

SOIL SURVEY

Moniteau County Missouri



This is the last survey of the 1953 series

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
Missouri Agricultural Experiment Station

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Moniteau County, Mo., will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid foresters in managing woodland; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of Soils." In this way, they first identify the soils on their farm and then

learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units and Capability Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit and the page where each of these is described.

Foresters and others interested in woodland can refer to the section "Use of the Soils for Woodland." In that section factors affecting the management of woodland are explained.

Engineers will want to refer to the section "Engineering Properties of Soils." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested in science will find information about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

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

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

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Fieldwork for this survey was completed in 1953. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time.

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SOIL SURVEY OF MONITEAU COUNTY, MISSOURI

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

MONITEAU COUNTY is approximately in the center of Missouri (fig. 1). It has a total land area of 267,520 acres, or 418 square miles. The town of California is the county seat.



Figure 1.—Location of Moniteau County in Missouri.

The relief in this county was produced by geologic erosion and dissection of what was once a broad upland plain that sloped gently toward the Missouri River. Now, the only remnants of the plain are the gently sloping interstream divides on which the towns of Fortuna, Tipton, California, Jamestown, Latham, and High Point are located. The greatest local differences in relief are in the northern part of the county, near the Missouri River. The areas adjacent to the streams are hilly, and the flood plains of most of the major streams are 75 to 150 feet below the tops of the interstream divides.

Four different physiographic areas make up the county. These are the flood plain of the Missouri River, along the northern boundary of the county; the part of the county called the river-hill area, which is covered by loess and consists of a narrow, hilly band of soils that parallels the bluffs of the Missouri River; the gently sloping prairie area near Tipton, Latham, and High Point, where many of the soils contain a claypan; and the Ozark Border area

in the southern part of the county. A general picture of these areas can be seen in figure 2, which shows the pattern of relief and drainage in the county. The section "General Soil Map" also helps to show how the general patterns of soils are related to the relief and drainage.

Agriculture is the principal enterprise, although zinc, lead, and coal are mined to some extent. A plant where woolen fabrics are manufactured is also located in the county.

General Soil Map

In a county or other large tract, it is easy to see differences as one travels from place to place. There are differences in the steepness, length, and shape of slopes; in the size and speed of the streams; in the kinds of native plants; and in the ways the soils are farmed or otherwise used. Along with the differences that are easy to see, there are many differences in the kinds of soils. The characteristics of the soils influence the kind of farming and other uses that can be made of the land.

After studying the soils and the way they are arranged, it is possible to make a general map that shows the principal patterns, or associations, of soils. Such a map is shown in figure 3.

As a rule, a general soil area, or soil association, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform. The soils within any one association are likely to differ greatly among themselves in some properties, for example, in slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but a pattern that has in it several kinds of different soils. Such a map is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the location of large areas suitable for a certain kind of farming or other land use.

In the following pages the soil associations in the county are described. Figures 4, 5, and 6 show some of the soil associations, or characteristic patterns of soils.

1. Winfield Association

Steep soils and soils on narrow, rounded ridgetops in the river-hill area

This association consists of steep, hilly areas in which there are ridges with narrow, rounded tops. It is in the northeastern part of the county, called the river-hill area.

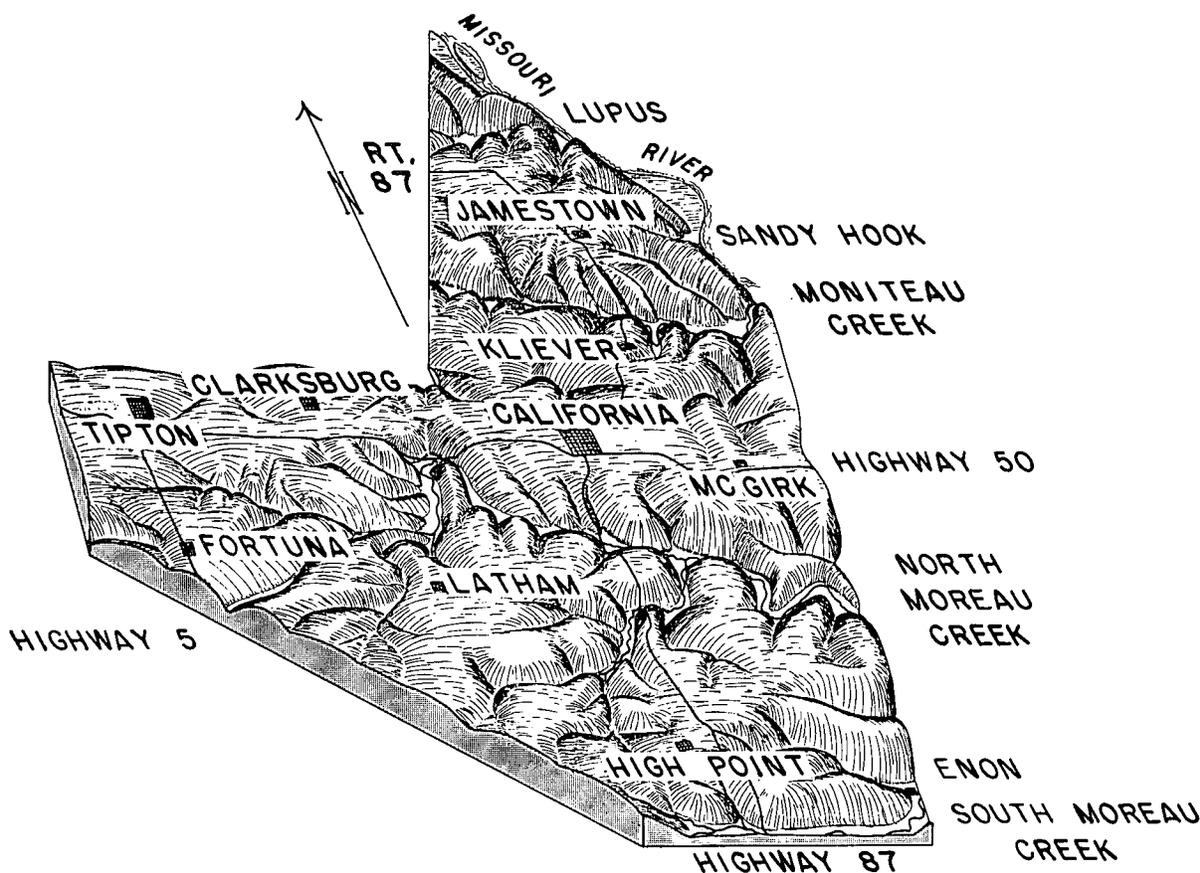


Figure 2.—Pattern of relief and drainage in the county.

Winfield soils make up most of the association. They formed in silty, windblown deposits, or loess, that is 10 feet or more thick. The original vegetation was forest, but most of the areas have now been cleared. The soils are light colored, moderately well drained, and moderately permeable.

The soils of this association respond well to good management, and they can be used to grow many different kinds of crops if erosion is controlled. Because of the hilly relief, however, only small fields on the narrow ridgetops can be tilled. Special crops, such as tobacco, fruit trees, and alfalfa, grow well. Pasture crops are grown successfully on the slopes.

2. Weldon-Weir Association

Light-colored, imperfectly drained soils on the broad, gently sloping interstream divide near Jamestown

Imperfectly drained soils in depressions and in nearly level or gently sloping areas, mainly on the top of the broad interstream divide near Jamestown, make up this association. The association consists of light-colored Weldon and Weir soils formed under forest. A typical landscape showing the relief and parent material and their relationship to the major soils in this association is shown in figure 4.

The soils of this association formed in loess that is typical of the river-hill areas. They have a subsoil of acid silty

Figure 3.—Soil associations in Moniteau County.

1. Winfield association: Steep soils and soils on narrow, rounded ridgetops in the river-hill area.
2. Weldon-Weir association: Light-colored, imperfectly drained soils on the broad, gently sloping interstream divide near Jamestown.
3. Union-McGirk-Bodine association: Light-colored soils in rolling to steep, dissected areas bordering creeks.
4. Bodine association: Cherty, sloping soils of forested areas.
5. Edina association: Gently sloping soils that have a grayish-brown to gray surface layer and a very dark gray claypan subsoil.
6. Seymour association: Dark-colored claypan soils that are sometimes excessively wet and are on the prairie near Tipton.
7. Craig-Glensted-Eldon association: Dark-colored soils that vary in depth over cherty material.
8. Onawa-Sarpy and Huntington-Lindsay associations: Bottom-land soils along the Missouri River and on the flood plains of creeks.

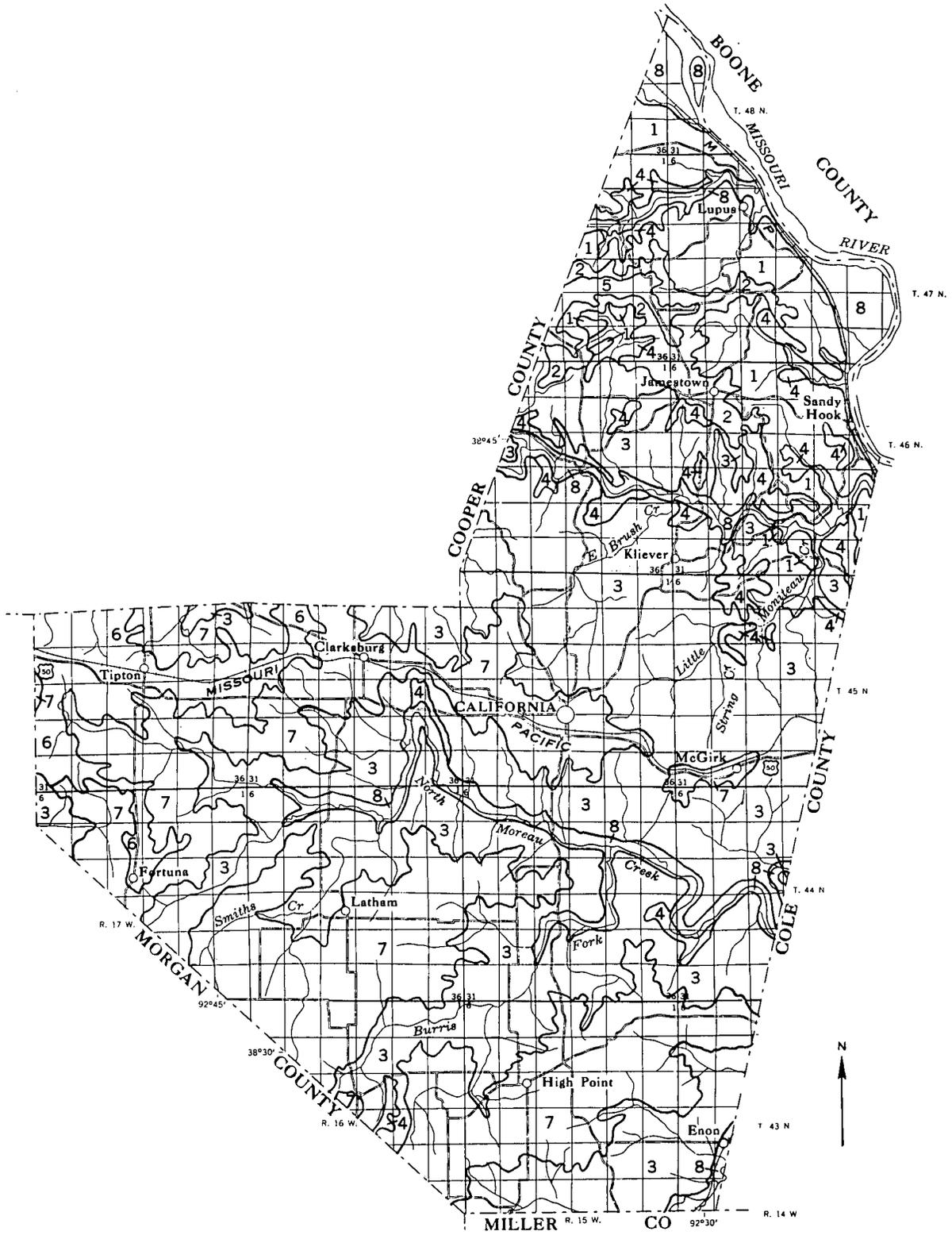


Figure 3.—Soil associations in Moniteau County—Continued

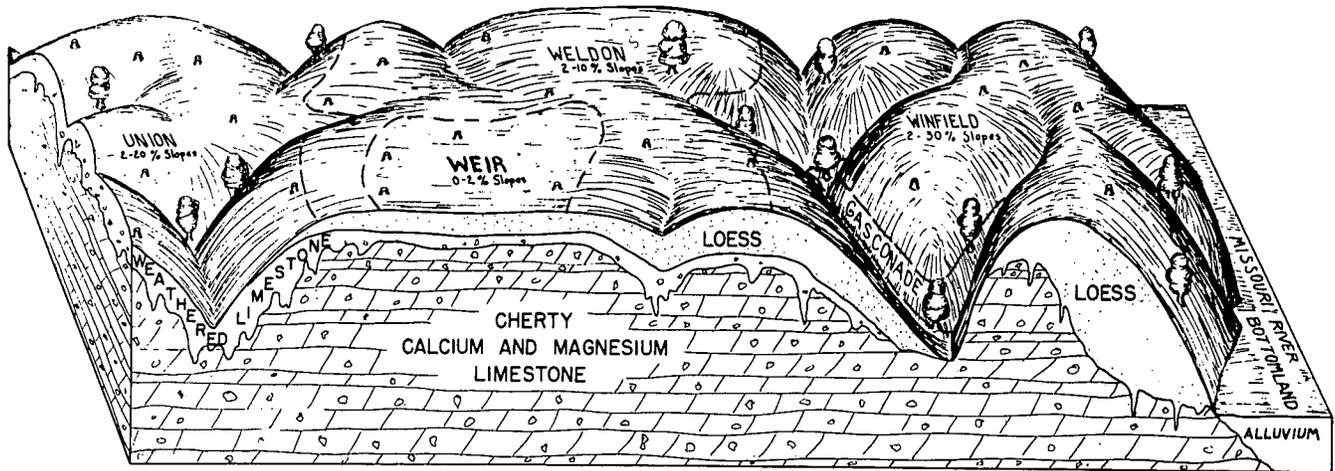


Figure 4.—Cross section of the river-hill area of northern Moniteau County showing the relationship of the slope and parent material to the major soils in association 2.

clay. The Weldon soils are gently sloping and are subject to some erosion if they are not protected. The Weir soils are in nearly level areas or in depressions, and they have poor surface drainage.

