of "percs rapidly" and other terms that describe soil characteristics. See text for definition of the terms "slight,""moderate," and "severe"]

| Soil series and map symbols | Camp areas | Picnic areas | Playgrounds | Paths and trails |
|---|---|---|---|---|
| Bates: | | | | |
| BaB---------- | Slight---------- | Slight---------- | Slight---------- | Slight. |
| BaC, BcC 1/--- | Slight---------- | Slight---------- | Moderate: depth to rock; slope. | Slight. |
| Cannon: Ca----- | Severe: floods- | Moderate: floods-- | Moderate: floods-- | Slight. |
| Captina: CcB--- | Moderate: percs slowly. | Slight---------- | Moderate: percs slowly, wet, slope. | Slight. |
| Choteau: ChA, ChB. | Moderate: wet; percs slowly. | Slight---------- | Moderate: wet; percs slowly. | Slight. |
| Clarksville: CkD, ClE, ClF. | Severe: small stones. | Severe: small stones. | Severe: small stones. | Severe: small stones. |
| Collinsville: CoE. | Severe: large stones. | Severe: large stones. | Severe: depth to rock; large stones. | Severe: large stones. |
| Craig: CrB, CrC. | Moderate: percs slowly. | Slight---------- | Moderate: percs slowly; small stones. | Slight. |
| Dennis: DnB, DnC, DnC2, DvE 1/. | Moderate: percs slowly. | Slight---------- | Moderate: percs slowly. | Slight. |
| Eldorado: ElD--- | Slight---------- | Slight---------- | Moderate: slope--- | Slight. |
| Elsah: Es------ | Severe: floods- | Severe: floods---- | Severe: floods; small stones. | Moderate: floods. |
| Enders 2/------- | Severe: percs slowly. | Moderate: slope--- | Severe: percs slowly. | Slight. |
| Hector: HeC 1/, HeE 1/, HsF. | Severe: large stones. | Severe: large stones. | Severe: depth to rock; large stones. | Severe: large stones. |
| Kanima: KaE---- | Severe: slope-- | Severe: slope----- | Severe: small stones. | Moderate: small stones. |
| Lenapah: LeB, LrD. | Moderate: percs slowly; too clayey. | Moderate: too clayey. | Severe: depth to rock. | Moderate: too clayey. |
| Lula: LuB------ | Slight---------- | Slight---------- | Slight---------- | Slight. |
| Mayes: Ma------ | Severe: percs slowly; wet. | Moderate: wet----- | Severe: wet; percs slowly. | Moderate: wet. |

TABLE 6.--LIMITATIONS OF THE SOILS FOR RECREATIONAL DEVELOPMENT--Continued

| Soil series and map symbols | Camp areas | Picnic areas | Playgrounds | Paths and trails |
|---|---|---|---|---|
| Nixa: NxB------ | Moderate: small stones. | Moderate: small stones. | Severe: small stones. | Moderate: small stones. |
| Okemah: OkA---- | Moderate: wet; percs slowly. | Moderate: too clayey. | Moderate: percs slowly. | Moderate: too clayey. |
| Osage: Os------ | Severe: floods; wet. | Severe: floods; wet. | Severe: floods; wet. | Severe: floods; wet. |
| Parsons: PaA--- | Severe: wet; percs slowly. | Moderate: wet----- | Severe: wet; percs slowly. | Moderate: wet. |
| Quarles: Qu---- | Severe: wet; floods. | Severe: wet------- | Severe: wet------- | Severe: wet. |
| Riverton: | | | | |
| ReB---------- | Slight--------- | Slight---------- | Slight---------- | Slight. |
| RvC---------- | Moderate: small stones. | Moderate: small stones. | Severe: small stones. | Moderate: small stones. |
| Sallisaw: SaB-- | Slight--------- | Slight---------- | Slight---------- | Slight. |
| Summit: SuA, SuB, SuC. | Moderate: wet; percs slowly. | Moderate: wet; too clayey. | Moderate: percs slowly; too clayey; wet. | Moderate: too clayey. |
| Taloka: TaA---- | Severe: wet; percs slowly. | Moderate: wet----- | Severe: wet; percs slowly. | Moderate: wet. |
| Verdigris: Ve, Vs. | Severe: floods- | Moderate: floods-- | Severe: floods---- | Slight. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

2/ Mapped only with Hector soils (HeC and HeE) in this survey area.

kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 7, 8, 9, 10, 11, 12, and 13, which show several estimated soil properties significant to engineering and which show interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 10, 11, 12, and 13. It can also be used to make other useful maps.

The information in this section does not eliminate 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 greater than 72 inches. 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 soil survey have special meaning to soil scientists that is not known to all engineers. Many of these terms commonly used in soil science are defined in the Glossary.

## Engineering Classification Systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (7) used by the SCS engineers, Department of Defense, and others; and the AASHO system (1) adopted by the American Association of State Highway Officials.

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

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 clayey soils that have low strength when wet and that are the poorest soils for subgrade. The AASHO estimated classification, is given in table 7 for all soils mapped in the survey area.

## Soil Properties Significant In Engineering

Several estimated soil properties and characteristics significant in engineering are given in tables 7, 8, and 9. These estimates are made for typical soil profiles, for the whole soil, and for layers sufficiently different to have different significance for 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 7.

Soil texture is described in table 7 in the standard terms used by the Department of Agriculture. These terms take into account the percentage of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 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, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary.

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 the semisolid to 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 are estimated in table 7.

Table 8 contains information on the estimated engineering properties of the soils. Following are explanations of some of the terms used in that table.

Erosion factors are used in an equation that predicts the amount of erosion resulting from certain land treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to detachment and transport by rainfall. Soils having the highest numbers are the most erodible. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or wind, that permits a high level of crop productivity to be sustained economically and indefinitely.

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 8 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water 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 in pH values. The pH values and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the change in the volume of soil material when the content of moisture changes. It is the extent to which the soil shrinks as it dries out or swells when it gets wet. This 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.

Corrosivity, as used in table 8, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The 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 entirely in one kind of soil or in one soil horizon. A corrosivity rating of low means that there is a low probability of soil-induced corrosion damage. A rating of high means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Table 9 contains information on the hydrologic features of the soils. Following are explanations of some of the terms used in that table.

Flooding is estimated in terms of frequency, duration, and probable time of occurrence.

The water table column gives the distance from the surface of the soil to the highest level that ground water reaches during most years. The kind of water table and the months when the water table is highest are also given.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer. The hardness of the bedrock affects the ease of excavation.

Hydrologic groups are those soils that have similar runoff potential under similar storm and cover conditions. The soils have been placed in four classes designated A, B, C, or D. Class A soils have the lowest potential for runoff.

## Engineering Interpretations

The interpretations in tables 10, 11, 12, and 13 are based on the estimated engineering properties of soils shown in tables 7, 8, and 9 and on the experiences of engineers and soil scientists with the soils of Mayes County. In tables 10, 11, and 12 ratings are shown of the limitations or suitabilities of the soils for specified purposes. Table 13 lists the features that affect the planning, installation, and maintenance of drainage systems for cropland and pasture, irrigation systems, terraces and diversions, and grassed waterways.

Soil limitations are indicated by the ratings slight, moderate, and severe. A rating of slight means that the soil properties are generally favorable for the rated use and that any limitations are minor and easily overcome. A rating of moderate

TABLE 7.--ESTIMATED ENGINEERING PROPERTIES

[The symbol < means less than; >, more than]

| Soil series and map symbols | Depth | USDA texture | Unified classification | AASHO classification | Fragments >3 inches | Soil material passing sieve-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | No. 4 | No. 10 | No. 40 | No. 200 | | |
| | In | | | | Pct | Pct | Pct | Pct | Pct | Pct | |
| Bates: BaB, BaC, BcC 1/. | 0-11 | Loam---------- | ML,CL | A-4 | 0 | 100 | 100 | 90-100 | 51-85 | 20-35 | 3-10 |
| | 11-16 | Loam, clay loam. | CL,ML | A-4, A-6 | 0 | 100 | 100 | 90-100 | 60-90 | 25-40 | 8-20 |
| | 16-30 | Clay loam----- | CL | A-4, A-6 | 0 | 100 | 100 | 90-100 | 60-90 | 25-40 | 10-25 |
| Cannon: Ca- | 0-12 | Gravelly loam- | GM,SC, ML,CL, SM,GC | A-2, A-4, A-6 | 0-8 | 60-85 | 55-75 | 45-70 | 30-65 | 20-36 | 5-15 |
| | 12-60 | Gravelly silt loam, gravelly silty clay loam. | GM,SM, SC,CL, ML,GC | A-2, A-4, A-6 | 0-17 | 60-85 | 55-75 | 40-70 | 25-65 | 20-38 | 5-18 |
| Captina: CcB. | 0-11 | Silt loam----- | ML,CL | A-4 | 0 | 100 | 95-100 | 90-100 | 80-95 | <30 | 2/ NP-10 |
| | 11-27 | Silty clay loam, silt loam. | CL,ML | A-4, A-6 | 0 | 100 | 95-100 | 90-100 | 85-95 | 20-40 | 5-20 |
| | 27-42 | Silty clay loam, cherty silty clay loam. | CL,GC SC | A-4, A-6 | 0 | 60-100 | 55-100 | 45-100 | 45-95 | 30-40 | 10-20 |
| Choteau: ChA, ChB. | 0-22 | Silt loam----- | ML,CL | A-4, A-6 | 0 | 100 | 100 | 96-100 | 75-90 | 20-35 | 1-12 |
| | 22-26 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 100 | 100 | 96-100 | 85-95 | 33-50 | 13-26 |
| | 26-65 | Clay, silty clay, silty clay loam. | CL,CH MH,ML | A-6, A-7 | 0 | 100 | 100 | 96-100 | 90-98 | 40-65 | 15-35 |
| Clarksville: CkD, ClE, ClF. | 0-16 | Cherty silt loam, very cherty silt loam. | GM,SM, GM-GP SM-SP | A-1, A-2, A-4 | 3-31 | 20-80 | 8-69 | 8-65 | 5-50 | <20 | NP-4 |
| | 16-60 | Very cherty silty clay loam. | GC,SC, GC-GP SC-SP | A-2, A-6 | 7-38 | 20-70 | 8-56 | 8-50 | 5-45 | 30-40 | 11-20 |
| Collinsville: CoE. | 0-9 | Fine sandy loam, loam, flaggy fine sandy loam, flaggy loam. | ML,CL, SM,SC | A-4 | 0-20 | 80-100 | 60-100 | 60-95 | 36-75 | <30 | NP-10 |

TABLE 7.--ESTIMATED ENGINEERING PROPERTIES--Continued

| Soil series and map symbols | Depth | USDA texture | Unified classification | AASHO classification | Fragments >3 inches | Soil material passing sieve-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | No. 4 | No. 10 | No. 40 | No. 200 | | |
| | In | | | | Pct | Pct | Pct | Pct | Pct | Pct | |
| Craig: CrB, CrC. | 0-15 | Silt loam----- | ML,CL | A-4 | 0-8 | 85-100 | 75-100 | 65-95 | 51-90 | 20-35 | 4-10 |
| | 15-36 | Silt loam, cherty silt loam. | ML,CL, GM,GC SM,SC | A-4, A-2 | 0-8 | 45-85 | 36-75 | 30-70 | 26-65 | 20-35 | 4-10 |
| | 36-50 | Cherty silty clay loam, cherty clay loam, very cherty silty clay loam. | GC,SC GC-GP SC-SP | A-2, A-6 | 8-16 | 15-65 | 5-56 | 5-50 | 5-40 | 21-40 | 11-26 |
| | 50-64 | Cherty silty clay loam, very cherty silty clay loam, very cherty clay. | GC,GP-GC | A-2 | 8-15 | 15-50 | 5-35 | 5-30 | 5-25 | 21-40 | 11-26 |
| Dennis: DnB, DnC, DnC2, DvE 1/. | 0-11 | Silt loam----- | ML,CL | A-4, A-6 | 0 | 100 | 100 | 96-100 | 65-97 | 21-37 | 1-15 |
| | 11-23 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 100 | 100 | 96-100 | 75-98 | 33-50 | 13-26 |
| | 23-60 | Silty clay loam, clay loam, loam. | CL,CH MH,ML | A-6, A-7 | 0 | 100 | 100 | 96-100 | 75-98 | 33-65 | 13-35 |
| Eldorado: ElD. | 0-12 | Cherty silt loam, coarse cherty silt loam. | SM,GM, SC,GC | A-4, A-2, A-1 | 0-8 | 40-85 | 27-75 | 20-60 | 15-50 | 21-37 | 1-10 |
| | 12-21 | Cherty silt loam, very cherty silt loam. | GC,SC | A-2, A-6 | 8-15 | 40-60 | 27-50 | 20-45 | 15-40 | 21-40 | 11-20 |
| | 21-60 | Very cherty clay loam, very cherty silty clay loam. | GC,SC GC-GP, SC-SP | A-2, A-6 | 13-34 | 10-60 | 5-54 | 5-50 | 5-40 | 35-55 | 11-26 |
| Elsah: Es-- | 0-14 | Gravelly loam, gravelly silt loam, silt loam. | ML,CL | A-4 | 0-8 | 65-95 | 56-92 | 50-80 | 51-75 | <37 | NP-10 |
| | 14-60 | Very gravelly loam, very gravelly silt loam. | GC,GM, GM-GP, GC-GP | A-2, A-1 | 0-8 | 15-50 | 5-36 | 5-30 | 5-30 | <37 | NP-10 |
| Enders 3/-- | 0-5 | Fine sandy loam. | ML,SM, SC,CL | A-4 | 0 | 80-100 | 80-97 | 75-90 | 40-85 | 25-35 | 4-10 |
| | 5-9 | Clay loam, silty clay loam, loam. | CL,ML | A-6 | 0 | 80-100 | 80-100 | 80-100 | 75-95 | 30-40 | 11-15 |
| | 9-42 | Silty clay, clay. | MH,CH | A-7 | 0 | 95-100 | 90-100 | 85-100 | 85-100 | 65-80 | 35-45 |
| | 42-48 | Soft weathered shale. | MH,CH | A-7 | 0 | 95-100 | 90-100 | 85-100 | 85-100 | 65-80 | 35-45 |

TABLE 7.--ESTIMATED ENGINEERING PROPERTIES--Continued

| Soil series and map symbols | Depth | USDA texture | Unified classification | AASHO classification | Fragments >3 inches | Soil material passing sieve-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | No. 4 | No. 10 | No. 40 | No. 200 | | |
| | In | | | | Pct | Pct | Pct | Pct | Pct | Pct | |
| Hector: HeC 1/, HeE 1/, HsF. | 0-6 | Gravelly fine sandy loam, fine sandy loam. | GM, GM-GC, SM-SC, SM | A-2, A-1, A-4 | 0-40 | 40-90 | 35-85 | 30-80 | 20-50 | <30 | NP-6 |
| | 6-18 | Fine sandy loam, gravelly fine sandy loam. | SM,ML, SM-SC, ML-CL | A-4, A-2 | 0 | 80-100 | 80-100 | 80-100 | 30-65 | <30 | NP-6 |
| Kanima: KaE. | 0-4 | Shaly silty clay loam, shaly clay loam. | GM,GC, GM-GP, GC-GP, SC-SP, ML,CL, SM,SC, SM-SP | A-1, A-2, A-6, A-7 | 0-7 | 10-80 | 7-78 | 7-78 | 7-70 | 30-49 | 12-25 |
| | 4-72 | Very shaly silty clay loam. | GM,GC, GP-GM, GC-GP, SC-SP, ML,CL, SM-SP, SM,SC | A-1, A-2, A-6, A-7 | 7-40 | 10-54 | 3-54 | 3-54 | 3-54 | 30-49 | 12-25 |
| Lenapah: LeB, LrD. | 0-14 | Silty clay loam. | CL | A-6, A-7 | 0 | 95-100 | 95-100 | 95-100 | 90-98 | 35-50 | 15-25 |
| | 14-18 | Clay, silty clay loam. | CL,CH, MH | A-7 | 0 | 95-100 | 95-100 | 95-100 | 90-95 | 41-65 | 25-35 |
| Lula: LuB-- | 0-11 | Loam, silt loam. | CL,ML | A-4, A-6 | 0 | 100 | 100 | 96-100 | 65-97 | 21-37 | 1-15 |
| | 11-42 | Silty clay loam, clay loam. | CL,ML | A-4, A-6, A-7 | 0 | 100 | 100 | 96-100 | 65-98 | 21-50 | 1-15 |
| Mayes: Ma-- | 0-14 | Silty clay loam. | CL | A-4, A-6, A-7 | 0 | 100 | 100 | 96-100 | 80-98 | 30-50 | 9-26 |
| | 14-60 | Clay, clay loam, silty clay loam. | CL,CH, MH | A-7 | 0 | 100 | 98-100 | 96-100 | 85-98 | 41-65 | 18-35 |
| Nixa: NxB. | 0-12 | Cherty silt loam. | GM,SM, SC,GC | A-1, A-2, A-4 | 0-10 | 40-70 | 30-60 | 25-55 | 20-50 | <25 | NP-8 |
| | 12-42 | Very cherty silt loam, cherty silty clay loam, very cherty silty clay loam. | GC,GM, SC,SM | A-1, A-2, A-4 | 0-10 | 40-70 | 30-60 | 25-55 | 20-50 | <25 | NP-8 |
| | 42-60 | Very cherty clay loam, very cherty silty clay loam. | GM,GC, GC-GP, GM-GP | A-1, A-2 | 10-20 | 15-45 | 5-40 | 5-35 | 5-30 | <25 | NP-8 |

TABLE 7.--ESTIMATED ENGINEERING PROPERTIES--Continued

| Soil series and map symbols | Depth | USDA texture | Unified classification | AASHO classification | Fragments >3 inches | Soil material passing sieve-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | No. 4 | No. 10 | No. 40 | No. 200 | | |
| | In | | | | Pct | Pct | Pct | Pct | Pct | Pct | |
| Okemah: OkA. | 0-11 | Silt loam----- | CL,ML | A-4, A-6 | 0 | 100 | 100 | 96-100 | 80-98 | 21-35 | 1-12 |
| | 11-18 | Silty clay loam. | CL,CH, MH | A-7 | 0 | 100 | 100 | 98-100 | 93-99 | 41-60 | 18-35 |
| | 18-60 | Silty clay, clay. | CL,CH, MH | A-7 | 0 | 100 | 100 | 96-100 | 90-95 | 45-65 | 20-35 |
| Osage: Os-- | 0-19 | Silty clay loam. | CH,MH, CL | A-7 | 0 | 100 | 100 | 100 | 90-100 | 41-65 | 20-35 |
| | 19-60 | Clay, silty clay. | CL,CH, MH | A-7 | 0 | 100 | 100 | 96-100 | 90-95 | 45-65 | 20-35 |
| Parsons: PaA. | 0-15 | Silt loam----- | ML,CL | A-4, A-6 | 0 | 100 | 96-100 | 96-100 | 75-90 | 20-35 | 1-12 |
| | 15-64 | Clay, silty clay loam. | CL,CH, MH | A-7 | 0 | 100 | 94-100 | 94-100 | 90-98 | 45-65 | 20-40 |
| Quarles: Qu. | 0-20 | Silt loam----- | ML,CL | A-4, A-6 | 0 | 100 | 100 | 90-100 | 70-90 | 30-40 | 5-15 |
| | 20-60 | Silty clay, clay. | CH | A-7 | 0 | 100 | 100 | 95-100 | 90-95 | 70-80 | 50-60 |
| Riverton: ReB, RvC | 0-7 | Gravelly loam, loam. | ML,CL | A-4, A-6 | 0 | 70-90 | 56-90 | 56-80 | 51-70 | 22-36 | 1-14 |
| | 7-34 | Gravelly loam, gravelly clay loam, very gravelly clay loam. | GM,GC, GM-GC, SC,SM | A-4, A-6, A-2 | 0 | 30-80 | 30-80 | 30-60 | 25-50 | 22-36 | 1-14 |
| | 34-64 | Very gravelly clay loam, very gravelly silty clay loam. | GC, GC-GP | A-2, A-6 | 0 | 10-40 | 5-40 | 5-40 | 5-40 | 25-40 | 11-22 |
| | 64-70 | Very gravelly clay loam, very gravelly clay. | GC, GC-GP | A-2, A-6 | 0 | 10-40 | 5-40 | 5-40 | 5-40 | 25-40 | 11-22 |
| Sallisaw: SaB. | 0-20 | Silt loam----- | ML,CL | A-4 | 0 | 80-100 | 70-100 | 55-90 | 51-80 | 20-30 | 1-10 |
| | 20-40 | Gravelly silty clay loam, gravelly clay loam. | CL,SC, SM,ML, GC,GM | A-4, A-6 | 0 | 60-75 | 50-75 | 40-75 | 36-60 | 25-40 | 8-20 |
| | 40-64 | Very gravelly clay loam, very gravelly silty clay loam. | GC,GP-GC | A-2 | 0 | 15-40 | 5-40 | 5-40 | 5-30 | 25-40 | 8-20 |
| Summit: SuA, SuB, SuC. | 0-18 | Silty clay loam, silty clay. | CL,CH, MH,ML | A-6, A-7 | 0 | 100 | 100 | 98-100 | 90-98 | 35-55 | 11-25 |
| | 18-60 | Silty clay, clay. | CL,CH MH | A-7 | 0 | 100 | 100 | 98-100 | 90-99 | 41-65 | 25-35 |

TABLE 7.--ESTIMATED ENGINEERING PROPERTIES--Continued

| Soil series and map symbols | Depth | USDA texture | Unified classification | AASHO classification | Fragments >3 inches | Soil material passing sieve-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | No. 4 | No. 10 | No. 40 | No. 200 | | |
| | In | | | | Pct | Pct | Pct | Pct | Pct | Pct | |
| Taloka: TaA. | 0-21 | Silt loam----- | ML,CL | A-4 | 0 | 100 | 96-100 | 96-100 | 75-90 | 20-35 | 1-10 |
| | 21-65 | Clay, silty clay loan. | CL,CH, MH | A-6, A-7 | 0 | 100 | 94-100 | 94-100 | 90-98 | 35-65 | 20-40 |
| Verdigris: Ve, Vs. | 0-60 | Silt loan, silty clay loam. | CL | A-4, A-6 | 0 | 100 | 100 | 95-100 | 70-90 | 25-35 | 8-18 |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvF | Verdigris |
| HeC | Enders |
| HeE | Enders |

The soils in this mapping unit may have different properties and limitations, and for this reason it is necessary to refer to the other series mentioned.

2/ Nonplastic.

3/ Mapped only with Hector soils (HeC and HeE) in this survey area.

means that some soil properties are unfavorable for the rated use but can be overcome or modified by special planning and design. A rating of severe means that the soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms good, fair, and poor; which have, respectively, meanings approximately parallel to the terms for limitations of slight, moderate, and severe. In addition, the term unsuited is used for soils that have no potential as sources of sand or gravel.

Interpretations of soils for sanitary facilities.--Table 10 contains information on the suitability of the soils for sanitary facilities. Following are explanations of some of the terms used in that table.