The nearly level or gently sloping relief favors cultivation. If the soils are cultivated, however, the Weldon soils need practices that control erosion and the Weir soils need drainage. The soils also need lime and fertilizer.

3. Union-McGirk-Bodine Association

Light-colored soils in rolling to steep, dissected areas bordering creeks

This association is made up of rolling to steep, dissected areas that border creeks. The principal soils are the Union, McGirk, and Bodine. These soils are light colored, and they formed in a mantle of loess that is only 1 to 4

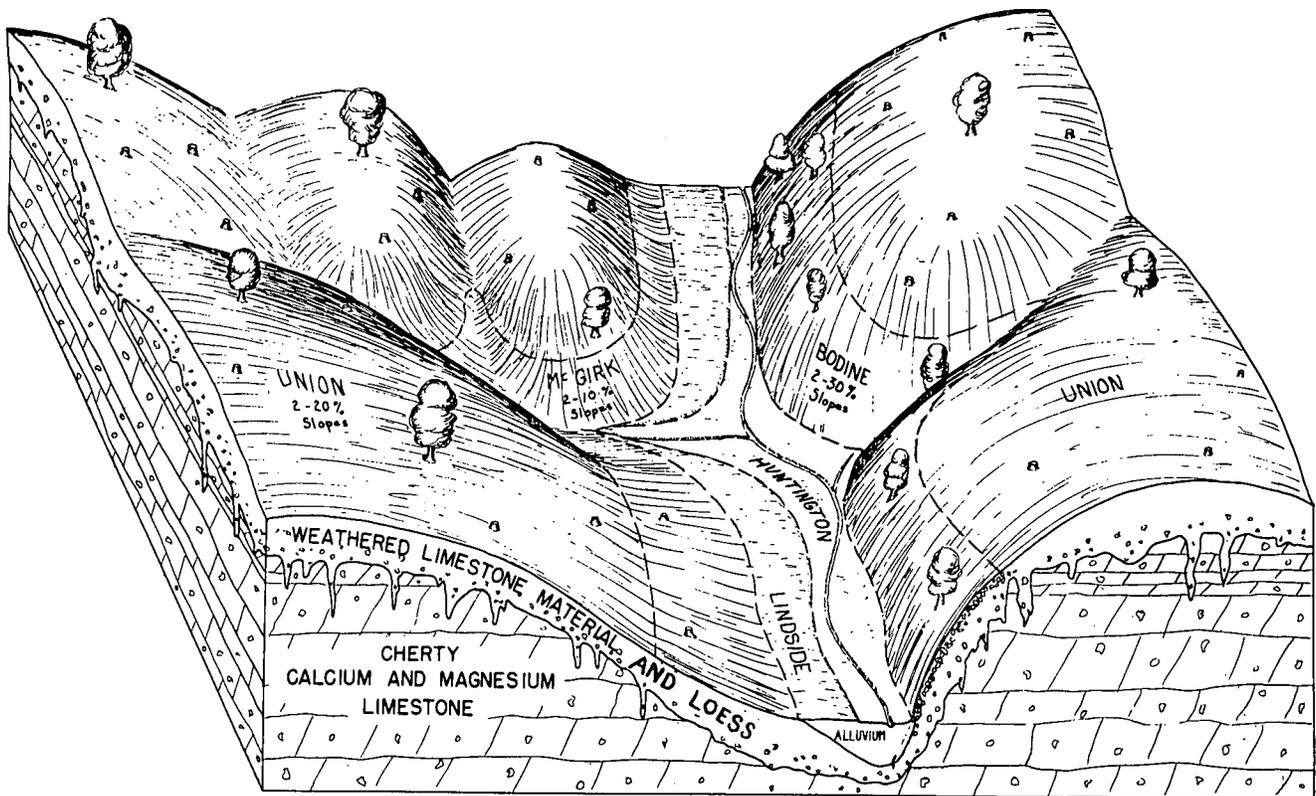


Figure 5.—Cross section of an area in association 3 showing the relationship of the slope and parent material to the major soils. This landscape is typical of areas in the central and southern parts of the county.

feet thick over weathered limestone. They developed under forest, but the forests have since been cleared. A typical landscape showing the relief and parent material and their relationship to the major soils is shown in figure 5. The Union, McGirk, and Bodine soils vary greatly. On many farms, however, all of these soils occur, and on the same farm there may also be soils of bottom lands.

The Union soils are the most extensive of the soils in this association. They are moderately well drained and are rolling. They have a compact layer, called a fragipan, in the lower part of the subsoil. If the Union soils are used for crops, they need fertilizer and require practices to control erosion. Pasture and small grains are their main use, but some row crops are grown.

The McGirk soils are mainly on the gentle slopes downslope from the Union soils. They are poorly drained. In many places a seep line is evident along the boundary between the McGirk and Union soils. Diversion channels or tile lines placed just upslope from the boundary between the McGirk and Union soils are sometimes used to prevent the McGirk soils from becoming excessively wet.

The Bodine soils occur only in steep areas. These soils are cherty and droughty, and they are mainly in trees.

4. Bodine Association

Cherty, sloping soils of forested areas

Cherty, sloping Bodine soils make up most of this association. The soils formed mainly in cherty and clayey material from weathered limestone or dolomite. The stones make the soils difficult to till and cause the available moisture capacity to be low. The soils are mainly in forest. They are commonly used to grow white oak, red oak, and walnut.

5. Edina Association

Gently sloping soils that have a grayish-brown to gray surface layer and a very dark gray claypan subsoil

This soil association is in the extreme eastern part of the prairie region, which has its center near Prairie Home in Cooper County. It is made up of gently sloping Edina soils, which have a grayish-brown to gray surface layer and a very dark gray claypan subsoil. The soils can be used for cultivated crops, but they need protection from erosion.

6. Seymour Association

Dark-colored claypan soils that are sometimes excessively wet and are on the prairie near Tipton

This association is made up of gently sloping Seymour soils, which are on the prairie near Tipton. The surface layer of these soils is dark silt loam. Their subsoil is acid and clayey. In areas that have not been eroded, it is at a depth of approximately 12 inches.

These soils can be used for crops if a complete fertilizer is added and if erosion is controlled. Practices to control erosion can be used because the slopes are long and gentle.

7. Craig-Glensted-Eldon Association

Dark-colored soils that vary in depth over cherty material

This association is in the western and southwestern parts of the county. It occupies large areas near High Point, Latham, Fortuna, and California. The association is made up mainly of dark-colored Craig, Glensted, and Eldon soils, which vary greatly in characteristics. The Craig soils lack a claypan. They have a cherty layer at a depth of about 20 inches, however, and they also contain a compact layer, or fragipan. The Glensted soils have a claypan subsoil and are often wet in spring. The Eldon soils are less extensive than the Craig and Glensted soils. They are important in the management of the surrounding soils, however, because their surface layer contains a large amount of chert, which makes these soils droughty and difficult to till. The pattern in which the Craig and Glensted soils generally occur is shown in figure 6.

8. Onawa-Sarpy and Huntington-Lindsay Associations

Bottom-land soils along the Missouri River and on the flood plains of creeks

The Onawa-Sarpy soil association occupies areas along the Missouri River. The soils in this association are among the most fertile soils of the county.

The Onawa soils have a surface layer of silty clay that has been deposited over a layer of silt loam or sandy loam. They are slightly wet and are poorly aerated, but they are highly productive of corn, wheat, and soybeans. Before crops can be grown, however, surface drainage must be provided in some areas. The Sarpy soils are sandy or loamy throughout. In general, they are well drained, but some of the more sandy spots are droughty. Alfalfa and corn grown on these soils make good yields.

The Huntington-Lindsay soil association is on the bottom lands of creeks. The Huntington soils are brown, well drained, and fertile. They are near the channels of creeks. The Lindsay soils are less well drained than the Huntington soils and are less fertile. In many places the positions they occupy are higher than those occupied by the Huntington soils. Excess wetness is a hazard.

How Soils Are Mapped and Classified

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those

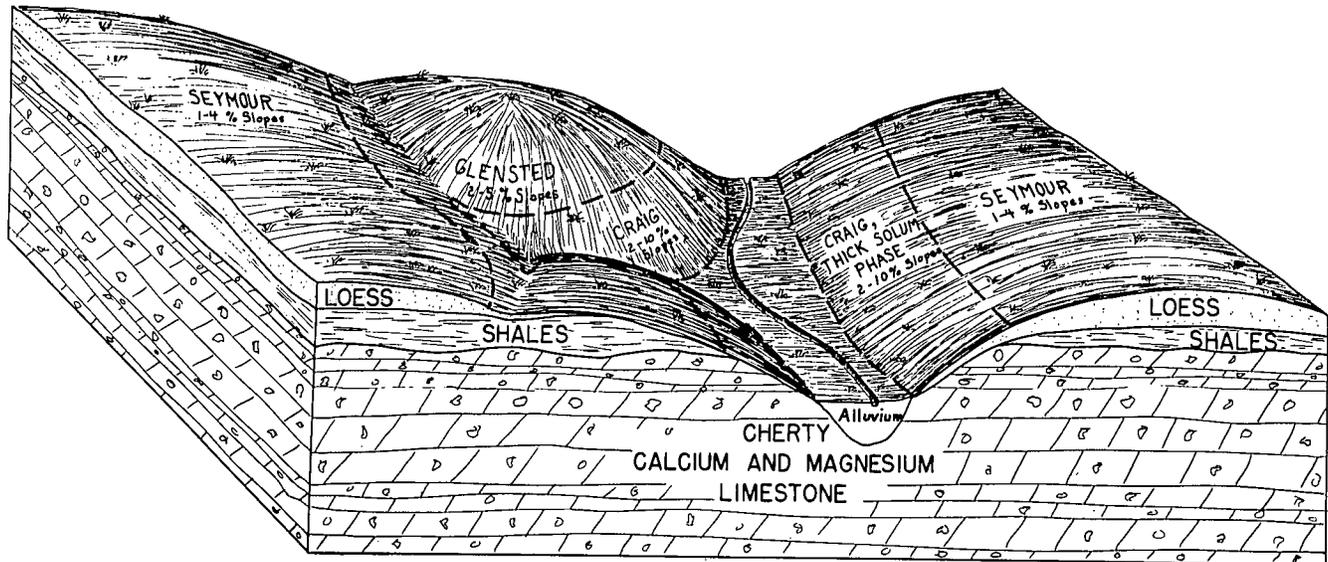


Figure 6.—Cross section of an area in association 7 showing the pattern in which the Craig and Glensted soils generally occur and also the relationship of the slope and parent material to some of the major soils developed under prairie.

in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, 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. Union and Seymour, for example, are the names of two soil series. All the soils in the United States having the same series names are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in the texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

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

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. In Moniteau County the soil types are divided into phases primarily on the basis of differences in slope and in degree of erosion because these differences affect management. For example, Union silt loam, 2 to 10 percent slopes, eroded, is one of several phases of Union silt loam, a soil type that ranges from nearly level to moderately steep.

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 (fig. 7). These photographs show woodland, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas that are so rocky, so shal-



Figure 7.—Soil boundaries are drawn on an aerial photograph by the soil scientist.

low, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Riverwash, and are called land types rather than soils.

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

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

Descriptions of the Soils

This section is provided for those who want detailed information about the soils in the county. It describes the individual soils, or mapping units; that is, the areas on the detailed soil map that are bounded by lines and identified by a symbol. For more general information about the soils, the reader can refer to the section "General Soil Map" in which the broad patterns of soils are described. The acreage and proportionate extent of each soil mapped in the county are given in table 1. Their location is shown on the soil map at the back of the report.

In the descriptions that follow, each soil series is first described, and then the soils in the series. The series description mentions features that apply to all of the soils it contains.

As a general rule, only one soil profile is described in detail for each series, and that profile is described under the first mapping unit of the series. The profile described is considered to be representative for all the soils in the series. The descriptions of the other soils in the series generally tell how their profiles differ from the one given as representative of the series.

In describing the profile a letter symbol, for example, "A1", was assigned to each of the various horizons, or layers. These letter symbols have a special meaning for soil scientists and others who make a special study of the soils. Most readers will need to remember only that all of the letter symbols beginning with "A" are surface soil;

those beginning with "B" are subsoil; those beginning with "C" are substratum, or parent material; and those beginning with "R" are bedrock.

The color of each horizon is described in words, such as yellowish brown, but it can also be indicated by symbols for the hue, value, and chroma, such as 10YR 5/4. These symbols, called Munsell color notations, are used by soil scientists to evaluate the color of the soil precisely. For the profiles described, the names of the colors and the color symbols are given for moist soil, unless stated otherwise.

Some of the terms used to describe the soils are defined in the section "How Soils Are Mapped and Classified." Others are defined in the Glossary at the back of this report.

Bewleyville Series

The Bewleyville soils in Moniteau County have a red subsoil that is underlain by cherty material derived from limestone. They formed in mixed material—the upper horizons in loess, and the lower horizons in material derived from limestone.

These soils are similar to soils in scattered areas in the Missouri Ozarks, in northern Arkansas, and in parts of Kentucky, Tennessee, and Indiana. They occur in small, scattered, sloping areas in association with the Union soils. The Bewleyville soils lack the fragipan that is typical of the Union soils, and they have a more reddish subsoil.

Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded (BeB2).—This is the only Bewleyville soil mapped in the county. All of it has been eroded to some extent, and there is a cherty layer at a depth of 40 inches or more. The cherty layer is not present in most Bewleyville soils outside this county, and for that reason this soil has been named as a shallow phase. The following describes a profile of this soil:

- Ap—0 to 7 inches, brown (10YR 5/3), very friable silt loam; weak, very fine, granular structure.
- B11—7 to 9 inches, brown (7.5YR 5/4), friable silt loam; weak, fine, granular structure.
- B12—9 to 12 inches, yellowish-red (5YR 5/6), friable silty clay loam; moderate, medium, subangular blocky structure.
- B2—12 to 18 inches, reddish-brown (5YR 5/4), slightly plastic silty clay loam; moderate, medium, subangular blocky structure.
- B3—18 to 40 inches, same as horizon just above but contains slightly more clay.

This soil is well suited to small grains, grasses, and clover. It can be used for most of the crops commonly grown in the area, however, if it is properly fertilized and protected from erosion. (Capability unit IIIe-6)

Bodine Series

The Bodine soils make up most of the acreage of forested, stony soils in this county. They consist of light-colored, cherty material to a depth of 24 to 30 inches (fig. 8), and below is red, plastic clay. The cherty layers are low in fertility. The red clay is nearer the surface than is typical for the Bodine soils in the Ozarks region, and for that reason the soils have been named as shallow over clay phases.

Chert, which makes cultivation difficult and lowers the available moisture-supplying capacity, has caused most of

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

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
BeB2	Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded	1, 296	0. 5	Rw	Riverwash	541	0. 2
BoB	Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes	2, 400	. 9	Sa	Sarpy fine sandy loam	1, 511	. 6
BoE	Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes	23, 095	8. 6	Sb	Sarpy loamy sand	887	. 3
BoF	Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes	159	. 1	Sc	Sarpy sand	1, 272	. 5
CaA	Chauncey silt loam, 0 to 1 percent slopes	4, 913	1. 8	SeA	Seymour silt loam, 0 to 2 percent slopes	1, 111	. 4
CgB	Craig silt loam, 2 to 10 percent slopes	7, 230	2. 7	SeB	Seymour silt loam, 2 to 5 percent slopes	8, 062	3. 0
CgB2	Craig silt loam, 2 to 10 percent slopes, eroded	9, 330	3. 5	SeB2	Seymour silt loam, 2 to 5 percent slopes, eroded	1, 770	. 7
CrB	Craig silt loam, thick solum phase, 3 to 7 percent slopes	1, 317	. 5	UnB2	Union silt loam, 2 to 10 percent slopes, eroded	42, 400	15. 7
CrB2	Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded	10, 063	3. 7	UnB3	Union silt loam, 2 to 10 percent slopes, severely eroded	1, 789	. 7
Dg	Dunning silt loam	7, 925	2. 9	UnC2	Union silt loam, 10 to 15 percent slopes, eroded	13, 226	4. 9
Du	Dunning silty clay	876	. 3	UnC3	Union silt loam, 10 to 15 percent slopes, severely eroded	2, 581	1. 0
EdB	Edina silt loam, 2 to 5 percent slopes	1, 891	. 7	UnD2	Union silt loam, 15 to 25 percent slopes, eroded	1, 526	. 6
EdB2	Edina silt loam, 2 to 5 percent slopes, eroded	240	. 1	UtB2	Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded	5, 243	1. 9
EnB	Eldon cherty loam, 2 to 10 percent slopes	3, 640	1. 3	UtC2	Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded	2, 836	1. 1
FrA	Freeburg silt loam, dark surface variant, 1 to 2 percent slopes	1, 169	. 4	We	Weir silt loam	5, 223	1. 9
FrB	Freeburg silt loam, dark surface variant, 2 to 10 percent slopes	1, 311	. 5	WdB2	Weldon silt loam, 2 to 10 percent slopes, eroded	340	. 1
GaB	Gasconade stony silty clay, 2 to 10 percent slopes	174	. 1	WfB2	Winfield silt loam, 2 to 10 percent slopes, eroded	5, 929	2. 2
GaE	Gasconade stony silty clay, 10 to 20 percent slopes	10, 480	3. 9	WfC2	Winfield silt loam, 10 to 15 percent slopes, eroded	2, 742	1. 0
GaF	Gasconade stony silty clay, 20 to 60 percent slopes	1, 123	. 4	WfD2	Winfield silt loam, 15 to 25 percent slopes, eroded	4, 792	1. 8
GsB	Glensted silt loam, 2 to 5 percent slopes	10, 123	3. 8	WfF2	Winfield silt loam, 25 to 40 percent slopes, eroded	347	. 1
GsB2	Glensted silt loam, 2 to 5 percent slopes, eroded	20, 290	7. 5	WtB	Winfield silt loam, terrace phase, 2 to 10 percent slopes	1, 322	. 5
Hu	Huntington silt loam	22, 774	8. 4	WtB2	Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded	1, 011	. 4
Ls	Lindside silt loam	8, 483	3. 1	WtC2	Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded	528	. 2
McB	McGirk silt loam, 2 to 5 percent slopes	1, 999	. 7		Total land area	267, 520	99. 3
McB2	McGirk silt loam, 2 to 5 percent slopes, eroded	4, 569	1. 7		Water	1, 920	. 7
Me	Melvin silt loam	1, 821	. 7		Total	269, 440	100. 0
On	Onawa silty clay	772	. 3				
RaA	Racoon silt loam, 1 to 2 percent slopes	1, 068	. 4				

the acreage to be left in native forest (fig. 9). The trees are mainly post oak, black oak, white oak, and hickory. The chert ranges from 1 inch to 10 inches in diameter. In many places it makes up more than 50 percent of the total volume of soil material to a depth of 30 inches. The layers of clay below a depth of 30 inches contain less chert.

Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes (BoB).—This soil has more gentle slopes than the other Bodine soils. The following describes a profile of this soil in the NW $\frac{1}{4}$, NW $\frac{1}{4}$ sec. 36, T. 43 N., R. 15 W.:

- A1—0 to 3 inches, dark grayish-brown (10YR 4/2), very friable coarse cherty silt loam; weak, fine, granular structure.
- AB—3 to 24 inches, pale-brown (10YR 6/3), very friable cherty silt loam; weak, fine, granular structure.
- BC—24 to 50 inches, red (2.5YR 4/8), plastic clay containing scattered fragments of chert; moderate, fine, subangular blocky structure.

This soil is medium acid to very strongly acid. The pH ranges from 4.8 to 5.8.

A small acreage of this soil has been cleared and is used to grow lespedeza for pasture or hay. Dry periods, however, generally cause the yields of forage to be greatly reduced. Second-growth stands of oak and hickory are the dominant vegetation on most of the acreage. Because of the hazard of drought, the yields of annual crops are likely to be low. Therefore, woodland is a desirable use of this soil. (Capability unit IVe-3)

Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes (BoE).—Most of this soil is in forests of native oak, and because of its strong slope, it should not be cleared. This soil is similar to Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes, but the steeper areas mapped include small areas of a shallow Gasconade soil. (Capability unit VIIe-3)



Figure 8.—A profile of a soil of the Bodine series. The rocks are chert, which resists weathering and remains after the limestone has completely weathered.



Figure 9.—A landscape showing Bodine and Union soils. The cherty Bodine soil in the background has been left in trees, but the stone-free Union soil has been cleared.

Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes (BoF).—This soil is steeper and more variable than Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes. Limestone or dolomite are also nearer the surface. As a result, this soil is more fertile and less acid than the less sloping soil, particularly below a depth of 30 inches.

This steep soil is more desirable for forest than the other Bodine soils. Its north- and east-facing slopes are particularly well suited to trees. The stand includes some walnut trees, but much of it is made up of white oak. The areas mapped include many small areas of a shallow Gasconade soil. (Capability unit VIIe-3)

Chauncey Series

The Chauncey soils are in small areas along small, meandering streams in parts of the county where Seymour and Glensted are the dominant soils of uplands. They are dark colored and formed under prairie. Their surface layer is thick and consists of dark grayish-brown silt loam. Their subsoil is clay or silty clay, similar to that of the Seymour and Glensted soils in surrounding areas of the uplands.

Water accumulates on the surface of the Chauncey soils. In addition, the lateral movement of ground water and the slow internal drainage cause these soils to be wet. Because they are wet, the soils have a gray, silty zone that contains concretions of iron and manganese, sometimes called buckshot.

Chauncey silt loam, 0 to 1 percent slopes (CaA).—This is the only Chauncey soil mapped in the county. The following describes a typical profile:

- A1—0 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, granular structure; pH 6.0.
- A2—24 to 30 inches, gray (10YR 5/1), very friable silt loam; weak, fine, granular structure; pH 5.0.

B2—30 to 40 inches, very dark gray (10YR 3/1), plastic clay or silty clay; weak, medium, subangular blocky structure; pH 4.6.

The thickness of the silty horizons ranges from 24 to 36 inches.

This soil is used mainly for pasture or is farmed along with the surrounding soils. If adequate drainage is provided, this soil can be made more productive than most of the surrounding soils of uplands. (Capability unit IIw-3)

Craig Series

The Craig soils are dark colored and occur in the prairie region. The A and B horizons, which make up the upper 2 feet of the soil material, formed in chert-free material presumed to be loess. The soil material below a depth of 2 feet was derived from cherty limestone (fig. 10.) It is



Figure 10.—A roadcut where a profile of a Craig silt loam is exposed. In this profile the abrupt boundary can be seen between the chert-free material and the cherty material derived from limestone.

cherty, compact silty clay loam in the upper part and cherty, plastic clay in the lower part. The abrupt boundary between the chert-free material and the cherty material and the characteristics of the cherty layers suggest that there is a layer, formerly the surface layer of an old, buried soil, at the point of contact between the two kinds of soil material.

The Craig soils are easy to till, and they normally dry out earlier in spring than do the associated Glensted soils. Crops grown on them make good yields during wet seasons. Because of the cherty substratum, however, yields are low in dry seasons. Erosion is a major hazard on these soils.

Craig silt loam, 2 to 10 percent slopes (CgB).—This soil is only slightly eroded. Its surface layer is nearly 1 foot thick and is very dark brown silt loam. The subsoil is grayish-brown to yellowish-brown silty clay loam. The following describes a profile of this soil:

A1—0 to 11 inches, very dark brown (10YR 2/2), friable silt loam; moderate, medium, granular structure; pH 5.3.

AB—11 to 15 inches, very dark grayish-brown (10YR 3/2), slightly plastic silty clay loam; moderate, medium, granular structure; pH 5.2.

B2—15 to 18 inches, dark yellowish-brown (10YR 4/4), slightly plastic silty clay loam; moderate, medium, subangular blocky structure; pH 4.6.

B3x—18 to 24 inches, dark yellowish-brown (10YR 4/4) cherty silty clay loam that is weakly cemented and brittle when dry; has some gray streaks and mottles.

IIBb—24 to 36 inches, dark yellowish-brown (10YR 4/4) cherty silty clay with some yellowish-red and gray mottles; content of chert approximately 50 percent, by volume, at a depth of 24 inches, and 20 percent at a depth of 36 inches.

In most areas the depth to the cherty layers is between 14 and 24 inches. The B3x horizon, or fragipan, is discontinuous. It is absent in many of the areas where the cherty layers are closest to the surface. When moist, the fragipan is friable and can be penetrated by roots, but it is brittle when dry. The fragipan is less distinct in these soils than in many of the soils of the Missouri Ozarks.

Practices to control erosion are desirable if cultivated crops are grown on this soil. The surface layer retains a large amount of water available to plants, but the cherty layers retain much less water. Thus, if much of the surface layer is lost through erosion, this soil will become a great deal more droughty.

Wheat and corn can be grown successfully on this soil if practices are used to control erosion. However, corn or pasture grasses are likely to be damaged by lack of moisture. (Capability unit IIIe-2).

Craig silt loam, 2 to 10 percent slopes, eroded (CgB2).—The profile of this soil is similar to that of Craig silt loam, 2 to 10 percent slopes. Because of erosion, however, the present surface layer consists of a mixture of material from the former surface layer and the subsoil. Also, the cherty substratum is only 8 to 18 inches from the surface.

This soil is droughty and low in plant nutrients. If it is cultivated, it continues to erode unless it is protected. Wheat grown on it makes good yields if it is properly fertilized because it matures before the normal dry periods in summer. Pasture grasses are likely to make only low yields during dry periods, but they make good yields if they are fertilized and are not overgrazed during July and August. (Capability unit IVe-3)

Craig silt loam, thick solum phase, 3 to 7 percent slopes (CrB).—The profile of this soil is similar to that of Craig silt loam, 2 to 10 percent slopes, but the cherty substratum is more than 30 inches below the surface. Also, the lower part of the subsoil is more clayey and has more gray mottles, particularly below a depth of 18 inches. Scattered fragments of chert occur below a depth of 40 inches. The following describes a profile of this soil:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2), friable silt loam; moderate, medium, granular structure.

A3—8 to 12 inches, dark yellowish-brown (10YR 4/4), slightly plastic silty clay loam; moderate, medium, granular structure.

B1—12 to 16 inches, dark yellowish-brown (10YR 4/4), slightly plastic silty clay loam; some reddish-brown (2.5YR 4/3) mottles; moderate, medium, subangular blocky structure.

B2—16 to 24 inches, grayish-brown (10YR 5/2), plastic silty clay or silty clay loam; many, small, reddish-brown (2.5YR 4/3) mottles.

B3x—24 to 40 inches, dark-gray (10YR 4/1) silty clay loam; 30 percent mottled with yellowish brown (10YR 5/6);

brittle when dry, but friable when moist; gray colors in tongues and cracks around large prisms.

In many places very cherty material is only 30 inches below the surface.

This soil is well drained and is easy to till. It responds well to fertilizer and has a greater capacity for storing moisture available for plants than the Craig soils that have a thinner solum. This soil needs to be protected from erosion, for if eroded, it will be droughty. It is suited to corn, small grains, and pasture grasses. (Capability unit IIIe-2)

Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded (CrB2).—Because of erosion, this soil has only 3 to 6 inches of dark surface soil remaining over the brownish subsoil and fragipan. Loss of part of the surface soil has resulted in loss of fertility because the subsoil and fragipan are very acid and are much less fertile than the surface soil. The capacity for storing water is much lower than in Craig silt loam, thick solum phase, 3 to 7 percent slopes. Larger amounts of lime and fertilizer are also required for crops to make satisfactory yields, and corn and pasture grasses are more likely to be damaged by drought. (Capability unit IIIe-2)

Dunning Series

The Dunning series consists of dark, imperfectly drained or poorly drained soils in scattered areas of bottom lands. The soils are along all the streams in the county, except the Missouri River. Some areas are on low bottoms along small streams that flow through the prairie region, but others are on high bottoms along the larger streams.

These soils have been influenced by sediments derived from limestone or by seep water that flows from areas underlain by limestone. The texture of their surface layer ranges from silt loam to silty clay or clay. Natural fertility is moderate to high, but drainage and aeration are restricted, particularly in some of the areas where the surface layer is clayey.

Dunning silt loam (Dg).—The surface layer of this soil is black or very dark brown silt loam that is 12 or more inches thick. The material in the surface layer grades to that in the subsoil, which is dark-gray, plastic silty clay loam or silty clay. The following describes a profile of this soil in the NW $\frac{1}{4}$ -NW $\frac{1}{4}$ sec. 8, T. 44 N., R. 17 W.:

- A1—0 to 12 inches, black (10YR 2/1), friable silt loam; well-developed, fine, granular structure.
- B1g—12 to 20 inches, very dark gray (10YR 3/1), slightly plastic silty clay loam; moderate, fine, blocky structure.
- B2g—20 to 42 inches, very dark gray (10YR 3/1), plastic silty clay loam or silty clay with a few, fine, brown mottles.

The dark-gray color of the subsoil is an indication of restricted aeration.

Included in some of the areas mapped along small streams is a soil that has a subsoil of very dark brown (10YR 2/2) silty clay loam. This included soil is better aerated than Dunning silt loam, and it is more desirable for crops.

Much of Dunning silt loam requires surface drainage or protection from runoff from the adjacent uplands. If this soil is drained and is protected from runoff, good

yields of corn, wheat, soybeans; and grass are obtained. (Capability unit IIw-1a)

Dunning silty clay (Du).—Like Dunning silt loam, this soil has a thick, dark-gray surface layer over a dark-gray subsoil, but its texture is more clayey throughout. The following describes a profile of this soil in the SE $\frac{1}{4}$ -SW $\frac{1}{4}$ sec. 28, T. 46 N., R. 14 W.:

- A1—0 to 25 inches, very dark gray (10YR 3/1), plastic silty clay; moderate, medium, granular structure; pH 6.0.
- Bg—25 to 40 inches, dark-gray (10YR 4/1), plastic silty clay; pH 6.5.

Aeration is restricted in this soil, and surface drainage is needed to remove excess water. Soybeans, wheat, and plants grown for pasture are the best adapted crops. Cultivation is difficult because of wetness and the clayey texture of the plow layer. (Capability unit IIIw-14)

Edina Series

The Edina series is made up of moderately dark colored soils formed in loess. The soils are mainly on the broad, gently sloping ridge near Jamestown, but some small areas are near Tipton. These soils are associated with the lighter colored Weldon soils, which also formed in loess. The areas near Tipton are associated with the Seymour soils. Where they are associated with the Seymour soils, the Edina soils are in nearly level areas or in depressions, and the Seymour soils are in gently sloping areas.

The Edina soils have a surface layer of silt loam. Their subsurface layer, or A2 horizon, is silty and is grayer than that of the Seymour soils. A very dark gray claypan subsoil, 12 to 20 inches thick, underlies the A2 horizon.

Edina silt loam, 2 to 5 percent slopes (EdB).—This moderately dark colored soil formed in loess. The following describes a profile of this soil:

- A1—0 to 8 inches, very dark grayish-brown (10YR 3/2), friable silt loam; moderate, medium, granular structure; pH 5.6.
- A2—8 to 13 inches, gray (10YR 5/1), very friable silt loam; weak, granular structure; pH 5.4.
- B2—13 to 27 inches, very dark gray (10YR 3/1), plastic clay; weak, medium, subangular blocky structure; some yellowish-brown mottles; pH 5.2.
- B3—27 to 37 inches, grayish-brown (10YR 5/2), plastic silty clay loam or silty clay mottled with yellowish brown (10YR 5/4); pH 4.8.

In areas of this soil near Jamestown, the surface layer is dark grayish brown (10YR 4/2), or slightly more grayish than the one in the profile described. The A2 horizon is also thicker than the one in the profile described.

This soil is easy to till and is well suited to small grains, soybeans, and grass. The areas near Jamestown are susceptible to erosion, but some of the areas near Tipton are less sloping and are less likely to be eroded. The nearly level areas near Tipton need surface drainage in places. (Capability unit IIIe-5)

Edina silt loam, 2 to 5 percent slopes, eroded (EdB2).—This eroded soil is near Jamestown. It has only 6 to 8 inches of the original silty surface layer remaining over the claypan subsoil. Because of this loss of soil material, this soil has lost much of its organic matter and supply of plant nutrients. In addition, the available moisture capacity is lower than it formerly was. Small grains and grasses are adapted crops. (Capability unit IVe-5)

Eldon Series

The Eldon series consists of dark, cherty soils in small, scattered areas throughout the prairie region. The surface layer is dark cherty silt loam, and the subsoil is red cherty clay.

The layer of chert that underlies the Eldon soils can be traced laterally. It is also in the lower part of the subsoil of the Craig soils, which are associated with the Eldon soils, and in some other soils. Even where this cherty layer is in the lower part of the subsoil, as in the Craig soils, it is underlain by red cherty clay. It appears that this cherty layer once lay just below the surface layer of an old, sloping soil. The old soil was later buried when loess was deposited on the areas. The loess was reworked by water and became the present surface layer and the old, buried surface layer became the sub-surface layer. Only where the old soil was not buried or has subsequently been uncovered by erosion are the soils mapped as Eldon soils.

The Eldon soils differ from the associated Craig soils in having chert in the surface layer. They also lack the weakly developed fragipan that is typical of the Craig soils.

The Eldon soils are droughty and are susceptible to erosion. The natural vegetation consists of bluestem, sumac, persimmon, and other plants adapted to dry sites. Few of the areas have been cultivated, and part of the natural vegetation has been preserved in most areas.

Eldon cherty loam, 2 to 10 percent slopes (EnB).—This is the only Eldon soil mapped in the county. It is only slightly eroded. The following describes a profile in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 44 N., R. 17 W.:

- A1—0 to 11 inches, very dark grayish-brown (10YR 3/2), very friable cherty loam; moderate, fine, granular structure; pH 5.4.
- A3—11 to 18 inches, brown (10YR 4/3), friable very cherty clay loam; moderate, fine, granular structure; pH 5.2.
- B21—18 to 25 inches, red (2.5YR 4/6), plastic cherty clay; moderate, fine, subangular blocky structure; pH 4.7.
- B22—25 to 46 inches, red (2.5YR 4/8), plastic cherty clay; very weak aggregation; pH 4.7.

The fragments of chert range from 1 inch to 6 inches in diameter. In many places they make up more than half of the soil material.

In the areas mapped are small areas of an included soil in which the surface layer is silt loam. In the included areas the soil material is free of chert to a depth of 12 inches.

Eldon cherty loam, 2 to 10 percent slopes, is droughty and is difficult to till. Pasture and meadow crops are well adapted. Bunch grasses, which tolerate drought, are better suited than other plants. (Capability unit IVe-3)

Freeburg Series

In this county the soils mapped as Freeburg soils are variants from the Freeburg series. Their surface layer is moderately dark colored, or darker than that of the typical Freeburg soils. These soils are on stream terraces, or high bottoms. They are somewhat similar to the Racoon soils, which are grayish colored and are also on stream terraces, but they are better aerated and are more fertile.

Freeburg silt loam, dark surface variant, 1 to 2 percent slopes (FrA).—This nearly level soil is not subject to

flooding. Runoff from the surrounding uplands is a problem in some places, however, because it accumulates and stands on the surface. The following describes a profile in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29, T. 44 N., R. 16 W.:

- A1—0 to 10 inches, very dark grayish-brown (10YR 3/2), friable silt loam; weak, fine, granular structure; pH 4.6.
- A2—10 to 20 inches, gray (10YR 5/1), friable silt loam; weak, fine, granular structure; pH 4.6.
- B21—20 to 36 inches, very dark gray (10YR 3/1) silty clay with a few small mottles of yellowish brown; weak, fine, subangular blocky structure; pH 4.6.
- B22—36 to 42 inches, same as the B21 horizon but contains more clay.

The color of the A1 horizon ranges from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2). The texture of the subsoil ranges from silty clay loam to silty clay.

Some areas of this soil require surface drainage or protection from runoff water from the adjacent uplands. This soil is poorly aerated, and the excess water makes it even less well aerated and less productive. Corn, wheat, soybeans, and legumes can be grown successfully if the soil is drained and protected from runoff. (Capability unit IIw-1a)

Freeburg silt loam, dark surface variant, 2 to 10 percent slopes (FrB).—This soil occupies short slopes between Freeburg silt loam, dark surface variant, 1 to 2 percent slopes, and the bottom lands, which, in most places, are several feet below the soils on stream terraces. This soil is suited to the same crops as Freeburg silt loam, dark surface variant, 1 to 2 percent slopes, and it is similar to that soil. However, it lacks a gray, silty layer just above the subsoil. Unlike the less sloping Freeburg soil, this soil needs protection from erosion rather than drainage and improvements in aeration. (Capability unit IIIe-6)

Gasconade Series

The Gasconade series is made up of very dark soils that are shallow over limestone (fig. 11). In most places limestone is at a depth of only 6 to 18 inches. The soil ma-



Figure 11.—A roadcut through a Gasconade stony silty clay. The larger rocks are limestone. Some of the smaller rocks are chert.

terial above the limestone is black or very dark brown silty clay that contains fragments of chert and limestone. In many places ledges of limestone outcrop, but in other places limestone is at a depth of as much as 30 inches. The limestone is of two kinds. Limestone occurs at some of the higher elevations, but calcium-magnesium limestone, or dolomitic limestone, underlies most areas at the lower elevations.

Gasconade stony silty clay, 2 to 10 percent slopes (G_sB).—This soil is dark colored and is shallow over limestone. In places limestone ledges outcrop. The following describes a profile of this soil:

- A1—0 to 7 inches, very dark brown (10YR 2/2) stony or cherty silty clay; strong, fine, granular structure; pH 7.2.
- R—7 inches +, cherty limestone with the cracks filled with silty clay of various colors; the clay is mainly dark reddish brown (5YR 3/4); pH 7.5.

Included in the mapped areas of this soil is a soil that has a profile similar to the following:

- A1—0 to 8 inches, very dark brown (10YR 2/2) stony silty clay; strong, fine, granular structure.
- B2—8 to 15 inches, dark reddish-brown (5YR 3/4) cherty silty clay.
- R1—15 to 17 inches, partly decomposed limestone that has a sandy texture; the sand was derived mainly from the limestone, and some grains are coated with clay.
- R2—17 inches +, cherty limestone.

Gasconade stony silty clay, 2 to 10 percent slopes, is fertile, but its capacity is limited for storing moisture available for plants. The content of stone prevents cultivation. Therefore, pastures and woodlots are the principal uses. The pastures are poor if dry periods last for 2 weeks or longer in summer. Post oak, blackjack oak, and cedar are the dominant trees in the woodlots. Cedar thrives if competing oaks are removed. (Capability unit VI_s-6)

Gasconade stony silty clay, 10 to 20 percent slopes (G_sE).—This dry, sloping soil is similar to Gasconade stony silty clay, 2 to 10 percent slopes. Pastures are hard to manage on this soil, however, and most of the acreage is in trees. The production of cedars is a feasible use. (Capability unit VI_s-6)

Gasconade stony silty clay, 20 to 60 percent slopes (G_sF).—This steep soil occupies many of the bluffs along the major streams. A large part of the acreage is made up of limestone or of outcrops of dolomite, and there is soil material only in the cracks between the rocks. In many places at the base of the slopes where soil material has accumulated, this soil is as much as 18 inches deep over limestone. (Capability unit VII_s-6)

Glensted Series

This series is made up of dark, gently sloping claypan soils formed in mixed parent material. Loess dominates the uppermost 30 inches of the soil material. Below that is shaly or cherty material. Many of the slopes surrounding these soils are occupied by cherty Craig or Eldon soils.

The Glensted soils are similar to the Seymour soils, which formed in loess on the prairie near Tipton. The scattered, fine chert in the profile of the Glensted soils, however, and the evidence of shale indicate that the parent material consisted of some material other than loess. The Glensted soils are naturally less productive than the Sey-

mour soils, largely because the lower part of their subsoil is less fertile.

Glensted silt loam, 2 to 5 percent slopes (G_sB).—This soil is only slightly eroded and has approximately 10 inches of silty soil material over the clayey subsoil. The surface layer is very dark grayish brown and is 7 inches thick. It is underlain by a subsurface layer, or A₂ horizon, of grayish-brown silt loam. The following describes a profile of this soil:

- A1—0 to 7 inches, very dark grayish-brown (10YR 3/2), friable silt loam; moderate, medium, granular structure; pH 4.8.
- A2—7 to 10 inches, dark grayish-brown (10YR 4/2), friable silt loam; weak, medium, granular structure; pH 4.6.
- B21—10 to 16 inches, dark-gray (10YR 4/1), very plastic silty clay; moderate, medium, subangular blocky structure; many, fine, dark-red mottles; pH 4.4.
- B22—16 to 24 inches, dark-gray (10YR 4/1), very plastic silty clay with fine mottles of yellowish brown and red.
- B3—24 to 40 inches, mottled gray (10YR 5/1) and yellowish-brown (10YR 5/6), slightly plastic silty clay loam; contains some very fine fragments of chert.