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 from a depth of 18 inches to 72 inches is evaluated for this use. The soil properties considered are those that affect both the absorption of effluent and the construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Properties that affect difficulty of layout and construction are slope, risk of soil erosion, and lateral seepage. Slope and lateral seepage also affect the flow of effluent. Large rocks and boulders increase the cost of construction of septic tank absorption fields.

Sewage lagoons are shallow ponds constructed to hold sewage at a depth of 24 to 60 inches for a long enough period for bacteria to decompose the solid waste. A lagoon has a nearly level floor and has sides, or embankments, of compacted soil material. The embankments are compacted to medium density and the pond is protected from flooding. In determining the suitability of soils for the construction of sewage lagoons, properties are considered that affect the pond floor and the embankments. Those that affect the pond floor are permeability, content of organic matter, slope, and, if the floor needs to be leveled, depth to bedrock. The soil properties that affect embankments are the engineering properties of the embankment material, as interpreted from the Unified Soil Classification, and the amount of stones. Stones influence the ease of excavation and the ease of compaction of the embankment material.

Sanitary landfills are used to dispose of refuse. The waste is spread in thin layers, compacted, and covered with soil. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill use are ease of excavation, hazard of polluting ground water, and trafficability. Ratings apply only to a depth of about 72 inches, and therefore ratings of slight or moderate may not be valid if excavations are much deeper. For some soils, reliable predictions can be made to a depth of 120 to 180 inches, but in most instances geologic investigations are needed below a depth of about 72 inches.

Trench sanitary landfills are dug trenches in which refuse is buried daily, or more frequently if necessary. The refuse is covered with a layer of soil material at least 6 inches thick, usually soil excavated in digging the trench. When a trench is full, a final cover of soil material, at least 24 inches thick, is placed over the landfill.

In areas of sanitary landfill refuse is placed on the surface of the soil in successive layers. The daily and final cover material generally must be imported. A final cover of soil material, at least 24 inches thick, is placed over the completed fill.

Interpretations of soils for use as construction sites.--Table 11 contains information on the suitability of the soils for use as construction sites. Following are explanations of some of the interpretations given in that table.

Shallow excavations are those that require digging or trenching to a depth of less than 72 inches. Examples are excavations for pipelines, sewer lines, telephone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

The ratings for dwellings and small commercial buildings in table 11 are for structures not more than three stories high and supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to the capacity to support a load and to resist settlement under load and are those that relate to the ease of excavation. Soil properties that affect the capacity to support a load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect ease of excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

The ratings for local roads and streets in table 11 are for 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 72 inches deep.

Soil properties that most affect design and construction of roads and streets are the load supporting capacity and the stability of the subgrade, and the workability and the quantity of cut and fill material available. The AASHO and Unified classifications and the shrink-swell potential indicate the traffic supporting capacity of a soil. Wetness and flooding affect the stability of soils. Slope, depth over hard rock, content of stones and rocks, and wetness affect the ease of excavation of soils and the amount of cut and fill needed to reach an even grade.

Interpretations of soils as source material.--Table 12 contains information on the suitability of soils as sources of various material. Following are explanations of the interpretations given in that table.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) 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 12 provide guidance about where to look for probable sources of sand and gravel. A soil rated as a good or fair source generally has a layer at least 36 inches thick, the top of which is within a depth of 72 inches. 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 they do not indicate quality of the deposit.

Topsoil is used to topdress 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 its response of plants when fertilizer is applied; and absence of substances toxic to



548-966 O - 75 - 6

TABLE 8.--ESTIMATED PHYSICAL AND CHEMICAL PROPERTIES

| Soil series and map symbols | Erosion factors | | Depth | Permeability | Available water capacity | Reaction | Shrink-swell potential | Corrosivity | |
|---|---|---|---|---|---|---|---|---|---|
| | K | T | | | | | | Steel | Concrete |
| | | | Inches | Inches per hour | Inches per inch of soil | pH | | | |
| Bates: BaB, BaC, BcC 1/. | 0.32 | 3 | 0-11 | 0.6-2.0 | 0.16-0.18 | 5.6-6.5 | Low------- | Low------- | Moderate. |
| | | | 11-16 | 0.6-2.0 | 0.16-0.18 | 5.1-6.5 | Low------- | Low------- | Moderate. |
| | | | 16-30 | 0.6-2.0 | 0.17-0.19 | 5.1-6.0 | Moderate-- | Low------- | Moderate. |
| Cannon: Ca------ | -- | -- | 0-12 | 2.0-6.0 | 0.12-0.16 | 5.6-6.5 | Low------- | Low------- | Low. |
| | | | 12-60 | 2.0-6.0 | 0.10-0.16 | 5.6-7.3 | Low------- | Low------- | Low. |
| Captina: CcB---- | .37 | 3 | 0-11 | 0.6-2.0 | 0.16-0.24 | 5.1-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 11-27 | 0.6-2.0 | 0.16-0.24 | 4.5-6.0 | Low------- | High------ | Moderate. |
| | | | 27-42 | 0.06-0.20 | 0.08-0.12 | 4.5-5.5 | Low------- | High------ | High. |
| Choteau: ChA, ChB. | .37 | 5 | 0-22 | 0.60-2.0 | 0.15-0.21 | 4.5-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 22-26 | 0.20-0.60 | 0.15-0.22 | 4.5-6.0 | Moderate-- | High------ | Moderate. |
| | | | 26-65 | 0.06-0.20 | 0.14-0.18 | 5.1-7.3 | High------ | High------ | Low. |
| Clarksville: CkD, ClE, ClF. | .24 | 2 | 0-16 | 2.0-6.0 | 0.07-0.12 | 4.5-5.0 | Very low-- | Low------- | High. |
| | | | 16-60 | 2.0-6.0 | 0.05-0.10 | 4.5-5.0 | Low------- | Very low-- | High. |
| Collinsville: CoE. | .24 | 2 | 0-9 | 2.0-6.0 | 0.09-0.16 | 5.6-6.5 | Low------- | Low------- | Moderate. |
| Craig: CrB, CrC. | .32 | 3 | 0-15 | 0.60-2.0 | 0.10-0.21 | 5.1-6.0 | Low------- | Moderate-- | Moderate. |
| | | | 15-36 | 0.60-2.0 | 0.10-0.21 | 4.5-6.0 | Low------- | Moderate-- | Moderate. |
| | | | 36-50 | 0.20-0.60 | 0.03-0.06 | 4.5-6.0 | Low------- | Moderate-- | Moderate. |
| | | | 50-64 | 0.20-0.60 | 0.03-0.06 | 4.5-6.0 | Low------- | Moderate-- | Moderate. |
| Dennis: DnB, DnC, DnC2, DvE 1/. | .37 | 5 | 0-11 | 0.60-2.0 | 0.15-0.21 | 5.1-6.0 | Low------- | Moderate-- | Moderate. |
| | | | 11-23 | 0.20-0.60 | 0.18-0.22 | 4.5-6.0 | Moderate-- | Moderate-- | Moderate. |
| | | | 23-60 | 0.06-0.20 | 0.14-0.22 | 5.6-6.5 | High------ | High------ | Moderate. |
| Eldorado: ElD-- | .20 | 3 | 0-12 | 0.60-2.0 | 0.10-0.15 | 5.6-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 12-21 | 0.60-2.0 | 0.07-0.11 | 5.6-6.5 | Moderate-- | Moderate-- | Moderate. |
| | | | 21-60 | 0.60-2.0 | 0.05-0.09 | 5.1-6.0 | Moderate-- | Moderate-- | Moderate. |
| Elsah: Es------- | -- | -- | 0-14 | 0.60-6.0 | 0.12-0.18 | 6.1-6.5 | Low------- | Low------- | Low. |
| | | | 14-60 | 0.60-6.0 | 0.03-0.10 | 5.6-7.3 | Low------- | Low------- | Low. |
| Enders 2/-------- | .49 | 3 | 0-5 | 0.60-2.0 | 0.10-0.20 | 5.1-5.5 | Low------- | Low------- | Moderate. |
| | | | 5-9 | 0.20-0.60 | 0.18-0.22 | 5.1-5.5 | Low------- | Moderate-- | High. |
| | | | 9-42 | 3/ <0.06 | 0.12-0.18 | 4.0-5.5 | High------ | High------ | High. |
| | | | 42-48 | <0.06 | 0.08-0.10 | 4.0-5.5 | Moderate-- | High------ | High. |
| Hector: HeC 1/, HeE 1/, HsF. | .37 | 1 | 0-6 | 2.0-6.0 | 0.05-0.14 | 5.1-6.5 | Low------- | Low------ | Moderate. |
| | | | 6-18 | 2.0-6.0 | 0.08-0.15 | 5.1-5.5 | Low------- | Low------ | Moderate. |
| Kanima: KaE----- | .24 | 4 | 0-4 | 0.60-2.0 | 0.06-0.15 | 5.6-8.4 | Low------- | Low------ | Low. |
| | | | 4-72 | 0.60-2.0 | 0.03-0.10 | 5.6-8.4 | Low------- | Low------ | Low. |
| Lenapah: LeB, LrD. | .37 | 1 | 0-14 | 0.20-0.60 | 0.18-0.22 | 5.6-7.3 | Moderate-- | Moderate-- | Low. |
| | | | 14-18 | 0.06-0.20 | 0.14-0.18 | 6.1-7.3 | High------ | Moderate-- | Low. |
| Lula: LuB------- | .32 | 3 | 0-11 | 0.60-2.0 | 0.15-0.21 | 5.6-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 11-42 | 0.60-2.0 | 0.15-0.22 | 5.1-7.3 | Moderate-- | Moderate-- | Moderate. |

TABLE 8.--ESTIMATED PHYSICAL AND CHEMICAL PROPERTIES--Cont.

| Soil series and map symbols | Erosion factors | | Depth | Permeability | Available water capacity | Reaction | Shrink-swell potential | Corrosivity | |
|---|---|---|---|---|---|---|---|---|---|
| | K | T | | | | | | Steel | Concrete |
| | | | Inches | Inches per hour | Inches per inch of soil | pH | | | |
| Mayes: Ma------ | -- | -- | 0-14 | 0.20-0.60 | 0.17-0.21 | 5.1-7.3 | Moderate-- | High------ | Moderate. |
| | | | 14-60 | <0.06 | 0.14-0.21 | 6.1-7.8 | High------ | High------ | Low. |
| Nixa: NxB------ | 0.43 | 2 | 0-12 | 0.60-0.20 | 0.08-0.10 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| | | | 12-42 | 0.2-0.6 | 0.08-0.10 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| | | | 42-60 | <0.06 | 0.03-0.06 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| Okemah: OkA---- | .37 | 5 | 0-11 | 0.20-2.0 | 0.17-0.22 | 5.6-6.5 | Moderate-- | High------ | Moderate. |
| | | | 11-18 | 0.06-0.20 | 0.14-0.18 | 5.6-6.5 | High------ | High------ | Moderate. |
| | | | 18-60 | 0.06-0.20 | 0.14-0.18 | 5.6-7.3 | High------ | High------ | Low. |
| Osage: Os------ | -- | -- | 0-19 | 0.06-0.20 | 0.15-0.19 | 5.6-7.3 | High------ | High------ | Moderate. |
| | | | 19-60 | <0.06 | 0.14-0.18 | 6.6-7.8 | High------ | Very high- | Moderate. |
| Parsons: PaA-- | .43 | 4 | 0-15 | 0.60-2.0 | 0.17-0.21 | 5.1-6.5 | Low------- | High------ | Moderate. |
| | | | 15-64 | <0.06 | 0.14-0.18 | 5.1-7.3 | High------ | High------ | Moderate. |
| Quarles: Qu--- | .37 | 4 | 0-20 | 0.20-0.60 | 0.22-0.24 | 5.1-5.5 | Low------- | High------ | High. |
| | | | 20-60 | 0.06-0.20 | 0.11-0.18 | 4.5-6.0 | High------ | High------ | High. |
| Riverton: ReB, RvC. | .37 | 3 | 0-7 | 0.60-2.0 | 0.13-0.21 | 5.1-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 7-34 | 0.60-2.0 | 0.13-0.18 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| | | | 34-64 | 0.60-2.0 | 0.03-0.11 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| | | | 64-70 | 0.60-2.0 | 0.03-0.11 | 4.5-5.5 | Low------- | Moderate-- | Moderate. |
| Sallisaw: SaB. | .24 | 4 | 0-20 | 0.60-2.0 | 0.10-0.18 | 5.1-6.5 | Low------- | Moderate-- | Moderate. |
| | | | 20-40 | 0.60-2.0 | 0.12-0.20 | 5.1-6.0 | Low------- | Moderate-- | Moderate. |
| | | | 40-64 | 2.0-6.0 | 0.02-0.10 | 5.1-6.0 | Low------- | Moderate-- | Moderate. |
| Summit: SuA, SuB, SuC. | .37 | 4 | 0-18 | 0.20-0.60 | 0.14-0.22 | 5.6-6.5 | Moderate-- | High------ | Low. |
| | | | 18-60 | 0.06-0.20 | 0.14-0.18 | 6.1-8.5 | High------ | Very high- | Low. |
| Taloka: TaA--- | .43 | 5 | 0-21 | 0.60-2.0 | 0.17-0.21 | 5.1-6.0 | Low------- | High------ | Moderate. |
| | | | 21-65 | <0.06 | 0.14-0.22 | 5.1-7.3 | High------ | High------ | Moderate. |
| Verdigris: Ve, Vs. | -- | -- | 0-60 | 0.06-2.0 | 0.15-0.19 | 5.6-6.5 | Moderate-- | Moderate-- | Low. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