The friable surface layer, moderate fertility, and gentle slopes make this soil desirable for cultivated crops. The claypan subsoil, however, is less fertile than the surface layer. It also stores less moisture available for plants and has poorer tilth. Corn, soybeans, and wheat are the principal crops. Practices are needed to control erosion on the long, gentle slopes. (Capability unit III_e-5)

Glensted silt loam, 2 to 5 percent slopes, eroded (G_sB2).—In this eroded soil only the plow layer remains over the claypan subsoil. In some places silty clay is exposed at the surface. The surface layer is lighter colored than that in areas that are less eroded. It is dark grayish brown (10YR 4/2).

Corn, wheat, soybeans, or grasses and legumes for pasture can be grown if terraces are used to protect this soil from further erosion. The soil is less fertile than the uneroded soil, and its capacity for storing moisture available for plants is lower. Even though larger amounts of fertilizer are used on this soil than on the uneroded soil, yields are generally lower. (Capability unit IV_e-5)

Huntington Series

The Huntington series is made up of dark-brown, well-drained, fertile soils of bottom lands. The soils are along the major creeks in the county. They were formed in recent sediments washed from uplands where the soils formed in loess or in material from limestone. In most areas these soils consist of silt loam to a depth of more than 3 feet, but in places they contain strata of sandy material, particularly in the areas adjacent to creeks.

Huntington silt loam (H_u).—This is the only Huntington soil mapped in the county. The following describes a profile in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T. 44 N., R. 14 W.:

- A1—0 to 14 inches, very dark grayish-brown (10YR 3/2), friable silt loam; moderate, fine, granular structure.
- C—14 to 42 inches, dark-brown (10YR 3/3), friable silt loam; moderate, fine, granular structure.

This soil is generally slightly acid or neutral. The pH ranges from 6.1 to 7.2.

This soil is well suited to a number of different crops including corn and alfalfa. The silt loam texture and the granular structure in the upper part of the profile cause this soil to have high available moisture-holding capacity.

The recent sediments are not highly leached, and the soil, therefore, contains a large amount of plant nutrients. A fertilizer high in nitrogen benefits corn, but other kinds of fertilizer are not consistently beneficial. In some low areas along the terraces, crops may be damaged slightly by flooding. The floodwaters normally do not remain long and do not seriously curtail the yields of crops. (Capability unit I-1)

Lindside Series

The Lindside series is made up of imperfectly drained, brown soils on high bottoms along creeks and in swales or in old stream channels. The soils are normally adjacent to areas of Huntington soils. Their surface layer is lighter brown than that of the Huntington soils, and their subsoil is more mottled or more grayish, indicating poor aeration. The Lindside soils are more acid and less fertile than the Huntington soils.

Lindside silt loam (Ls).—This is the only Lindside soil mapped in the county. The following describes a profile in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 14, T. 44 N., R. 17 W.:

- A1—0 to 10 inches, brown (10YR 4/2.5), friable silt loam; weak, fine, granular structure; pH 6.4.
- C1—10 to 18 inches, grayish-brown (10YR 5/2), friable silt loam; weak, fine, granular structure; pH 5.4.
- C2—18 to 36 inches, pale-brown (10YR 6/2.5), friable silt loam; pH 5.4.
- C3—36 to 44 inches, dark grayish-brown (10YR 4/2) silty clay loam; weak, fine, granular aggregates coated with light brownish gray (10YR 6/2); pH 5.4.

These soils are less productive than the Huntington soils, but they are used in the same way, mainly to grow corn, soybeans, and other cultivated crops. Some areas need protection from overflow. In many places poor surface drainage may restrict the growing of crops to some extent. Lime is not generally applied, but it is slightly beneficial. Corn is responsive to nitrogen, phosphate, and potash. (Capability unit IIw-1a)

McGirk Series

The McGirk series is made up of gray, acid soils at the base of slopes. Because of poor drainage, these soils have a subsoil that is much like a claypan. Their surface layer is gray silt loam.

The principal material in which these soils formed is probably colluvium and alluvium that fell or was washed from the adjoining slopes. In places, however, reworked loess may also be included in the parent material. These soils are generally downslope from the Union soils. They are poorly drained because they receive seep water and runoff from the Union soils.

The McGirk soils are susceptible to erosion. Wetness is also a hazard.

McGirk silt loam, 2 to 5 percent slopes (McB).—This soil has not been damaged appreciably by erosion. The following describes a profile in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 20, T. 45 N., R. 14 W.:

- Ap—0 to 6 inches, light brownish-gray (10YR 6/2), very friable silt loam containing small concretions of iron and manganese, called buckshot.
- A2—6 to 14 inches, light brownish-gray (10YR 6/2), very friable silt loam with weak, fine, granular structure.
- B21—14 to 17 inches, dark grayish-brown (10YR 4/2), plastic silty clay; weak, medium, subangular blocky struc-

ture; surfaces of peds coated with white (10YR 8/2), silty material.

B22—17 to 38 inches, same as B21 horizon, except that white, silty coatings are lacking.

B3—38 to 50 inches, gray (10YR 6/1), plastic silty clay with many yellow mottles; nearly massive.

Low fertility, periodic wetness, and poor aeration associated with wetness are problems in areas of these soils. Because of their long, gentle slopes, these soils are desirable for cultivated crops, although erosion is a major hazard. A complete fertilizer is required for any cropping system that is used. The areas are well suited to improved pasture, but they can be used to grow wheat, soybeans, or possibly corn. Water from the adjacent hills needs to be diverted so that it does not flow onto this soil. (Capability unit IIIe-5)

McGirk silt loam, 2 to 5 percent slopes, eroded (McB2).—This soil has lost much of its original surface layer through erosion. The remaining silty surface layer is only about 6 inches thick, and it overlies plastic silty clay. This soil is not well suited to cultivated crops, and it is used mainly for pasture and meadow. Regardless of the kinds of crops that are grown, fertilizer is required. (Capability unit IVe-5)

Melvin Series

The Melvin series consists of gray, wet, poorly aerated, acid soils of bottom lands. The surface layer of these soils is silty. Their subsoil is silty clay loam. The Melvin soils in this county are generally more acid than those in many other areas. In most places the pH is between 4 and 5.

Melvin silt loam (Me).—This is the only Melvin soil mapped in the county. It is associated with the Huntington and Lindside soils, but it is much more grayish than those soils. The following describes a profile in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 46 N., R. 14 W.:

- 0 to 24 inches, light brownish-gray (10YR 6/2), very friable silt loam; weak structure.
- 24 to 45 inches, gray (10YR 5/1), slightly plastic silty clay loam.

In many places the depth to silty clay loam is as great as 36 inches.

Surface drainage is a major problem in managing this soil. Without drainage, the soil is suitable only for pasture or trees. Corn, soybeans, and wheat can be grown, however, if ditches are used to improve the drainage. (Capability unit IIIw-3)

Onawa Series

The Onawa series is made up of dark soils on the bottom lands of the Missouri River. These soils formed in material recently deposited by the river. The upper part of their profile is clayey, and the lower part is silty or sandy.

Onawa silty clay (On).—This is the only Onawa soil mapped in this county. It occurs in low areas in association with the Sarpy soils, but it is at a slightly lower elevation than those soils. Some areas are in long, narrow swales. The following describes a profile of this soil:

- 0 to 20 inches, dark-gray (10YR 4/1), plastic silty clay; moderate, medium, granular structure; neutral.
- 20 to 42 inches, dark grayish-brown (10YR 4/2), friable sandy loam; calcareous.

Variations in color and in texture are common in this soil, and the horizons also vary in thickness. The surface layer ranges from nearly black to dark gray or dark grayish brown in color and from silty clay or clay to clay loam in texture. It is 12 to 30 inches thick.

Poor drainage is a major problem in managing this soil. In addition, tillage is difficult because of the fine texture of the surface layer. Because this soil is nearly level, however, and is high in fertility, it is used extensively to grow field crops. Wheat, soybeans, and corn are adapted. (Capability unit IIw-1b)

Raccoon Series

Light-gray, acid, poorly drained soils on nearly level high bottoms or stream terraces make up the Raccoon series. These soils have a silty surface layer. They are somewhat similar to the Melvin soils, but they have a subsoil of plastic silty clay instead of silty clay loam.

Raccoon silt loam, 1 to 2 percent slopes (RcA).—This is the only Raccoon soil mapped in this county. The following describes a profile of this soil:

- A1—0 to 8 inches, light brownish-gray (10YR 6/2), very friable silt loam; weak, fine, granular structure; pH 5.5.
- A2—8 to 18 inches, light-gray (10YR 7/1), very friable silt loam; weak, fine, granular structure; pH 5.0.
- B21—18 to 30 inches, gray (10YR 5/1), plastic silty clay with

yellowish-brown mottles; weak, medium, subangular blocky structure; pH 5.0.

B22—30 to 45 inches, light brownish-gray (10YR 6/2), plastic silty clay with yellowish-brown mottles; pH 5.0.

Restricted drainage (fig. 12) and poor aeration are limiting factors in the use of this soil. The soil is also low in fertility. Ditches are needed to provide surface drainage, and lime and fertilizer are required for profitable yields. Pasture and meadow are the best adapted crops. Where other nearly level or gently sloping areas are not available for cultivation, however, this soil is used to grow soybeans or small grains. In some areas corn is grown. (Capability unit IIIw-3)

Riverwash (Rw)

Riverwash is a miscellaneous land type that occurs as sandbars along the Missouri River. The areas are flooded frequently. They have no agricultural value at the present time, but in the past many similar areas have received enough deposition to become valuable for agriculture. (Capability unit VIIIs-6)

Sarpy Series

The Sarpy series is made up of light-colored, sandy soils formed in recent alluvial deposits. The soils are



Figure 12.—A wet, dark-colored spot in a field of Raccoon silt loam. A ditch is needed to drain this area.

on the flood plains of the Missouri River. They lack distinct horizons and contain lenses or strata of various textures that were left by floodwaters in the past. These soils contain a large amount of mineral sediments. They vary in productivity, however, because of differences in their moisture-holding capacity. These differences were caused by differences in the content of sand. These soils are fertile and are well aerated.

Sarpy fine sandy loam (Sc).—This soil is sandy, but it has much silt and fine sand throughout the profile. Because of this finer textured material, the moisture-holding capacity is high. The following describes a profile of this soil:

0 to 42 inches, dark grayish-brown (10YR 4/2), friable fine sandy loam; neutral to calcareous.

In many areas there are lenses of silty clay, silt, or sand. In other areas, which have apparently been stable for a longer period, the surface layer is very dark grayish brown (10YR 3/2) and the subsoil is brown (10YR 5/3).

This soil can be used successfully for special crops, such as truck crops, that require intensive management and high yields for economic production. It has no major hazards, but infrequent flooding occurs in some low areas. This soil can be used continuously for corn or similar crops. In many places only nitrogen is required for high yields. (Capability unit I-1)

Sarpy loamy sand (Sb).—This soil is more sandy throughout than Sarpy fine sandy loam. It is similar in color and reaction to that soil, however, and it contains about the same amount of plant nutrients.

Its sandy texture is a serious handicap in using this soil for crops. The available moisture-holding capacity is less than half that of Sarpy fine sandy loam. Alfalfa makes good yields, but corn is likely to be damaged by dry weather. The soil can be irrigated, but frequent applications of water are necessary during dry periods. (Capability unit IIIs-4)

Sarpy sand (Sc).—This droughty soil is made up of loose, brownish-gray sand that extends to a depth of 3 feet or more. Floods occasionally deposit finer textured material on the areas, however, and this improves the soil for crops. Many of the areas have been left idle for a period of several years. Some willows and cottonwood trees grow on them. (Capability unit IVs-4)

Seymour Series

The Seymour series consists of dark, gently sloping soils in the prairie region near Tipton. The soils formed in loess that is more than 5 feet thick. The soils have a silty surface layer and a subsoil of dark-gray, acid silty clay.

Seymour silt loam, 0 to 2 percent slopes (SeA).—This soil is only slightly eroded. Therefore, in many places the A horizons combined are 12 or more inches thick. Although little erosion has taken place, the long, gentle slopes and the slowly permeable subsoil make this soil susceptible to erosion. Some of the areas are narrow, but they range from ½ mile to 1 mile in length. These areas, which are generally in the center of a broad, gently sloping ridge or divide, make up only a comparatively small part of the acreage. This soil is similar to the Edina soils, except that its A2 horizon is grayish brown rather than gray.

The following describes a profile in the SE¼SE¼ sec. 15, T. 45 N., R. 17 W.:

- A1—0 to 10 inches, very dark brown (10YR 2/2), friable silt loam; moderate, medium, granular structure; pH 5.4.
- A2—10 to 15 inches, grayish-brown (10YR 5/2), very friable silt loam; weak, fine, granular structure; pH 5.0.
- B21—15 to 27 inches, very dark gray (10YR 3/1), plastic silty clay with mottles of yellowish brown; weak, medium, subangular blocky structure with clay films on the surfaces of the peds; pH 4.8.
- B22—27 to 40 inches, mottled gray (10YR 5/1) and dark yellowish-brown (10YR 4/4), plastic silty clay with clay films on the vertical cleavage planes; pH 4.6.
- B3—40 to 50 inches, gray (10YR 6/1) heavy silty clay loam with mottles of yellowish brown; pH 5.6.

The chief variation in this soil is in the A2 horizon. In many places there are gray coatings on the darker colored material in that horizon.

The thick, dark surface layer and the favorable available moisture-holding capacity make this soil productive. Cultivated crops are grown on nearly all of the acreage. Susceptibility to erosion and slow surface and internal drainage are the main problems, but they do not interfere with using this soil to grow corn, wheat, or soybeans. (Capability unit IIIe-5)

Seymour silt loam, 2 to 5 percent slopes (SeB).—This soil is on broad, rounded ridges or on long slopes. Therefore, the hazard of erosion is greater than on Seymour silt loam, 0 to 2 percent slopes, and the surface layer is thinner than the one in that soil. This soil has been protected by vegetation or by terraces to the extent that the remaining surface layer is thicker than plow depth. The remaining A horizon has approximately 8 to 10 inches of silty material over the silty clay of the B2 horizon. The A2 horizon is less grayish than that in the profile described.

This soil is well suited to corn, wheat, and soybeans. If it is well managed, it is among the most productive soils in the county. Control of erosion and the addition of fertilizer will help to maintain the productivity of this soil. The prevention of further erosion is important because the subsoil is acid and plastic. The subsoil is far inferior to the surface layer for the growth of plants. At least half of the acreage has been terraced. (Capability unit IIIe-5)

Seymour silt loam, 2 to 5 percent slopes, eroded (SeB2).—The profile of this soil is similar to the one described for Seymour silt loam, 0 to 2 percent slopes. This soil has long, gentle slopes, however, and erosion has removed as much as 1 foot of the original surface layer. In the present surface layer, material from the subsoil is mixed with that of the original surface layer. In some places dark-gray, plastic, acid clay is only at plow depth below the surface. Fields of this soil appear patchy because the proportions of material from the original surface layer and the subsoil vary from place to place. Because of variations in the kind of soil material, yields are spotty.

Erosion is the main problem in managing this soil. Also, the capacity for storing moisture available for plants is about 20 percent less than in the uneroded or only slightly eroded Seymour soils. In addition, areas where the plow layer is made up largely of material from the subsoil are difficult to till. They need a large amount of fertilizer as compared to areas that are only slightly eroded.

Wheat, which generally matures before dry periods in summer, is better suited to this soil than corn or soybeans. Regardless of the crop that is grown, however, a complete fertilizer is required. Yields can be increased by adding fertilizer, but they will be lower than those on the well-managed, only slightly eroded Seymour soils. (Capability unit IVe-5)

Union Series

The Union soils are the most extensive of the soils in this county. They are light-colored soils formed in loess under forest vegetation on uplands. These soils formed in loess that is underlain by material weathered from cherty limestone. Their surface layer is light-colored silt loam, and their subsoil is yellowish-brown to reddish-brown silty clay. The soils have a fragipan just below the subsoil and above the material weathered from cherty limestone or dolomite. They have slopes of 2 to 25 percent.

Union silt loam, 2 to 10 percent slopes, eroded (UnB2).—This sloping soil is susceptible to further erosion if it is used for cultivated crops and is not protected. The following describes a profile in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 22, T. 45 N., R. 14 W.:

- Ap—0 to 6 inches, dark grayish-brown (10YR 4/2), friable silt loam; weak, fine, granular structure; pH 5.0.
- A2—6 to 8 inches, yellowish-brown (10YR 5/4), friable silt loam; weak, fine, granular structure; pH 5.0.
- B1—8 to 10 inches, yellowish-red (5YR 5/6), slightly plastic silty clay loam; moderate, fine, subangular blocky structure; pH 5.0.
- B2—10 to 21 inches, reddish-brown (5YR 4/4), slightly plastic silty clay loam; strong, fine, subangular blocky structure; pH 5.0.
- B31x—21 to 30 inches, yellowish-brown (10YR 5/6) silty clay loam mottled with light brownish gray (10YR 6/2); has gray, silty material in the cracks, which form a polygonal network; firm and compact.
- IIB32x—30 to 42 inches, similar to B31x horizon but contains scattered fragments of chert.

The soil material is more cherty at increasing depths. Depth to cherty red clay is variable. The clay is at a depth of only 30 inches in some places.

The B31x horizon is called a fragipan because it is so firm and compact. It is acid, infertile, and lower in capacity for storing moisture available for plants than the soil material above it. As a result, it contains only a few roots.

This soil must be terraced or other means of controlling erosion must be provided if satisfactory yields of cultivated crops are to be maintained. The fragipan and the underlying layers of cherty material cause this soil to be slightly droughty. In addition lime and a complete fertilizer are needed. If erosion is controlled and if lime is added and the proper kinds and amounts of fertilizer are applied, this soil is not too droughty for crops such as corn to be grown. Yields of wheat or grass, however, are more dependable than those of corn. (Capability unit IIIe-6)

Union silt loam, 2 to 10 percent slopes, severely eroded (UnB3).—This soil has slopes that are mild enough to permit tillage, but it has lost nearly all of the A horizon through erosion. Plowed fields appear patchy, and they have a color pattern of grayish brown, yellowish brown, and reddish brown, depending on the kind of soil material

exposed at that particular spot. Only about 1 foot of the yellowish-red subsoil remains over the fragipan.

This soil is better suited to hay crops, pasture, or wheat than to cultivated crops. It is low in fertility, and lime and fertilizer must be added for satisfactory yields to be maintained. (Capability unit IVe-6)

Union silt loam, 10 to 15 percent slopes, eroded (UnC2).—This soil has a profile similar to the one described for Union silt loam, 2 to 10 percent slopes, eroded. It is too steep for cultivation, however, although most of the areas have been cleared of native forest. This soil is probably best used for improved pasture. (Capability unit IVe-6)

Union silt loam, 10 to 15 percent slopes, severely eroded (UnC3).—This soil is too sloping for cultivated crops, and, in addition, it has lost most of the original surface layer through erosion. In at least half of the acreage, the present surface layer is reddish-brown silty clay loam from the subsoil. The fragipan is exposed in the sides of some gullies. This soil is probably best used for hay or pasture, but lime and fertilizer are necessary for either hay or pasture to be profitable. (Capability unit VIe-6)

Union silt loam, 15 to 25 percent slopes, eroded (UnD2).—This soil has a profile similar to the one described for Union silt loam, 2 to 10 percent slopes, eroded, but the fragipan is less well defined. The slopes are too steep for field crops to be grown regularly. This soil can be used for pasture, but management of the pasture is difficult. Growing wood crops is desirable, particularly if this soil has not been cleared previously. White oak and black oak are adapted. (Capability unit VIIe-6)

Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded (UtB2).—In this soil the surface layer and subsoil are similar to those described for Union silt loam, 2 to 10 percent slopes, eroded. The subsoil contains cherty layers, however, which are at a depth of 24 to 36 inches. In places as much as 60 percent, by volume, of the B31x horizon, or fragipan, is chert. In the upper part of this horizon, the material between the fragments of chert is silty clay loam, which grades to clay in the lower part of the horizon.

The mapped areas of this soil contain many areas of a soil that is similar to a Dickson soil. The Dickson soils are not mapped in Moniteau County.

Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded, is slightly droughty, low in fertility, and susceptible to further erosion. Corn can be grown on it, but wheat or other small grains that mature before the normal dry period in summer are better adapted. Hay or pasture crops can be grown, but the carrying capacity of pasture is low in July and August. (Capability unit IVe-6)

Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded (UtC2).—This soil has a profile similar to that of the other thin solum phases of the Union silt loams, but it is steeper than those soils. It is suited mainly to trees or to hay and pasture. (Capability unit VIIe-6)

Weir Series

The Weir series is made up of light-colored, nearly level soils, mainly in the vicinity of Jamestown. The soils are

locally called white land. They are generally surrounded by Weldon soils, which are on the adjacent gentle slopes.

Weir silt loam (We).—This is the only Weir soil mapped in this county. The following describes a profile in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 47 N., R. 14 W.:

- A1—0 to 9 inches, grayish-brown (10YR 5/2) silt loam; weak, fine, granular structure; pH 5.4.
- A2—9 to 24 inches, light brownish-gray (10YR 6/2), very friable silt loam containing many concretions of iron and manganese; pH 5.4.
- B1—24 to 28 inches, light brownish-gray (10YR 6/2) silty clay loam with a few, small mottles of yellowish brown; pH 4.2.
- B2—28 to 42 inches, gray (10YR 6/1), plastic silty clay mottled with yellowish brown; pH 4.2.

This soil is poorly aerated and is poorly drained. It is naturally very low in fertility, but it has a thick, silty surface layer and can be fertilized effectively and easily. Except in wet seasons, corn makes good yields if a complete fertilizer is added. Wheat and pastures yield well. (Capability unit IIIw-3)

Weldon Series

The Weldon series consists of light-colored, gently sloping soils that are in the northern part of the county. The Weldon soils, like the Winfield and Weir, formed in thick deposits of loess, associated with the bluffs and hills along the Missouri River. They have a pale-brown surface layer and a subsoil of gray, plastic silty clay. These soils are more acid than the Winfield soils, and they are less well drained.

Weldon silt loam, 2 to 10 percent slopes, eroded (WdB2).—This is the only Weldon soil mapped in this county, although many spots, too small to map, are eroded or severely eroded. The profile in the eroded areas differs from that of a typical uneroded Weldon soil in that the plow layer is directly underlain by the B2 and A horizon, which consists of yellowish-brown silty clay loam with grayish, silty coatings on the peds. The following describes a profile of an uneroded Weldon silt loam in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 13, T. 47 N., R. 15 W.:

- A1—0 to 8 inches, brown (10YR 5/3), very friable silt loam; weak, fine, granular structure; pH 5.0.
- A2—8 to 12 inches, pale-brown (10YR 6/3), very friable silt loam; weak, fine, granular structure; pH 5.0.
- B2—12 to 16 inches, yellowish-brown (10YR 5/4), slightly and A plastic silty clay loam; moderate, medium, subangular blocky structure; has light brownish-gray (10YR 6/2) silty coatings on the surfaces of peds; pH 5.0.
- B2—16 to 30 inches, grayish-brown (10YR 5/2), plastic silty clay mottled with yellowish brown (10YR 5/6); pH 5.0.
- B3—30 to 40 inches, same as B2 horizon, except that its texture is silty clay loam.
- C—40 inches, gray (10YR 5/1), slightly plastic silty clay loam.

If cultivated crops are grown on Weldon silt loam, 2 to 10 percent slopes, eroded, practices are necessary to control erosion. Terraces are required if corn and soybeans are grown. Lime and a complete fertilizer are required for all crops. This soil is less fertile and less well aerated than the Winfield soils. It is, therefore, less desirable than those soils for tobacco or alfalfa. (Capability unit IIIe-5)

Winfield Series

The Winfield series is made up of brown soils in an area approximately 6 miles wide that parallels the bluffs along the Missouri River. The soils, called river-hill soils, formed in a thick deposit of loess. The topography in this area is characterized by steep slopes that are separated by narrow ridges. Some of these steep slopes are still covered by the original forest of mixed hardwoods. Most of the ridgetops and many of the slopes, however, have been cleared and are farmed intensively.

The Winfield soils are moderately well drained. They are more fertile and better aerated than the associated Weldon soils, and they have a less clayey subsoil. They are more fertile than the Union soils, and they lack a fragipan.

Winfield silt loam, 2 to 10 percent slopes, eroded (WfB2).—This soil is mainly on narrow, rounded ridgetops. It is the only Winfield soil used to any extent for cultivated crops. The soil profile at the midpoint of the ridgetops has many ridges that show little evidence of erosion. The greatest part of each area, however, has been eroded until only 6 inches of the silt loam plow layer remains above the subsoil of silty clay loam. The following describes a profile of an uneroded Winfield silt loam at the midpoint of a ridgetop in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 8, T. 47 N., R. 14 W.:

- A1—0 to 5 inches, brown (10YR 4/3), friable silt loam; moderate, medium, granular structure; pH 6.2.
- A2—5 to 12 inches, yellowish-brown (10YR 5/4), friable silt loam; moderate, medium, granular structure; pH 6.0.
- B2—12 to 22 inches, brown (10YR 4/3), slightly plastic silty clay loam; moderate, medium, subangular blocky structure; pH 4.4.
- B3—22 to 40 inches, mottled gray (10YR 6/1) and brown (10YR 4/3), slightly plastic silty clay loam; moderate, medium, subangular blocky structure; pH 4.4.

This soil is well aerated and more fertile than most of the soils on uplands in the county. Therefore, corn, wheat, legumes, tobacco, and fruit trees can be grown successfully. Controlling erosion is an important problem. This can be done by terracing, but terraces are hard to construct on the narrow, rounded ridgetops. Some areas have been managed successfully by keeping them in a cover of permanent grass. Some lime and organic matter, nitrogen, and phosphate supply the main requirements for amendments. (Capability unit IIIe-6)

Winfield silt loam, 10 to 15 percent slopes, eroded (WfC2).—In most places this soil has a profile similar to that of Winfield silt loam, 2 to 10 percent slopes, eroded, and it generally lies below areas of that soil. It is too steep and there is too great a hazard of erosion for regular cultivation. This soil is probably best used to grow small grains, hay, or pasture crops, but the production of timber is desirable where the areas have not been cleared. (Capability unit IVe-6)

Winfield silt loam, 15 to 25 percent slopes, eroded (WfD2).—This soil has a profile similar to that of Winfield silt loam, 2 to 10 percent slopes, eroded, but it is so steep that it cannot be protected from severe erosion if it is cultivated. Pastures are difficult to manage, but this soil, except for its steep slopes, is desirable for pasture and can be managed successfully if used for that purpose.