The soils in this mapping unit may have different properties and limitations, and for this reason it is necessary to refer to the other series mentioned.

2/ Mapped only with Hector soils (HeC and HeE) in this survey area.

3/ The symbol < means less than.

TABLE 9.--SOIL AND WATER FEATURES

[The symbol > means more than]

| Soil series and map symbols | Flooding--1/ | | High water table 2/ | | Bedrock | | Hydrologic soil group |
|---|---|---|---|---|---|---|---|
| | Frequency | Duration | Depth | Kind | Depth | Hardness | |
| | | | Feet | | Inches | | |
| Bates: BaB, BaC, BcC 3/. | ---------- | ---------- | >6 | ---------- | 20-40 | Rippable--- | B |
| Cannon: Ca------ | Occasional 4/-- | Very brief-- | >6 | ---------- | 60 | ---------- | B |
| Captina: CcB---- | ---------- | ---------- | 2-3 | Perched 5/-- | 40-60 | Hard------- | C |
| Choteau: ChA, ChB. | ---------- | ---------- | 2-3 | Perched 5/-- | 60 | ---------- | C |
| Clarksville: ClkD, ClE, ClF. | ---------- | ---------- | >6 | ---------- | 60 | ---------- | B |
| Collinsville: CoE. | ---------- | ---------- | >6 | ---------- | 4-20 | Hard------- | C |
| Craig: CrB, CrC. | ---------- | ---------- | >6 | ---------- | 60 | ---------- | C |
| Dennis: DnB, DnC, DnC2, DvE 3/. | ---------- | ---------- | 2-3 | Perched 5/-- | 60 | ---------- | C |
| Eldorado: ElD---- | ---------- | ---------- | >6 | ---------- | 60 | ---------- | C |
| Elsah: Es------- | Frequent 4/---- | Brief------- | >6 | ---------- | 60 | ---------- | B |
| Enders 6/-------- | ---------- | ---------- | >6 | ---------- | 40-60 | Rippable--- | C |
| Hector: HeC 3/, HeE 3/, HsF. | ---------- | ---------- | >6 | ---------- | 10-20 | Hard------- | D |
| Kanima: KaE----- | ---------- | ---------- | >6 | ---------- | 60 | ---------- | C |
| Lenapah: LeB, LrD. | ---------- | ---------- | >6 | ---------- | 16-20 | Hard------- | D |
| Lula: LuB------- | ---------- | ---------- | >6 | ---------- | 40-60 | Hard------- | B |
| Mayes: Ma------- | ---------- | ---------- | 1-2 | Perched 5/-- | 60 | ---------- | D |
| Nixa: NxB------- | ---------- | ---------- | >6 | ---------- | 40-60 | Hard------- | C |
| Okemah: OkA----- | ---------- | ---------- | 2-3 | Perched 5/-- | 60 | ---------- | C |
| Osage: Os------- | Occasional 4/-- | Brief------- | 1-2 | Perched 5/-- | 60 | ---------- | D |
| Parsons: PaA---- | ---------- | ---------- | 0-1 | Perched 5/-- | 60 | ---------- | D |
| Quarles: Qu----- | Occasional 4/-- | Brief------- | 0-1 | Perched 5/-- | 60 | ---------- | D |
| Riverton: ReB, RvC. | ---------- | ---------- | >6 | ---------- | 60 | ---------- | C |
| Sallisaw: SaB--- | ---------- | ---------- | >6 | ---------- | 60 | ---------- | B |
| Summit: SuA, SuB, SuC. | ---------- | ---------- | 1-2 | Perched 5/-- | 60 | ---------- | C |
| Taloka: TaA----- | ---------- | ---------- | 1-2 | Perched 5/-- | 60 | ---------- | D |
| Verdigris: Ve, Vs. | Occasional 4/-- | Very brief-- | >6 | ---------- | 60 | ---------- | B |

1/ Absence of an entry indicates that soil is not flooded.

2/ Absence of an entry indicates that soil has no high water table.

3/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

4/ Period of flooding is December through April.

5/ Period of perched water table is December through April.

6/ Mapped only with Hector soils (HeC and HeE) in this survey.

plants. The texture of a soil and the content of coarse fragments are characteristics that affect the suitability of a soil for use as topdressing. Also considered in the ratings is the damage that results in the area from which the topsoil is taken.

Daily cover for landfill must frequently be obtained from a source away from the site of use, and therefore soils from an area away from the landfill must be rated for suitability for use as cover material. Soils rated as suitable can be used as both daily and final cover material.

The suitability of a soil for use as cover is based on properties that reflect workability; ease of digging, moving, and spreading over the refuse daily during both wet and dry periods; slope; and thickness of the soil material.

Interpretations of soils for water management.--Table 13 contains interpretations of the suitability of the soils for use in water management. Following are explanations of the interpretations given in that table.

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

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and that has favorable stability, shrink-swell potential, shear strength, and compactibility. The presence of stones or organic matter in a soil are unfavorable factors in the suitability of a soil for use in embankments, dikes, and levees.

An aquifer-fed excavated pond is a body of water created by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by runoff and embankment ponds that impound water to a depth of more than 36 inches. The suitability ratings are for properly designed, located, and constructed ponds that impound good-quality water. Properties affecting aquifer-fed ponds are permanent water table, and the permeability of the aquifer. Stoniness and rockiness are properties that interfere with excavation.

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

The irrigation of a soil is affected by such features as slope; susceptibility to flooding, water erosion, and soil blowing; texture; content of stones; accumulations of salts and alkalis; depth of root zone; rate of water intake at the surface; permeability of the soil below the surface layer; available water capacity; need for drainage; depth of the water table; and depth over bedrock.

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

Grassed waterways are used to carry runoff water safely to outlets. The features that affect the use of soils for waterways are permeability, erodibility, and suitability for permanent vegetation.

TABLE 10.--SOIL RATINGS FOR SANITARY FACILITIES

[Soil characteristics in this table are expressed in computer-adapted terms differing from those in the Soil Survey Manual. Refer to Explanation of Key Phrases following the Glossary for definition of "percs rapidly" and other terms that describe soil characteristics. See text for definition of the terms "slight," "moderate," and "severe"]

| Soil series and map symbols | Septic tank absorption fields | Sewage lagoons | Sanitary landfill-- | |
|---|---|---|---|---|
| | | | Trenches | Areas |
| Bates: BaB, BaC, BcC 1/. | Severe: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Slight. |
| Cannon: Ca------- | Severe: floods--- | Severe: floods; percs rapidly. | Severe: floods; percs rapidly. | Severe: floods; percs rapidly. |
| Captina: CcB----- | Severe: percs slowly. | Moderate: depth to rock. | Severe: depth to rock. | Slight. |
| Choteau: ChA, ChB. | Severe: percs slowly; wet. | Slight---------- | Moderate: too clayey; wet. | Severe: wet. |
| Clarksville: | | | | |
| CkD---------- | Slight---------- | Severe: percs rapidly. | Severe: percs rapidly. | Severe: percs rapidly. |
| ClE---------- | Moderate: slope-- | Severe: percs rapidly. | Severe: percs rapidly. | Severe: percs rapidly. |
| ClF---------- | Severe: slope---- | Severe: percs rapidly. | Severe: percs rapidly. | Severe: percs rapidly. |
| Collinsville: CoE. | Severe: depth to rock. | Severe: depth to rock; percs rapidly. | Severe: depth to rock; percs rapidly. | Severe: percs rapidly. |
| Craig: | | | | |
| CrB---------- | Severe: percs slowly. | Moderate: small stones. | Moderate: too clayey. | Slight. |
| CrC---------- | Severe: percs slowly. | Moderate: slope; small stones. | Moderate: too clayey. | Slight. |
| Dennis: | | | | |
| DnB---------- | Severe: percs slowly; wet; slope. | Slight---------- | Severe: too clayey. | Severe: wet. |
| DnC, DnC2, DvE 1/. | Severe: percs slowly; wet; slope. | Moderate: slope- | Severe: too clayey. | Severe: wet. |
| Eldorado: ElD---- | Slight---------- | Moderate: percs rapidly; small stones. | Moderate: too clayey. | Slight. |
| Elsah: Es-------- | Severe: floods; depth to rock. | Severe: floods; small stones; percs rapidly. | Severe: floods; depth to rock; percs rapidly. | Severe: floods; percs rapidly. |
| Enders 2/--------- | Severe: percs slowly. | Severe: slope--- | Severe: depth to rock; too clayey. | Moderate: slope. |
| Hector: HeC 1/, HeE 1/, HsF. | Severe: depth to rock. | Severe: depth to rock; percs rapidly. | Severe: depth to rock; percs rapidly. | Severe: percs rapidly. |

TABLE 10.--SOIL RATINGS FOR SANITARY FACILITIES--Continued

| Soil series and map symbols | Septic tank absorption fields | Sewage lagoons | Sanitary landfill-- | |
|---|---|---|---|---|
| | | | Trenches | Areas |
| Kanima: KaE------ | Severe: slope----- | Severe: percs rapidly; small stones. | Moderate: slope-- | Severe: slope. |
| Lenapah: LeB, LrD. | Severe: depth to rock; percs slowly. | Severe: depth to rock. | Severe: depth to rock; too clayey. | Slight. |
| Lula: LuB-------- | Moderate: depth to rock. | Moderate: depth to rock; percs rapidly. | Severe: depth to rock. | Slight. |
| Mayes: Ma-------- | Severe: percs slowly; wet. | Slight---------- | Severe: too clayey. | Severe: wet. |
| Nixa: NxB-------- | Severe: depth to rock; percs slowly. | Severe: small stones. | Severe: depth to rock. | Slight. |
| Okemah: OkA------ | Severe: percs slowly; wet. | Slight---------- | Moderate: too clayey. | Severe: wet. |
| Osage: Os-------- | Severe: percs slowly; wet. | Severe: floods-- | Severe: floods; too clayey; wet. | Severe: floods; too clayey; wet. |
| Parsons: PaA----- | Severe: percs slowly; wet. | Slight---------- | Severe: too clayey. | Severe: wet. |
| Quarles: Qu------ | Severe: floods; wet; percs slowly. | Severe: floods-- | Severe: floods; wet; too clayey. | Severe: floods; wet. |
| Riverton: ReB, RvC. | Moderate: percs slowly | Moderate: percs rapidly; small stones. | Slight---------- | Slight. |
| Sallisaw: SaB--- | Slight---------- | Severe: percs rapidly; small stones. | Slight---------- | Slight. |
| Summit: SuA, SuB, SuC. | Severe: percs slowly; wet. | Moderate: depth to rock; slope. | Severe: depth to rock; too clayey. | Severe: wet. |
| Taloka: TaA------ | Severe: percs slowly; wet. | Slight---------- | Moderate: too clayey; wet. | Severe: wet. |
| Verdigris: Ve, Vs. | Severe: floods--- | Severe: floods-- | Severe: floods--- | Severe: floods. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

2/ Mapped only with Hector soils (HeC and HeE) in this survey area.