Much of it is in forest, and, as a rule, it should not be cleared. The forests consist mainly of second-growth white oak, post oak, and black oak, but the stand is made up partly of walnut, hickory, and ash. (Capability unit VIe-6)

Winfield silt loam, 25 to 40 percent slopes, eroded (WfF2).—In spite of its steep slopes, this soil has a profile similar to the one described for Winfield silt loam, 2 to 10 percent slopes, eroded. This soil is more fertile and better aerated than the other steep soils in this county. It has potential for growing timber, and white oak, red oak, black oak, and walnut are the most desirable kinds of trees to grow. Most of the acreage is in second-growth forest. Some thinning and careful selection of the trees that will be harvested is necessary. (Capability unit VIIe-6)

Winfield silt loam, terrace phase, 2 to 10 percent slopes (WtB).—The profile of this soil is nearly identical to the one described under Winfield silt loam, 2 to 10 percent slopes, eroded. This soil is on loess-capped terraces that are at an elevation of 10 to 20 feet above the adjoining flood plains. Most of the areas are along Moniteau Creek near the bottom lands of the Missouri River. Some, however, are along other creeks near the Missouri River. Below the mantle of loess, this soil is underlain by sandy clay loam, which appears to have been deposited by water during glacial periods.

This soil, like the other Winfield soils, is well aerated and more fertile than most of the soils in the county. In addition, it has long, gentle slopes. Terraces, diversion channels, or other mechanical means of controlling erosion are necessary in the upper parts of the areas if the soil is to be cultivated. If such measures are used, alfalfa, corn, wheat, soybeans, and a number of other crops can be grown. The crops respond well if fertilizer is added. (Capability unit IIIe-6)

Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded (WtB2).—This soil is like Winfield silt loam, terrace phase, 2 to 10 percent slopes, except that it is eroded. The plow layer is only 6 inches thick over the silty clay loam subsoil.

A number of different crops can be grown if this soil is protected from further erosion. It requires more fertilizer than the uneroded Winfield soil on loess-capped terraces, but crops respond well where fertilizer has been added. (Capability unit IIIe-6)

Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded (WtC2).—This soil is on terrace escarpments below areas of Winfield silt loam, terrace phase, 2 to 10 percent slopes. Its color is the same as that of the other Winfield soils, but the subsoil formed in the sandy material that underlies the loess. In many places the texture of the subsoil is clay loam.

Although this soil contains more sand than the other Winfield soils on terraces, it is approximately as fertile as those soils, and yields of crops grown on it are about the same. The steep slopes are better for permanent pasture than for cultivated crops, and they should be used for that purpose wherever feasible. Some areas of this soil are too narrow, however, to be managed separately. (Capability unit IVe-6)

Use and Management of Soils

In the first part of this section, the use and management of the soils for crops and pastures are discussed. The system of grouping soils according to their capability is described and the capability classes, subclasses, and units in this county are listed. Then, management is discussed for the soils of each capability unit; in addition, a table is given in which there are examples of cropping systems and supporting practices suitable for the soils in each capability unit. The second part gives estimated yields of the principal crops grown on the soils of the county. This is followed by a discussion of the engineering properties of the soils and, finally, by a brief section about the use of the soils for woodland.

Use of the Soils for Crops and Pasture

The capability grouping of soils is defined in the following pages. Then, the use and management of the soils in each capability unit are discussed. Following this, the estimated average acre yields of the principal crops, obtained under customary management and under improved management, are given.

Capability grouping of soils

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

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

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be as many as four subclasses. The subclass is indicated by adding a small letter *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is a climate that is too cold or too dry. There are no soils of subclass *c* in this county.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V (none in Moniteau County) can contain, at the most, only subclasses *w*, *s*, and *c* because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping of soils for making many statements about their management. Capability units are generally identified by numbers assigned locally, for example, IIw-3 or IIIe-5.

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

The capability classes, subclasses, and units in which the soils of Moniteau County are classified are defined in the listing that follows. The soils were assigned to capability units on a statewide basis. Because not all of the capability units in the State are represented in this county, the numbering of the units may not be consecutive. For example, no soils of capability unit IIw-2 have been recognized in Moniteau County. Therefore, this capability unit is not discussed in this report.

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

(No subclasses)

Unit I-1. Well-drained, nearly level or undulating soils of the bottom lands.

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

Subclass IIw. Soils that have moderate limitations because of excess water.

Unit IIw-1a. Imperfectly drained or poorly drained, nearly level to undulating soils of the bottom lands.

Unit IIw-1b. Imperfectly drained or poorly drained soil that has a fine-textured surface layer and a moderately coarse textured subsoil and is on bottom lands.

Unit IIw-3. Poorly drained soil that has a silt loam surface layer over a clayey subsoil.

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

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

Unit IIIe-2. Dark, moderately well drained soils that have a subsoil of cherty clay at a depth of 24 to 36 inches and are on uplands.

Unit IIIe-5. Poorly drained claypan soils that have a silty surface layer and a plastic, clayey subsoil and are on uplands.

Unit IIIe-6. Moderately well drained soils that have a light-colored, silty surface layer and a moderately fine textured subsoil.

Subclass IIIw. Soils that have severe limitations because of excess water.

Unit IIIw-3. Poorly drained soils that have a light-gray, silty surface layer and a mottled, fine textured or moderately fine textured subsoil.

Unit IIIw-14. Poorly drained or imperfectly drained soil that has a clayey surface layer and subsoil and is on bottom lands.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Unit IIIs-4. Gently sloping or undulating, sandy and droughty soil on flood plains.

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

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

Unit IVe-3. Nearly level to rolling soils that have cherty material in or near the surface.

Unit IVe-5. Eroded, poorly drained, silty soils that are on uplands and have a claypan subsoil, which is at the surface in many places.

Unit IVe-6. Moderately well drained, light-colored, eroded, rolling soils that have a moderately fine textured subsoil at the surface in many places.

Subclass IVs. Soils that have very severe limitations of stoniness, low moisture capacity, or other soil features.

Unit IVs-4. Nearly level or undulating, sandy soil on bottom lands.

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

(None in Moniteau County)

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

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

Unit VIe-6. Light-colored, eroded, rolling to steep soils that have a silty surface layer and a moderately well drained subsoil.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by stones.

Unit VIs-6. Stony, nonarable soils that are rolling to steep.

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

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

Unit VIIe-3. Light-colored, rolling to steep soils that have cherty upper layers.

Unit VIIe-6. Light-colored, rolling to steep, eroded soils that have a silty surface layer and a subsoil of silty clay loam.

Subclass VIIs. Soils very severely limited by stones.

Unit VIIs-6. Stony, nonarable soil that is steep.

Class VIII. Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs. Soil material that has little potential for production of vegetation.

Unit VIIIs-6. Undulating areas of coarse sand and gravel deposited along streams.

Management by capability groups

In the following pages each capability unit is described briefly, the soils in each unit are listed, and some suggestions are given for the use and management of the soils in each unit. In table 2 the soils are grouped according to capability units, and, for each unit, cropping systems or land uses are suggested for two levels of management. The suggestions for cropping systems and supporting practices were taken from various technical guides used by the Soil Conservation Service.

CAPABILITY UNIT I-1

This unit consists of deep, well-drained, silty and loamy soils that are nearly level or undulating and are on bottom lands. The soils store a favorable supply of moisture for plants.

These soils are friable and are generally highly productive. They are neutral or slightly acid. Water moves through the profile well, and the moisture-holding capacity is adequate for a number of different crops. Overflow occurs occasionally, but it is not a serious threat during the normal growing season. The following soils are in this unit:

Huntington silt loam (Hu).
Sarpy fine sandy loam (Sc).

These soils are generally used for crops. Row crops can be grown year after year if crop residues are turned under, if fertilizer is applied according to the needs of the crop to be grown, and if tillage is kept to a minimum. A small grain, followed by a winter cover crop to be turned under for green manure, should be grown 1 year in 4 if management is less intensive.

Practices to control erosion are usually not needed, but some simple precautions to prevent streambank erosion and to provide drainage of low spots along fence lines and headlands may be advisable. The soils are suited to many different meadow grasses, legumes, and trees. Ordinarily, grasses and trees are grown only in long, narrow areas where the use of regular farm machinery is not practical.

CAPABILITY UNIT IIw-1a

In this unit are imperfectly drained or poorly drained, nearly level to undulating soils of the bottom lands. The surface layer is silty, and the subsoil is moderately fine textured or fine textured.

These soils are subject to occasional overflow in places, although overflow is not a major hazard. Surface ponding, or excess water that has accumulated on the surface as the result of restricted drainage, is likely to damage crops. Corn, wheat, and soybeans and other legumes can be grown successfully if moderate drainage is provided. The following soils are in this unit:

Dunning silt loam (Dg).
Freeburg silt loam, dark surface variant, 1 to 2 percent slopes (FrA).
Lindside silt loam (Ls).

Corn and soybeans are grown intensively on these soils, and some areas are commonly used for other field crops.

Under good management, row crops can be grown year after year; yields do not become unduly low, and little soil material is lost through erosion.

Diversion terraces are advisable in places to give protection from runoff from the adjacent hills. Where intensive management practices are not used to protect the soils, growing a meadow crop every third or fourth year is beneficial. The cropping system should also include a small grain grown for 1 year. Nitrogen fertilizer is especially beneficial to aid the growth of plants early in spring.

CAPABILITY UNIT IIw-1b

Only one soil, Onawa silty clay (On), is in this capability unit. This is an imperfectly drained or poorly drained soil of the bottom lands. It has a clayey surface layer and a moderately coarse textured subsoil. The soil is neutral to calcareous. In most places it is high in fertility.

The main limitations to growing tilled crops are the slow drainage and the difficulty of tilling this soil because of the fine texture of the plow layer. Overflow occurs occasionally, but it is a minor hazard.

Wheat, soybeans, and corn are all well suited to this soil. Row crops, primarily corn and soybeans, can be grown year after year, but it is a good practice to grow a small grain occasionally. A cover crop should be seeded in the small grain if row crops have been grown year after year and if the yields of grain and crop residues have become low.

CAPABILITY UNIT IIw-3

Chauncey silt loam, 0 to 1 percent slopes (CaA), is the only soil in this unit. It is poorly drained and has a dark-gray, acid surface layer and a clayey subsoil. A band of concretions of concentrated iron and manganese is generally between the surface layer and the subsoil.

The major limitation is excess water. Wetness is caused partly by slow internal drainage and partly by the lateral movement of ground water.

This soil is normally in long, narrow areas along meandering streams, and it is commonly used the same as the soils in adjacent fields. It is slightly more productive, however, than the soils on the adjacent uplands. If the areas are large enough, this soil is farmed alone and makes a productive field unit. If proper kinds and amounts of fertilizer are added and if crop residues are turned under and good tillage practices are used, corn, soybeans, or other row crops can be grown year after year. Cultivating on the contour or using terraces are practices that are needed to help prevent excessive erosion on the long, gentle slopes.

CAPABILITY UNIT IIIe-2

This unit consists of dark, moderately well drained soils of the uplands. The soils have a surface layer of silt loam. Their subsoil is cherty clay, which typically is at a depth of 20 to 30 inches. The upper part of the silty material was probably deposited by wind. Between the silty material and the clayey material, in many places, is a dense, mottled layer, which varies in depth over chert. This dense layer is discontinuous; it is absent where the cherty material is closest to the surface.

Erosion is a major hazard. The soils are normally dry early in spring, but in places they are droughty during dry periods in midsummer. The uneroded Craig soil that has

TABLE 2.—*Maximum intensity of land use and supporting practices¹ for soils of the*

Average management consists of applying about half the amounts of lime and fertilizer indicated by soil tests, and returning crop residues management consists of improving drainage where needed (D); returning crop residues to the soil (R); applying lime and fertilizer the soil (M); practicing wind stripcropping to prevent wind erosion (S); planting adapted crop varieties and seeding mixtures (V); (W); and harvesting mature trees and removing poor trees (Z). These capital letters are to be used to identify the practices in

Capability units	Cropping systems and practices for nearly level areas—	
	Under average management	Under specialized management
Unit I-1. Well-drained, nearly level or undulating soils of the bottom lands: (Hu) Huntington silt loam. (Sa) Sarpy fine sandy loam.	3 years of row crops followed by 1 year of a small grain; with the small grain, seed a cover crop to be turned under for green manure.	Continuous row crops if supported by specialized management practices R, F, and T.
Unit IIw-1a. Imperfectly drained or poorly drained, nearly level to undulating soils of the bottom lands: (Dg) Dunning silt loam. (FrA) Freeburg silt loam, dark surface variant, 1 to 2 percent slopes. (Ls) Lindside silt loam.	2 or 3 years of row crops; follow with 1 year of a small grain seeded for a winter cover crop, or follow with 1 year of meadow.	Continuous row crops if supported by specialized management practices R, F, T, and D.
Unit IIw-1b. Imperfectly drained or poorly drained soil that has a fine-textured surface layer and a moderately coarse textured subsoil and is on bottom lands: (On) Onawa silty clay.	3 years of row crops followed by 1 year of a small grain; with the small grain, seed a cover crop to be turned under for green manure.	Continuous row crops if supported by specialized management practices R, F, T, and D.
Unit IIw-3. Poorly drained soil that has a silt loam surface layer over a clayey subsoil: (CaA) Chauncey silt loam, 0 to 1 percent slopes.	3 years of row crops followed by a small grain; with the small grain, seed a meadow crop, and leave the meadow crop for 1 year.	Continuous row crops if supported by specialized management practices R, F, and T.
Unit IIIe-2. Dark, moderately well drained soils that have a subsoil of cherty clay at a depth of 24 to 36 inches and are on uplands: (CrB) Craig silt loam, thick solum phase, 3 to 7 percent slopes. (CrB2) Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded. (CgB) Craig silt loam, 2 to 10 percent slopes.	Most areas are sloping.....	Most areas are sloping.....
Unit IIIe-5. Poorly drained claypan soils that have a silty surface layer and a plastic, clayey subsoil that are on uplands: (EdB) Edina silt loam, 2 to 5 percent slopes. (GsB) Glensted silt loam, 2 to 5 percent slopes. (McB) McGirk silt loam, 2 to 5 percent slopes. (SeA) Seymour silt loam, 0 to 2 percent slopes. (SeB) Seymour silt loam, 2 to 5 percent slopes. (WdB2) Weldon silt loam, 2 to 10 percent slopes, eroded.	In the few small areas that are nearly level, grow row crops for 3 years and follow with a small grain for 1 year; with the small grain, seed a meadow crop and leave the meadow crop for 1 year.	Continuous row crops in nearly level areas if supported by special management practices R, F, T, and D.
Unit IIIe-6. Moderately well drained soils that have a light-colored, silty surface layer and a moderately fine textured subsoil: (BeB2) Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded. (FrB) Freeburg silt loam, dark surface variant, 2 to 10 percent slopes. (UnB2) Union silt loam, 2 to 10 percent slopes, eroded. (WfB2) Winfield silt loam, 2 to 10 percent slopes, eroded. (WtB) Winfield silt loam, terrace phase, 2 to 10 percent slopes. (WtB2) Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded.	Most areas are sloping.....	Most areas are sloping.....