TABLE 11.--RATINGS OF SOILS AS CONSTRUCTION SITES

[Soil characteristics in this table are expressed in computer-adapted terms differing from those in the Soil Survey Manual. Refer to Explanation of Key Phrases following the Glossary for definition of " shrink-swell" and other terms that describe soil characteristics. See text for definition of the terms "slight," "moderate," and "severe"]

| Soil series and map symbols | Shallow excavations | Dwellings-- | | Small commercial buildings | Local roads and streets |
|---|---|---|---|---|---|
| | | Without basements | With basements | | |
| Bates: BaB, BaC, BcC 1/. | Moderate: depth to rock. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell; low strength. |
| Cannon: Ca-- | Severe: floods. | Severe: floods. | Severe: floods-- | Severe: floods-- | Severe: floods. |
| Captina: CcB. | Severe: wet--- | Moderate: low strength. | Moderate: depth to rock; wet. | Moderate: wet; low strength. | Moderate: depth to rock; low strength. |
| Choteau: ChA, ChB. | Moderate: too clayey; wet. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. |
| Clarksville: | | | | | |
| CkD-------- | Moderate: small stones. | Slight-------- | Slight---------- | Moderate: slope. | Slight. |
| ClE-------- | Moderate: small stones. | Moderate: slope. | Moderate: slope. | Severe: slope--- | Moderate: slope. |
| ClF-------- | Severe: slope- | Severe: slope- | Severe: slope--- | Severe: slope--- | Severe: slope. |
| Collinsville: CoE. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. |
| Craig: CrB, CrC. | Moderate: small stones. | Slight-------- | Slight---------- | Slight---------- | Slight. |
| Dennis: DnB, DnC, DnC2, DvE 1/. | Severe: too clayey; wet. | Severe: shrink-swell; wet. | Severe: shrink-swell; wet. | Severe: shrink-swell; wet. | Severe: shrink-swell; wet. |
| Eldorado: ElD. | Moderate: slope; too clayey. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: low strength; shrink-swell. |
| Elsah: Es--- | Severe: floods. | Severe: floods. | Severe: floods-- | Severe: floods-- | Severe: floods. |
| Enders 2/---- | Severe: too clayey. | Severe: shrink-swell; low strength. | Severe: shrink-swell; low strength. | Severe: shrink-swell; low strength. | Severe: shrink-swell; low strength. |
| Hector: HeC 1/, HeE 1/, HsF. | Severe: depth to rock | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. |
| Kanima: KaE-- | Moderate: slope. | Severe: slope. | Severe: slope--- | Severe: slope--- | Severe: slope. |
| Lenapah: LeB, LrD. | Severe: depth to rock; too clayey. | Severe: depth to rock; low strength; shrink-swell. | Severe: depth to rock; low strength; shrink-swell. | Severe: depth to rock; low strength; shrink-swell. | Severe: depth to rock; low strength; shrink-swell. |

TABLE 11.--RATINGS OF SOILS AS CONSTRUCTION SITES--Continued

| Soil series and map symbols | Shallow excavations | Dwellings-- | | Small commercial buildings | Local roads and streets |
|---|---|---|---|---|---|
| | | Without basements | With basements | | |
| Lula: LuB---- | Moderate: depth to rock; too clayey. | Moderate: depth to rock; low strength; shrink-swell. | Moderate: depth to rock; low strength; shrink-swell. | Moderate: depth to rock; low strength; shrink-swell. | Moderate: low strength; shrink-swell. |
| Mayes: Ma---- | Severe: wet; too clayey. | Severe: wet; shrink-swell; low strength. | Severe: wet; shrink-swell; low strength. | Severe: wet; shrink-swell; low strength. | Severe: shrink-swell; low strength. |
| Nixa: NxB---- | Severe: small stones. | Slight-------- | Moderate: depth to rock. | Slight---------- | Slight. |
| Okemah: OkA-- | Severe: wet; too clayey. | Severe: shrink-swell; wet. | Severe: shrink-swell; wet. | Severe: shrink-swell. | Severe: shrink-swell; low strength. |
| Osage: Os---- | Severe: floods; wet. | Severe: floods; wet; shrink-swell. | Severe: floods; wet; shrink-swell. | Severe: floods; wet; shrink-swell. | Severe: floods; wet; shrink-swell. |
| Parsons: PaA- | Severe: wet; too clayey. | Severe: wet; low strength; shrink-swell. | Severe: wet; low strength; shrink-swell. | Severe: wet; low strength; shrink-swell. | Severe: low strength; shrink-swell. |
| Quarles: Qu-- | Severe: wet; too clayey; floods. | Severe: wet; floods; low strength; shrink-swell. | Severe: wet; floods; low strength; shrink-swell. | Severe: wet; floods; low strength; shrink-swell. | Severe: wet; low strength; shrink-swell. |
| Riverton: ReB, RvC. | Moderate: small stones; too clayey. | Slight-------- | Slight---------- | Slight---------- | Slight. |
| Sallisaw: SaB. | Moderate: small stones. | Slight-------- | Slight---------- | Slight---------- | Moderate: low strength. |
| Summit: SuA, SuB, SuC. | Severe: wet; too clayey. | Severe: low strength; shrink-swell; wet. | Severe: low strength; shrink-swell; wet. | Severe: low strength; shrink-swell; wet. | Severe: low strength; shrink-swell; wet. |
| Taloka: TaA-- | Severe: wet; too clayey. | Severe: wet; low strength; shrink-swell. | Severe: wet; low strength; shrink-swell. | Severe: wet; low strength; shrink-swell. | Severe: low strength; shrink-swell. |
| Verdigris: | | | | | |
| Ve--------- | Severe: floods. | Severe: floods. | Severe: floods-- | Severe: floods-- | Moderate: low strength; floods. |
| Vs--------- | Severe: floods. | Severe: floods. | Severe: floods-- | Severe: floods-- | Severe: floods. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders. |
| HeE | Enders |

2/ Mapped only with Hector soils (HeC and HeE) in this survey.

TABLE 12.--RATINGS OF SOILS AS SOURCES OF CONSTRUCTION MATERIAL

[Soil characteristics in this table are expressed in computer-adapted terms differing from those in the Soil Survey Manual. Refer to Explanation of Key Phrases following the Glossary for definition of "percs rapidly" and other terms that describe soil characteristics. See text for definition of the terms "slight," "moderate," and "severe"]

| Soil series and map symbols | Road fill | Sand | Gravel | Topsoil | Cover for landfill |
|---|---|---|---|---|---|
| Bates: BaB, BaC, BcC 1/. | Fair: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Fair: thin layer. |
| Cannon: Ca---- | Fair: low strength. | Unsuitable------ | Poor---------- | Poor: small stones. | Fair: small stones. |
| Captina: CcB-- | Fair: low strength. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Fair: thin layer. |
| Choteau: ChA, ChB. | Poor: shrink-swell; low strength. | Unsuitable------ | Unsuitable----- | Good---------- | Fair: thin layer. |
| Clarksville: CkD---------- | Good---------- | Unsuitable------ | Poor---------- | Poor: small stones. | Poor: percs rapidly; coarse fragments. |
| ClE---------- | Fair: slope-- | Unsuitable------ | Poor---------- | Poor: small stones. | Poor: percs rapidly; coarse fragments. |
| ClF---------- | Poor: slope-- | Unsuitable------ | Poor---------- | Poor: small stones. | Poor: percs rapidly; coarse fragments. |
| Collinsville: CoE. | Poor: thin layer. | Unsuitable------ | Unsuitable----- | Poor: thin layer; slope. | Poor: thin layer. |
| Craig: CrB, CrC. | Good---------- | Unsuitable------ | Poor---------- | Fair: small stones. | Fair: small stones; thin layer. |
| Dennis: DnB, DnC, DnC2, DvE 1/. | Poor: shrink-swell; low strength. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Poor: thin layer. |
| Eldorado: ElD-- | Fair: low strength; shrink-swell. | Unsuitable------ | Fair---------- | Fair: small stones. | Poor: small stones; slope. |
| Elsah: Es----- | Good---------- | Unsuitable------ | Fair---------- | Poor: small stones. | Poor: small stones. |
| Enders 2/------ | Poor: shrink-swell; low strength. | Unsuitable------ | Unsuitable----- | Poor: thin layer; small stones. | Poor: thin layer. |
| Hector: HeC 1/, HeE 1/, HsF. | Poor: thin layer; low strength. | Poor---------- | Poor---------- | Poor: thin layer; large stones; area reclaim. | Poor: thin layer. |
| Kanima: KaE---- | Fair: low strength; slope. | Unsuitable------ | Poor---------- | Poor: small stones. | Fair: slope. |

TABLE 12.--RATINGS OF SOILS AS SOURCES OF CONSTRUCTION MATERIAL--Continued

| Soil series and map symbols | Road fill | Sand | Gravel | Topsoil | Cover for landfill |
|---|---|---|---|---|---|
| Lenapah: LeB, LrD. | Poor: thin layer; low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Fair: thin layer; too clayey; area reclaim. | Poor: thin layer. |
| Lula: LuB------ | Fair: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Fair: thin layer. |
| Mayes: Ma------ | Poor: shrink-swell; low strength. | Unsuitable------ | Unsuitable----- | Poor: wet; thin layer. | Poor: thin layer. |
| Nixa: NxB------ | Fair: low strength. | Unsuitable------ | Poor---------- | Unsuited: small stones. | Poor: small stones. |
| Okemah: OkA---- | Poor: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Fair: thin layer. |
| Osage: Os------ | Poor: shrink-swell; low strength. | Unsuitable------ | Unsuitable----- | Poor: wet----- | Poor: thin layer; wet. |
| Parsons: PaA--- | Poor: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Fair: thin layer. | Poor: thin layer. |
| Quarles: Qu---- | Poor: wet; low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Poor: wet----- | Poor: wet; thin layer. |
| Riverton: ReB, RvC. | Fair: low strength. | Unsuitable------ | Poor---------- | Poor: small stones. | Fair: small stones; thin layer. |
| Sallisaw: SaB-- | Fair: low strength. | Unsuitable------ | Poor---------- | Fair: thin layer. | Fair: small stones. |
| Summit: SuA, SuB, SuC. | Poor: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Poor: too clayey. | Poor: thin layer. |
| Taloka: TaA---- | Poor: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Good---------- | Fair: thin layer. |
| Verdigris: Ve, Vs. | Fair: low strength; shrink-swell. | Unsuitable------ | Unsuitable----- | Good---------- | Good. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders. |

2/ Mapped only with Hector soils (HeC and HeE) in this survey.

TABLE 13.--WATER MANAGEMENT

[Soil characteristics in this table are expressed in computer-adapted terms differing from those in the Soil Survey Manual. Refer to Explanation of Key Phrases following the Glossary for definition of "percs rapidly" and other terms that describe soil characteristics. See text for definition of the terms "slight," "moderate," and "severe"]

| Soil series and map symbols | Limitations for-- | | | Features affecting-- | | | |
|---|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
| Bates: BaB, BaC, BcC 1/. | Moderate: depth to rock. | Moderate: unstable fill; compressible; piping. | Severe: no water. | Not needed. | Slope----- | Depth to rock. | Favorable. |
| Cannon: Ca---- | Severe: percs rapidly. | Moderate: piping; unstable fill; compressible. | Severe: no water. | Not needed. | Fast intake. | Not needed. | Favorable. |
| Captina: CcB--- | Moderate: depth to rock. | Moderate: unstable fill; compressible; piping. | Severe: no water. | Depth to rock. | Slow intake; slope. | Cemented pan. | Favorable. |
| Choteau: ChA, ChB. | Slight------ | Moderate: unstable fill; piping. | Severe: no water. | Percs slowly. | Slow intake. | Favorable. | Favorable. |
| Clarksville: CkD, ClE, ClF. | Severe: percs rapidly. | Moderate: unstable fill. | Severe: no water. | Not needed. | Slope----- | Small stones. | Slope. |
| Collinsville: CoE. | Severe: depth to bedrock. | Severe: thin layer. | Severe: no water. | Not needed. | Rooting depth. | Rooting depth. | Rooting depth. |
| Craig: CrB, CrC. | Moderate: percs rapidly. | Moderate: thin layer; piping. | Severe: no water. | Not needed. | Droughty; slope. | Favorable. | Favorable. |
| Dennis: DnB, DnC, DnC2, DvE 1/. | Slight------ | Moderate: unstable fill; piping; compressible. | Severe: no water. | Percs slowly. | Slow intake. | Favorable. | Favorable. |
| Eldorado: ElD-- | Severe: depth to rock. | Moderate: unstable fill; piping. | Severe: no water. | Not needed. | Slope----- | Slope---- | Slope. |
| Elsah: Es----- | Severe: percs rapidly. | Severe: percs rapidly. | Severe: no water. | Not needed. | Percs rapidly. | Not needed. | Droughty. |
| Enders 2/------ | Slight------ | Severe: compressible; unstable fill; low strength. | Severe: no water. | Not needed. | Slow intake; slope. | Slope---- | Slope. |
| Hector: HeC 1/, HeE 1/, HsF 1/. | Severe: depth to rock; percs rapidly. | Severe: thin layer. | Severe: no water. | Not needed. | Droughty; percs rapidly. | Depth to rock. | Droughty; slope. |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil series and map symbols | Limitations for-- | | | Features affecting-- | | | |
|---|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
| Kanima: KaE---- | Severe: percs rapidly. | Moderate: unstable fill; percs rapidly; piping. | Severe: no water. | Not needed. | Droughty; slope. | Slope---- | Slope; droughty. |
| Lenapah: LeB, LrD. | Severe: depth to rock. | Severe: thin layer. | Severe: no water. | Percs slowly; depth to rock. | Rooting depth. | Depth to rock. | Rooting depth. |
| Lula: LuB------ | Moderate: depth to rock; percs rapidly. | Moderate: thin layer; compressible; piping. | Severe: no water. | Not needed. | Slope----- | Favorable. | Favorable. |
| Mayes: Ma----- | Slight------ | Moderate: unstable fill; compressible. | Severe: no water. | Percs slowly. | Wet; slow intake. | Not needed. | Wet; percs slowly. |
| Nixa: NxB----- | Moderate: depth to rock. | Severe: thin layer; piping; small stones. | Severe: no water. | Not needed. | Droughty; slope; slow intake. | Rooting depth; percs slowly. | Rooting droughty; percs slowly. |
| Okemah: OkA---- | Slight------ | Moderate: unstable fill. | Severe: no water. | Percs slowly. | Slow intake. | Percs slowly. | Percs slowly. |
| Osage: Os------ | Slight------ | Moderate: unstable fill; compressible. | Severe: slow refill. | Percs slowly. | Slow intake. | Not needed. | Percs slowly; wet. |
| Parsons: PaA--- | Slight------ | Moderate: unstable fill; compressible. | Severe: slow refill. | Percs slowly. | Slow intake. | Percs slowly. | Percs slowly. |
| Quarles: Qu--- | Slight------ | Moderate: unstable fill; compressible. | Severe: slow refill. | Floods-- | Slow intake. | Percs slowly. | Wet; percs slowly. |
| Riverton: ReB, RvC. | Severe: depth to rock; percs rapidly. | Moderate: unstable fill; percs rapidly. | Severe: no water. | Not needed. | Droughty-- | Rooting depth. | Droughty. |
| Sallisaw: SaB-- | Severe: percs rapidly. | Moderate: percs rapidly. | Severe: no water. | Not needed. | Slope----- | Favorable. | Favorable. |
| Summit: SuA, SuB, SuC. | Moderate: depth to rock. | Severe: compressible; piping. | Severe: no water. | Percs slowly. | Slow intake. | Percs slowly. | Percs slowly; slope. |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil series and map symbols | Limitations for-- | | | Features affecting-- | | | |
|---|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
| Taloka: TaA---- | Slight------ | Moderate: unstable fill; compressible. | Severe: no water. | Percs slowly. | Slow intake. | Percs slowly. | Percs slowly. |
| Verdigris: Ve, Vs. | Moderate: percs rapidly. | Moderate: unstable fill; compressible; piping. | Moderate: no water. | Floods-- | Favorable- | Not needed. | Floods. |

1/ This mapping unit, and several others, consists of more than one kind of soil. The soil series for the other soil is shown as follows:

| Map symbol | Series |
|---|---|
| BcC | Collinsville |
| DvE | Verdigris |
| HeC | Enders |
| HeE | Enders |

2/ Mapped only with Hector soils (HeC and HeE) in this survey.

# FORMATION AND CLASSIFICATION OF THE SOILS

Described in this section are the major factors of soil formation and the processes of soil formation, as they relate to the soils in Mayes County, 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 given factor, vegetation for example, differs from one area to another, but the other four factors remain the same, the soil formed in the two areas differs.

Parent material.--Soils form in unconsolidated material that influences the rate at which the soil forms; the chemical, physical, and mineral composition of the soil; and the color of the soil.

Soils on the uplands of Mayes County formed in material weathered from sandstone, limestone, and shale. Bates, Collinsville, and Hector soils are examples of soils that formed in material weathered from sandstone. Summit and Lula soils formed in material weathered from limestone. Enders soils 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, depends largely on the source of the sediment and the velocity of the floodwater. Verdigris soils formed in loamy sediment deposited near overflowing streams. Osage soils formed in clayey sediment deposited by slowly moving water at the outer edges of flood plains.

Climate.--Mayes County has a warm, temperate climate. Precipitation is adequate for rapid soil 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 the soil structure and porosity. Soils that formed under prairie vegetation, such as those of the Summit series, have a black surface layer and a moderately high content of organic matter. Soils that formed under trees, such as those of the Enders series, have a dark-brown surface layer and a moderate content of organic matter.

Relief.--Relief influences the formation of the soils mainly through its effect on movement of water, on erosion, on soil temperature, and on the kind of plant cover. In Mayes County relief is determined largely by the resistance of underlying formations to weathering and geological erosion. About 8 percent of the acreage in Mayes County is nearly level soils on flood plains and about 92 percent is nearly level to very steep soils on uplands.

Bates and Collinsville soils formed in similar sandstone parent material. Their development, however, was controlled to a large extent by relief, and the moderately deep Bates soils are less sloping than the shallow and very shallow Collinsville soils.

Time.--As a factor in soil formation, time cannot be measured strictly in years. The length of time needed for development of genetic horizons depends on the intensity and the interactions of soil-forming factors in promoting the losses, gains, transfers, or transformations of the constituents necessary in forming soil horizons. Soils that have no definite genetic horizons are young, or immature. Mature, or older, soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils of Mayes County range from young to old. Parsons and Taloka soils are examples of old soils on uplands. Bates and Enders soils are younger, but they have well-expressed soil horizons. Collinsville and Hector soils are young soils that have had sufficient time to develop well-expressed horizons but, because they are sloping, geological erosion has taken away the soil material almost as fast as it has formed. Osage and Verdigris soils are also young soils. They formed on flood plains so recently that they show little horizon development.

## Processes of Soil Formation

Several processes were involved in the formation of the soils of Mayes 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, content of organic matter, 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 than the A1 horizon and is strongly leached of bases. Many of the soils of this county, such as those of the Parsons 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 Parsons series, it is the horizon of maximum accumulation of silicate clay. The younger soils of the county, such as those of the Elsah series, do not have a B horizon.

The C horizon is weathered rock that has been little affected by soil-forming processes. In some cases it has been modified by a reduction in the content of iron or by an accumulation of calcium carbonates.

The R layer is consolidated bedrock.

## Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and revised later (4). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (3) and was adopted in 1965 (6). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 14 shows the classification of each soil series of Mayes County by family, subgroup, and order, according to the current system. Classes of the current system are briefly described in the following paragraphs.

ORDER. Ten soil orders are recognized. 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. Each order is named with a word of three or four syllables ending in sol (Ent-i-sol).

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting 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 have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and those that have 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 subdivided into subgroups, one representing 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.

TABLE 14.--CLASSIFICATION OF THE SOIL SERIES OF MAYES COUNTY

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Bates | Fine-loamy, siliceous, thermic (mixed) | Typic Argiudolls | Mollisols. |
| Cannon | Fine-loamy, mixed, thermic | Cumulic Hapludolls | Mollisols. |
| Captina | Fine-silty, mixed, mesic | Typic Fragiudults | Ultisols. |
| Choteau | Fine, mixed, thermic | Aquic Paleudolls | Mollisols. |
| Clarksville | Loamy-skeletal, siliceous, mesic (mixed) | Typic Paleudults (Ultic Paleudalfs). | Ultisols. |
| Collinsville | Loamy, siliceous, thermic | Lithic Hapludolls | Mollisols. |
| Craig | Clayey-skeletal, mixed, thermic | Mollic Paleudalfs | Alfisols. |
| Dennis | Fine, mixed, thermic | Aquic Paleudolls | Mollisols. |
| Eldorado | Loamy-skeletal, mixed, thermic | Typic Paleudolls | Mollisols. |
| Elsah | Loamy-skeletal, mixed, nonacid, mesic | Typic Udifluvents | Entisols. |
| Enders | Clayey, mixed, thermic | Typic Hapludults | Ultisols. |
| Hector | Loamy, siliceous, thermic | Lithic Dystrochrepts | Inceptisols. |
| Kanima | Loamy-skeletal, mixed, nonacid, thermic | Udalfic Arents | Entisols. |
| Kenapah | Clayey, montmorillonitic, thermic | Lithic Vertic Argiustolls | Mollisols. |
| Lula | Fine-silty, mixed, thermic | Typic Argiudolls | Mollisols. |
| Mayes | Fine, montmorillonitic, thermic | Vertic Argiaquolls | Mollisols. |
| Nixa | Loamy-skeletal, siliceous, mesic | Glossic Fragiudults | Ultisols. |
| Okemah | Fine, mixed, thermic | Aquic Paleudolls | Mollisols. |
| Osage | Fine, montmorillonitic, thermic | Vertic Haplaquolls | Mollisols. |
| Parsons | Fine, mixed, thermic | Mollic Albaqualfs | Alfisols. |
| Quarles | Fine, mixed, thermic | Mollic Ochraqualfs | Alfisols. |
| Riverton | Loamy-skeletal, mixed, thermic | Mollic Paleudalfs | Alfisols. |
| Sallisaw | Fine-loamy, siliceous, thermic | Typic Paleudalfs | Alfisols. |
| Summit | Fine, montmorillonitic, thermic | Vertic Argiudolls | Mollisols. |
| Taloka | Fine, mixed, thermic | Mollic Albaqualfs | Alfisols. |
| Verdigris | Fine-silty, mixed, thermic | Cumulic Hapludolls | Mollisols. |

Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the 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 14). An example is the "coarse-loamy, siliceous, acid, thermic family of Typic Haplaquents."

Additional information about the county is given in this section. It will be useful to readers not familiar with Mayes County. Briefly described are the relief and drainage of the county, the settlement and development, the natural resources, the transportation and industry, the farming, and the climate.

## Relief and Drainage

About 92 percent of Mayes County is nearly level to very steep uplands. About 8 percent is nearly level flood plains.

Most of the county is drained by the Neosho River and its tributaries. The major tributaries are Pryor Creek, Saline Creek, Choteau Creek, Cabin Creek, and Spavinaw Creek.

## Settlement and Development

Before 1800, the area now in Mayes County was the hunting ground of Indians, mainly the Osage. Early traders reported an abundance of game and fish in the prairies, and open-timbered hills, and the clear streams.

The first white settlement in the area was made at Salina in about 1804, when Col. A. P. Choteau established a trading post on the Neosho River. A few years later the area was made part of the Cherokee Indian Nation and became the home of some of the Cherokee Indians as they were moved from Georgia. The Cherokees settled mainly in the timbered hills of the eastern part of the area.

Pryor Creek grew to be the largest town and was made the county seat when Oklahoma became a state. It was named after Nathaniel Pryor, an early explorer who accompanied the Lewis and Clark Expedition to the Pacific in 1803.

When Oklahoma became a state in 1907, some land was allotted to full-blooded Indians. The allottees became wards of the Indian agency, and the sale and use of their property was restricted. Other land was allotted to individuals who were part Cherokee. This land could be used or sold without restriction.

The good timber was cut off the wooded areas. Many areas were cleared and cultivated but soon reverted to scrubby, woody pasture.

The prairie areas in the western part of the county were developed into large farms and ranches and were prosperous until the economic depression of the 1920's and 1930's. The severe damage to the farming economy caused the change of ownership of most of the lands. During the depression the U. S. Government constructed a multipurpose dam on Neosho River at Langley, Oklahoma. This dam was turned over to The Grand Lake Dam Authority to generate electricity for the area and to furnish water for farm, municipal, and industrial uses. Lake Hudson is near Locust Grove on the Neosho River, and a large pump-back lake is near Salina. The upper part of Ft. Gibson Reservoir is in Mayes County on the Neosho River. It furnishes water for an industrial complex and covers several thousand acres near Chouteau.

The many miles of wooded and hilly lake shoreline, are being used as recreation sites. Many lake-front homes and vacation homes are now being built in the county.

## Natural Resources

The main natural resources in the area are water, timber, native pasture, tame pasture, limestone, gravel, wild game, and fish.

The water supply for towns comes from lakes, rivers, springs, and wells. Hydroelectric and flood-control reservoirs generate electricity and furnish irrigation water. Wells, springs, and ponds supply water for livestock. The water in the lakes and streams is clear and of high quality. The City of Tulsa and many small towns have spent millions of dollars constructing reservoirs and pumping facilities in the county.

The income from timber is much less than it has been in the past. Most of the timber has been cut over and the trees that were left to propagate the stands are of poor quality. This timber is now used mainly for the production of hand-tool handles, gunstocks, and special furniture parts.

Native pasture provides some of the grazing for livestock and much of the hay for feeding livestock during the winter. Tame pasture provides most of the grazing and some of the hay for livestock. Alfalfa is grown on the upland prairies but the stands do not last long.

Limestone is the most common mineral in the area. In places it is mined for commercial and agricultural uses. Gravel deposits along streams are abundant. The gravel is used in cement mixtures and for surfacing

[7] DON D. DONAHOO, district conservationist, Soil Conservation Service, assisted in the preparation of the section.

roads, mainly on gently sloping soils, because most of the soils in the hilly areas contain sufficient chert, sandstone, or shale.

Wildlife and fish are abundant in the area. Big game have been restocked on a game reserve in the Spavinaw Hills. During short periods the reserve is open for deer hunting. Quail, dove, and duck are hunted during season in all areas of the county. Fishing is a year-round sport on the streams and lakes because commercial docks are heated during winter.

Clear streams and lakes in the hilly, timbered areas provide scenic beauty that attracts thousands of visitors each year. Redbud and dogwood trees bloom in spring, and the hardwoods turn brilliant colors in the fall. Many visitors come to the area during these two seasons of the year.

## Transportation and Industry

Federal and State highways form a network of paved roads in the county. U.S. Highway 69 and State Highway 82 extend north to south across the county. State Highways 28, 20, and 33 cross the county west to east.

In all areas graded chert, sandstone, gravel, and dirt roads provide access to the hard-surfaced roads. Some areas in the most hilly part, however, have few roads.

The county is serviced by railroads, bus lines, and freight services. The railroad has spur lines running to the industrial area south of Pryor Creek.

Grain elevators are located in Dawes and Chouteau. Dairy farmers market most of the milk in nearby large cities.

Livestock is marketed at the Pryor Creek and Locust Grove sale rings and the Tulsa stockyards.

Small sawmills are scattered throughout the eastern part of the county. The timber is sold to a handle factory, to a gunstock factory, and, as rough-sawed timber, to individuals.

The industrial area has several industries located on it at the present time and has room for several more. Some industries have located near the industrial area but not on it. A large payroll in the county is derived from the industrial area.

## Farming

The first settlers in Mayes County, who were Indians, found forests of pine and oak, and grassy prairies. Wheat, corn, tobacco, and cotton were among the first crops grown in the area. By the mid 1930's the crops were mainly wheat, oats, and corn, and much of the cropland was idle. The U. S. Censuses of Agriculture show, since the early 1940's, a steady decrease in acreage of cultivated crops and increase in pasture. The increase in acreage of pasture has been accompanied by a large increase in the number of livestock, mainly cows and calves.

For many years the trend has been for farms to decrease in number and to increase in size. This trend may now be reversing. The industrial area in the county is attracting people who are buying small tracts of land for country homes and small-scale livestock farming. Only a few of the farms in the county are operated by tenants.

## Climate 8/

Mayes County has a humid climate. Average yearly precipitation is slightly more than 40 inches. In a typical year, 32 percent of the moisture falls during spring, 29 percent during summer, 25 percent during fall, and 14 percent during winter. Much of the rainfall comes in thunderstorms, which occur 55 days each year, on the average, and are more numerous during April, May, and June. In a typical year, daily precipitation of 0.01 inch or more occurs 95 times; 0.1 inch or more 59 times; and 1 inch or more 10 times. Since 1941, the greatest recorded rainfall within a 24-hour period is 6.05 inches, at Pryor in June 1943. It is estimated, however, that a 24-hour rainfall of 6.45 inches or greater occurs once every 10 years, and a 24-hour rainfall of at least 7.5 inches once every 25 years. See table 15.

Summers are hot. Daily temperatures typically reach 100 F. ten times during an average year, mainly in July and August. The highest temperature recorded in Pryor was 117° F., on July 18, 1936.

Winters are somewhat mild, although on about 10 days each year, the temperature remains at 32 or below. A temperature of 0 F. occurs about once each year. The lowest temperature recorded in Pryor was -21° F., on January 22, 1930.

About 9 inches of snow falls each year, although as much as 26 inches and as little as a trace have fallen. About 4 days each year have 1 inch or more of snowfall. Approximately 7 days each year have 1 inch or more of snow on the ground. On these days, the average depth of the snow is 2 inches.

8/ By BILLY R. CURRY, climatologist for Oklahoma, National Weather Service, U.S. Department of Commerce.

TABLE 15.--TEMPERATURE AND PRECIPITATION

All data from Pryor; period of record, 1941-70

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | One year in 10 will have-- | | Days having snow cover of 1 inch or more | Average depth of snow on days having snow cover |
| | Average daily maximum | Average daily minimum | Average monthly maximum | Average monthly minimum | Average monthly total | Less than-- | More than-- | | |
| | °F | °F | °F | °F | Inches | Inches | Inches | Number | Inches |
| January---- | 48 | 25 | 70 | 4 | 1.7 | 0.6 | 3.7 | 3 | 2 |
| February--- | 53 | 29 | 74 | 11 | 2.0 | .6 | 4.1 | 1 | 2 |
| March------ | 60 | 36 | 81 | 16 | 2.7 | .8 | 4.7 | 1 | 3 |
| April------ | 72 | 49 | 86 | 31 | 4.6 | 1.7 | 9.8 | (1/) | -- |
| May-------- | 80 | 57 | 90 | 41 | 5.4 | 1.6 | 10.3 | ---- | -- |
| June------- | 88 | 66 | 96 | 52 | 5.3 | 1.8 | 10.4 | ---- | -- |
| July------- | 93 | 69 | 101 | 59 | 3.0 | .4 | 8.0 | ---- | -- |
| August----- | 94 | 68 | 103 | 56 | 3.5 | 1.2 | 7.6 | ---- | -- |
| September-- | 86 | 59 | 97 | 43 | 4.0 | .5 | 8.3 | ---- | -- |
| October---- | 76 | 48 | 89 | 31 | 3.9 | .2 | 9.3 | ---- | -- |
| November--- | 62 | 36 | 79 | 18 | 2.2 | .2 | 4.5 | (1/) | -- |
| December--- | 51 | 28 | 70 | 9 | 1.9 | .5 | 3.5 | 2 | 2 |
| Year | 72 | 48 | 2/ 104 | 3/ 2 | 40.2 | 27.4 | 54.9 | 7 | 2 |

1/ Less than one-half day.

2/ Average annual maximum temperature.

3/ Average annual minimum temperature.

TABLE 16.--PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING AND FIRST IN FALL

All data from Pryor; 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 14 | March 27 | April 3 | April 13 | April 22 |
| 2 years in 10 later than---- | March 6 | March 19 | March 27 | April 7 | April 16 |
| 5 years in 10 later than---- | February 16 | March 5 | March 16 | March 29 | April 7 |
| Fall: | | | | | |
| 1 year in 10 earlier than--- | November 17 | November 11 | October 29 | October 21 | October 17 |
| 2 years in 10 earlier than-- | November 24 | November 18 | November 4 | October 25 | October 20 |
| 5 years in 10 earlier than-- | December 10 | December 1 | November 16 | November 4 | October 29 |

The prevailing winds are southerly, although northerly winds prevail during January and February. The average yearly wind speed is 11 miles per hour, and the range is from 9 miles per hour in August to 13 miles per hour in March and April. Strong, gusty winds are common during spring storms and the winter storms called "northers."

Average relative humidity at noontime is 60 percent in January and 55 percent in July. When air is heated it expands and can therefore hold more moisture. For this reason, the relative humidity is usually lowest during the warm part of the afternoon and highest during the cool early morning hours. The average monthly percentage of possible sunshine received in this county is 51 percent in January, 57 percent in April, 70 percent in July, and 67 percent in October.

Mayes County, like all of Oklahoma, is susceptible to severe storms. These storms are more frequent during hot spring afternoons, but they can and do occur in every month of the year and at every hour of the day. At any one location within the county, hail falls on about 3 days of each year. The hail is not necessarily damaging.

The growing season, or frost-free period, in Mayes County is about 205 days. The average date of the last freeze in spring at Pryor is on April 7, and the average date of the first freeze in fall is as early as October 6. See table 16.

## LITERATURE CITED


(1) American Association of State Highway Officials.
1961. *Standard Specifications for Highway Materials and Methods of Sampling and Testing.* Ed. 8, 2 v., illus.

(2) Baldwin, Mark, Kellogg, Charles E., and Thorp, James.
1938. *Soil Classification.* U.S. Dept. Agr. Ybk., pp. 979-1001, illus.

(3) Simonson, Roy W.
1962. *Soil Classification in the United States.* Sci. 137: 1027-1034, illus.

(4) Thorp, James, and Smith Guy D.
1949. *Higher Categories of Soil Classification: Order, Suborder, and Great Soil Groups.* Soil Sci. 67: 117-126.

(5) United States Department of Agriculture.
1951. *Soil Survey Manual.* U.S. Dept. Agr. Handbook No. 18, 503 pp., illus.

(6) _____
1960. *Soil Classification, A Comprehensive System, 7th Approximation.* 265 pp., illus. Supplements issued in March 1967 and in September 1968.

(7) United States Department of Defense.
1968: *Unified Soil Classification System for Roads, Airfields, Embankments and Foundations.* MIL-STD-619B, 30 pp., illus.

# 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, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

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 wilting 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.

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 horizon 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.

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.

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 water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A 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 15 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.

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.

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 specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has a few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gleyed soil.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons.

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant 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.

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.

Miscellaneous land type. A mapping unit for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance--few, common, and many; size--fine, medium, and coarse; and contrast--faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables--hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

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.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

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 |

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. As a soil separate, 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. As a textural class, any soil that contains 85 percent or more sand and nor 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.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may

occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral praticles, 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 0.002 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 characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are 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.

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.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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.

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. Constrasts 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.

## EXPLANATION OF KEY PHRASES

| | |
|---|---|
| Area reclaim | *Borrow areas hard to reclaim.* |
| Cemented pan | *Cemented pan too close to surface.* |
| Complex slope | *Slopes short and irregular.* |
| Compressible | *Decrease in soil volume excessive under load.* |
| Corrosive | *Soils corrode uncoated steel pipe.* |
| Cutbanks cave | *Walls of cuts not stable.* |
| Deep to water | *Deep to permanent water table during dry season.* |
| Depth to rock | *Bedrock too close to surface.* |
| Droughty | *Soils cannot hold enough water for plants during dry periods.* |
| Dusty | *Soil particles detach easily and cause dust.* |
| Erodes easily | *Water erodes soil easily.* |
| Excess alkali | *Exchangeable sodium affects soil properties and restricts growth of plants.* |
| Excess humus | *Contains too much organic matter.* |
| Excess lime | *Carbonates restrict plant growth.* |
| Excess salt | *Soluble salts restrict plant growth.* |
| Fast intake | *Water infiltrates rapidly.* |
| Favorable | *Features of soil favorable.* |
| Floods | *Soil floods by stream overflow, runoff or high tides.* |
| Frost action | *Freezing may damage structures.* |
| Hard to pack | *Difficult to compact.* |
| Large stones | *Rock fragments 10 inches or more across.* |
| Low strength | *Not enough strength to adequately support the load.* |
| No water | *Too deep to ground water.* |
| Not needed | *Practice not applicable.* |
| Percs rapidly | *Water moves through soil too fast.* |
| Percs slowly | *Water moves through the soil too slowly.* |
| Piping | *Water may form tunnels or pipelike cavities.* |
| Poor outlets | *Difficult or expensive to install outlets for drainage.* |
| Rock outcrops | *Outcrops of fixed rock.* |
| Rooting depth | *Soil is thin over layer that restricts root growth.* |
| Shrink-swell | *Soil expands significantly on wetting and shrinks on drying.* |
| Slope | *Slope is too great.* |
| Slow intake | *Water infiltration restricted.* |
| Slow refill | *Ponds fill slowly because of restricted soil permeability.* |
| Small stones | *Contains many rock fragments less than 10 inches across.* |
| Soil blowing | *Soil easily moved and deposited by wind.* |
| Thin layer | *Inadequate thickness of suitable soil.* |
| Too clayey | *Soil slippery and sticky when wet and slow to dry.* |
| Too sandy | *Soil soft and loose; droughty and low in fertility.* |
| Unstable fill | *Banks of fills likely to cave or slough.* |
| Wet | *Soil wet during period of use.* |

## GUIDE TO MAPPING UNITS

For a complete description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. An outline of the capability classification of soils is given on page 36, the pasture and hayland suitability groups are described on page 39, and the woodland suitability groups are described in table 4, page 50. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Estimated yields, table 2, page 40.
Plant community on rangeland, table 3, page 45.
Potential for wildlife, table 5, page 54.
Limitations for recreation, table 6, page 56.
Engineering uses of the soils, table 7, page 60, tables 8 and 9, pages 66 through 68, and tables 10, 11, 12, and 13, pages 70 through 78.

| Map symbol | Mapping unit | Page | Capability unit | Range site | | Pasture and hayland suitability group | Woodland suitability group |
|---|---|---|---|---|---|---|---|
| | | | Symbol | Name | Page | Number | Number |
| BaB | Bates loam, 1 to 3 percent slopes | 8 | IIe-1 | Loamy Prairie | 43 | 8A | --- |
| BaC | Bates loam, 3 to 5 percent slopes | 8 | IIIe-1 | Loamy Prairie | 43 | 8A | --- |
| BcC | Bates-Collinsville complex, 1 to 5 percent slopes | 8 | | | | | |
| | Bates part | -- | IVe-1 | Loamy Prairie | 43 | 8A | --- |
| | Collinsville part | -- | IVe-1 | Shallow Prairie | 44 | 14A | --- |
| Ca | Cannon gravelly loam | 9 | IIw-1 | --- | -- | 2A | 2o7 |
| CcB | Captina silt loam, 1 to 3 percent slopes | 10 | IIe-1 | Smooth Chert Savannah | 44 | 8A | 4o7 |
| ChA | Choteau silt loam, 0 to 1 percent slopes | 11 | I-1 | Loamy Prairie | 43 | 8A | --- |
| ChB | Choteau silt loam, 1 to 3 percent slopes | 11 | IIe-1 | Loamy Prairie | 43 | 8A | --- |
| CkD | Clarksville cherty silt loam, 1 to 8 percent slopes | 12 | IVs-1 | Smooth Chert Savannah | 44 | 8B | 4f8 |
| ClE | Clarksville stony silt loam, 5 to 20 percent slopes | 12 | VIs-1 | Smooth Chert Savannah | 44 | 8B | 4f8 |
| ClF | Clarksville stony silt loam, 20 to 50 percent slopes | 13 | VIIs-1 | Steep Chert Savannah | 48 | -- | 4f8 |
| CoE | Collinsville soils, 5 to 30 percent slopes | 13 | VIIs-2 | Shallow Prairie | 44 | -- | --- |
| CrB | Craig silt loam, 1 to 3 percent slopes | 14 | IIe-1 | Loamy Prairie | 43 | 8A | 5f2 |
| CrC | Craig silt loam, 3 to 5 percent slopes | 14 | IIIe-1 | Loamy Prairie | 43 | 8A | 5f2 |
| DnB | Dennis silt loam, 1 to 3 percent slopes | 15 | IIe-1 | Loamy Prairie | 43 | 8A | --- |
| DnC | Dennis silt loam, 3 to 5 percent slopes | 16 | IIIe-2 | Loamy Prairie | 43 | 8A | --- |
| DnC2 | Dennis silt loam, 2 to 5 percent slopes, eroded | 16 | IIIe-3 | Loamy Prairie | 43 | 8A | --- |
| DvE | Dennis-Verdigris complex, 0 to 15 percent slopes | 16 | | | | | |
| | Dennis part | -- | VIe-1 | Loamy Prairie | 43 | 8A | --- |
| | Verdigris part | -- | VIe-1 | Loamy Bottomland | 43 | 2A | --- |
| ElD | Eldorado soils, 1 to 8 percent slopes | 17 | VIs-2 | Loamy Prairie | 43 | 8A | 5f2 |
| Es | Elsah soils, frequently flooded | 18 | Vw-1 | --- | -- | 2A | 2f4 |

U. S. GOVERNMENT PRINTING OFFICE : 1975 O - 548-966

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit | Range site | | Pasture and hayland suitability group | Woodland suitability group |
|---|---|---|---|---|---|---|---|
| | | | Symbol | Name | Page | Number | Number |
| HeC | Hector-Enders complex, 1 to 5 percent slopes | 20 | | | | | |
| | Hector part | -- | IVe-2 | Shallow Savannah | 44 | 14A | 5d2 |
| | Enders part | -- | IVe-2 | Sandy Savannah | 43 | 8B | 4o1 |
| HeE | Hector-Enders complex, 5 to 20 percent slopes | 20 | | | | | |
| | Hector part | -- | VIIs-3 | Shallow Savannah | 44 | -- | 5d2 |
| | Enders part | -- | VIIs-3 | Sandy Savannah | 43 | -- | 4o1 |
| HsF | Hector soils, 20 to 50 percent slopes | 20 | VIIs-4 | Savannah Breaks | 44 | --- | 5d2 |
| KaE | Kanima soils, 1 to 30 percent slopes | 21 | VIIe-1 | ---------- | -- | --- | --- |
| LeB | Lenapah silty clay loam, 0 to 3 percent slopes | 22 | IIIe-2 | Shallow Prairie | 44 | 14A | --- |
| LrD | Lenapah-Rock outcrop complex, 1 to 8 percent slopes | 22 | VIIs-5 | Shallow Prairie | 44 | 14A | --- |
| LuB | Lula silt loam, 1 to 3 percent slopes | 23 | IIe-1 | Loamy Prairie | 43 | 8A | --- |
| Ma | Mayes silty clay loam | 24 | IIw-2 | Claypan Prairie | 43 | 8C | --- |
| NxB | Nixa cherty silt loam, 0 to 3 percent slopes | 25 | IIIs-1 | Smooth Chert Savannah | 44 | 8A | 4f8 |
| OkA | Okemah silt loam, 0 to 1 percent slopes | 26 | I-1 | Loamy Prairie | 43 | 8A | --- |
| Os | Osage silty clay loam | 26 | IIw-1 | Heavy Bottomland | 43 | 2B | 5w6 |
| PaA | Parsons silt loam, 0 to 1 percent slopes | 27 | IIs-1 | Claypan Prairie | 43 | 8C | --- |
| Qu | Quarles silt loam | 28 | IIIw-1 | Heavy Bottomland | 43 | 2B | 3w6 |
| ReB | Riverton loam, 1 to 3 percent slopes | 29 | IIe-1 | Loamy Prairie | 43 | 8A | 5f2 |
| RvC | Riverton gravelly loam, 1 to 5 percent slopes | 30 | IIIe-1 | Loamy Prairie | 43 | 8A | 5f2 |
| SaB | Sallisaw silt loam, 1 to 3 percent slopes | 31 | IIe-1 | Smooth Chert Savannah | 44 | 8A | 3o7 |
| SuA | Summit silty clay loam, 0 to 1 percent slopes | 32 | I-1 | Loamy Prairie | 43 | 8A | --- |
| SuB | Summit silty clay loam, 1 to 3 percent slopes | 32 | IIe-1 | Loamy Prairie | 43 | 8A | --- |
| SuC | Summit silty clay loam, 3 to 5 percent slopes | 32 | IIIe-2 | Loamy Prairie | 43 | 8A | --- |
| TaA | Taloka silt loam, 0 to 1 percent slopes | 33 | IIs-1 | Loamy Prairie | 43 | 8C | --- |
| Ve | Verdigris silty clay loam | 34 | IIw-1 | Loamy Bottomland | 43 | 2A | 3w5 |
| Vs | Verdigris soils, channeled | 34 | Vw-1 | Loamy Bottomland | 43 | 2A | 3w6 |

# Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457–3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at www.ascr.usda.gov, or write to:

USDA
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW.
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender.

Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).