See footnote at end of table.

different capability units under average management and highly specialized management

to the soil by leaving straw, stalks, and stubble in the field, by feeding livestock in the field, or by spreading barnyard manure. Specialized in amounts indicated by soil tests (F); practicing minimum tillage to preserve soil structure (T); practicing stubble-mulch tillage to protect managing grazing, controlling weeds, and practicing timely field operations (C); protecting woodland from fire and from excessive grazing this table]

Cropping systems and practices for sloping areas under specialized management—			Remarks
Without contouring or terracing	With contour cultivation	With terraces that have outlets	
Same as for nearly level areas under specialized management.	Cropping systems the same as those suggested for nearly level areas under both levels of management, but contour cultivation is needed on the gentle slopes.	Cropping systems the same as those suggested for nearly level areas under both levels of management, but standard terraces or diversions should be used on the long, gentle slopes.	Some areas may need protection from runoff from the hills; some simple surface drainage may be needed in low, isolated spots.
Same as for nearly level areas under specialized management.	Contour cultivation generally not needed, but may be needed on the long, gentle slopes.	Terraces generally not needed, but may be needed on the long, gentle slopes.	Nitrogen fertilizer is especially important for the early growth of plants in wet spring seasons.
Same as for nearly level areas under specialized management.	Contour cultivation generally not needed.	Terraces generally not needed---	Crop-residue management and timely tillage are especially important because of the fine texture of the surface soil.
Same as for nearly level areas under specialized management.	Farm gently sloping areas on the contour, and grow row crops for no more than 2 years; follow the row crop with a small grain; seed meadow with the small grain, and leave the meadow for a full year.	Terrace long, gentle slopes to control surface runoff and to reduce loss of soil material; if erosion is controlled, row crops can be grown for 3 years and small grains for 1 year; seed a meadow crop with the small grain, and leave for 1 year.	Nitrogen fertilizer is especially important for early growth of plants in wet spring seasons; contour cultivation may aggravate the wetness slightly, but it may be necessary to prevent excessive erosion.
1 year of a small grain followed by 3 years of meadow.	1 year of a row crop followed by 1 year of a small grain and then 2 years of meadow; contour operations are effective only on slopes of up to 6 percent, unless accompanied by terraces.	2 years of a row crop followed by 2 years of a small grain and then 1 year of meadow.	Grain sorghum is somewhat better adapted than corn because of droughts in summer; in many places cherty soils on sharply breaking slopes are a problem in developing terrace outlets.
2 years of a small grain, followed by 3 years of meadow.	1 year of a row crop followed by 1 year of a small grain and then 2 years of meadow; contour operations are not effective on slopes of more than 6 percent.	2 years of a row crop followed by 1 year of a small grain, and then 1 year of meadow.	Seepage areas may occur at the heads of drainageways; nitrogen fertilizer is important for the growth of plants early in spring.
1 year of a small grain and 3 years of meadow.	1 year of a row crop followed by 1 year of a small grain and then 3 years of meadow; contour operations generally not effective on slopes of more than 6 percent.	2 years of a row crop followed by 1 year of a small grain and then 2 years of meadow.	Irregular slopes are common; in many areas there are spots where erosion has removed all of the surface layer.

TABLE 2.—*Maximum intensity of land use and supporting practices*¹ for soils of the different

Capability units	Cropping systems and practices for nearly level areas—	
	Under average management	Under specialized management
Unit IIIw-3. Poorly-drained soils that have a light-gray, silty surface layer and a mottled, fine textured or moderately fine textured subsoil: (Me) Melvin silt loam. (RaA) Racoon silt loam, 1 to 2 percent slopes. (We) Weir silt loam.	3 years of row crops followed by 1 year of a small grain; with the small grain, seed a meadow crop and leave the meadow crop for 1 year.	4 years of row crops followed by 1 year of a small grain; seed a green-manure crop with the small grain. Use management practices R, F, and D.
Unit IIIw-14. Poorly drained or imperfectly drained soil that has a clayey surface layer and subsoil and is on bottom lands: (Du) Dunning silty clay.	3 to 5 years of row crops; seed meadow in the row crop the last year, and leave the meadow for 1 year.	Continuous row crops if supported by specialized management practices R, F, and D.
Unit IIIs-4. Gently sloping or undulating, sandy and droughty soil on flood plains: (Sb) Sarpy loamy sand.	1 year of a row crop followed by a small grain; with the small grain, seed a fall and winter cover crop that is to be turned under for green manure.	Row crops can be grown each year; a fall and winter cover crop is turned under for green manure each spring, and special management practices R, F, and M or S are used.
Unit IVe-3. Nearly level to rolling soils that have cherty material in or near the surface: (BoB) Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes. (CgB2) Craig silt loam, 2 to 10 percent slopes, eroded. (EnB) Eldon cherty loam, 2 to 10 percent slopes.	Most areas are sloping.....	Most areas are sloping.....
Unit IVe-5. Eroded, poorly drained, silty soils that are on uplands and have a claypan subsoil, which is at the surface in many places: (EdB2) Edina silt loam, 2 to 5 percent slopes, eroded. (GsB2) Glensted silt loam, 2 to 5 percent slopes, eroded. (McB2) McGirk silt loam, 2 to 5 percent slopes, eroded. (SeB2) Seymour silt loam, 2 to 5 percent slopes, eroded.	Most areas are sloping and eroded.....	Most areas are sloping and eroded.....
Unit IVe-6. Moderately well drained, light-colored, eroded, rolling soils that have a moderately fine textured subsoil at the surface in many places: (UnB3) Union silt loam, 2 to 10 percent slopes, severely eroded. (UnC2) Union silt loam, 10 to 15 percent slopes, eroded. (UtB2) Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded. (WfC2) Winfield silt loam, 10 to 15 percent slopes, eroded. (WtC2) Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded.	No level areas.....	No level areas.....
Unit IVs-4. Nearly level or undulating, sandy soil on bottom lands: (Sc) Sarpy sand.	Small grains, meadow, or legumes if stubble-mulch tillage and crop-residue management are used.	Grow row crops or specialized crops, and seed a fall and winter cover crop; use specialized management practices R, F, and M or S.
Unit VIe-6. Light-colored, eroded, rolling to steep soils that have a silty surface layer and a moderately well drained subsoil: (UnC3) Union silt loam, 10 to 15 percent slopes, severely eroded. (WfD2) Winfield silt loam, 15 to 25 percent slopes, eroded.	No level areas.....	No level areas.....

See footnote at end of table.

capability units under average management and highly specialized management—Continued

Cropping systems and practices for sloping areas under specialized management—			Remarks
Without contouring or terracing	With contour cultivation	With terraces that have outlets	
Same as for nearly level areas under average management.	Farm sloping areas on the contour; grow a row crop for only 1 year, and follow it with 1 year of a small grain and 2 years of meadow.	Long slopes should be terraced so that a row crop can be grown for 2 years followed by 1 year of a small grain and 1 year of meadow.	Nitrogen fertilizer is especially important for the early growth of plants; the soils should not be tilled when wet; crop-residue management is especially important on these gray, silty soils, which are inclined to puddle.
Same as for nearly level areas under average management.	Contour cultivation generally not needed.	Terraces generally not needed---	Risk of crop failure is common because of delayed farming operations in spring and fall as a result of wetness.
2 years of a small grain followed by 3 years of meadow.	1 year of a row crop followed by 1 year of a small grain and then 2 years of meadow.	1 year of a row crop followed by 1 year of a small grain with a cover crop that has a good root system.	This sandy soil of the bottom lands is subject to occasional overflow in places; wind erosion occurs in bare areas in some seasons.
Primarily meadow crops-----	1 year of a small grain followed by 2 or 3 years of meadow; contour operations are generally not effective on slopes of more than 6 percent.	2 years of a small grain and 2 years of meadow; terracing is normally not well suited to these soils.	These soils are somewhat droughty because of the content of chert in the upper soil layers.
1 year of a small grain followed by 3 years of meadow.	2 years of small grains followed by 2 years of meadow.	1 year of a row crop followed by 1 year of a small grain and then 1 year of meadow.	The stands of crops on these soils normally will be spotty because of the irregular slopes and the irregular pattern of erosion; small gullies are common in the drainageways; adding nitrogen fertilizer and managing crop residues carefully are especially important; stands are poor where the terrace channels extend into the clayey subsoil.
Primarily meadow crops-----	1 year of a small grain followed by 3 years of meadow; contour operations are generally not effective on slopes of more than 6 percent.	1 year of a row crop, 1 year of a small grain, and 3 years of meadow.	The slopes are irregular in many places and are not well suited to the construction of terraces; the stands of crops will be spotty because of the irregular slope and the irregular pattern of erosion.
Generally not needed-----	Generally not needed-----	Generally not needed-----	These areas are subject to wind erosion in some seasons.
Not suited to tilled crops-----	New seeding operations or the renovation of areas already in grass should be on the contour.	Terraces are generally not applicable; diversion terraces may be needed to divert hillside runoff from critical areas.	Renovate pastures as needed, and follow special practices F, V, and C; practices W and Z apply to areas used as woodland.

TABLE 2.—*Maximum intensity of land use and supporting practices*¹ for soils of the different

Capability units	Cropping systems and practices for nearly level areas—	
	Under average management	Under specialized management
Unit VIIs-6. Stony, nonarable soils that are rolling to steep: (GaB) Gasconade stony silty clay, 2 to 10 percent slopes. (GaE) Gasconade stony silty clay, 10 to 20 percent slopes.	No level areas-----	No level areas-----
Unit VIIe-3. Light-colored, rolling to steep soils that have cherty upper layers: (BoE) Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes. (BoF) Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes.	No level areas-----	No level areas-----
Unit VIIe-6. Light-colored, rolling to steep, eroded soils that have a silty surface layer and a subsoil of silty clay loam: (UnD2) Union silt loam, 15 to 25 percent slopes, eroded. (UtC2) Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded. (Wif2) Winfield silt loam, 25 to 40 percent slopes, eroded.	No level areas-----	No level areas-----
Unit VIIIs-6. Stony, nonarable soil that is steep: (GaF) Gasconade stony silty clay, 20 to 60 percent slopes.	No level areas-----	No level areas-----
Unit VIIIIs-6. Undulating areas of coarse sand and gravel deposited along streams: (Rw) Riverwash.	No productive vegetation-----	No productive vegetation-----

¹ The cropping systems and supporting practices suggested are those described in various technical guides used by the Soil Conservation Service. They are subject to revision as additional techniques and knowledge become available.

a thick solum is less droughty than the Craig soil that has a solum of normal thickness. Corn, small grains, and pasture grasses are adapted, but yields may be reduced as the result of erosion or lack of moisture. The following soils are in this unit:

- Craig silt loam, 2 to 10 percent slopes (CgB).
- Craig silt loam, thick solum phase, 3 to 7 percent slopes (CrB).
- Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded (CrB2).

If good management is used, a suitable cropping system for these soils is one in which a row crop is grown 2 years, a small grain is grown 2 years, and a meadow crop is grown 1 year. If such a cropping system is used, erosion needs to be controlled, crop residues should be managed properly, and fertilizer should be added in the right kinds and amounts. If less effective erosion control practices and soil management are used, row crops should be grown only 1 year in 4 or not at all, and meadow crops need to be grown longer than 1 year.

CAPABILITY UNIT IIIe-5

In this unit are poorly drained claypan soils of the uplands. The soils have a surface layer of brown to dark grayish-brown silt loam and a subsoil of plastic silty clay or clay. In most places they are gently sloping, but some

areas are nearly level. Surface drainage is medium, and internal drainage is slow.

Because of the slow permeability and the long slopes, erosion is a major hazard. Excess wetness in spring and fall also limits the kinds of crops that can be grown and affects the timely planting and harvesting of crops. In seasons of extreme drought, lack of available water is a hazard. The following soils are in this unit:

- Edina silt loam, 2 to 5 percent slopes (EdB).
- Glensted silt loam, 2 to 5 percent slopes (GsB).
- McGirk silt loam, 2 to 5 percent slopes (McB).
- Seymour silt loam, 0 to 2 percent slopes (SeA).
- Seymour silt loam, 2 to 5 percent slopes (SeB).
- Weldon silt loam, 2 to 10 percent slopes, eroded (WdB2).

These soils have only moderate inherent fertility, but moderate to high yields of adapted crops can be obtained under good management. From the standpoint of the size of fields and the ease of cultivation, these soils are among the most favorable soils for agriculture in the county. They are limited, however, by the hazards of erosion, excess wetness, and droughtiness. The seriousness of these hazards varies as the result of differences in the season and in use.

If terraces are constructed and if good management is used, row crops can be grown on these soils about half the

capability units under average management and highly specialized management—Continued

Cropping systems and practices for sloping areas under specialized management—			Remarks
Without contouring or terracing	With contour cultivation	With terraces that have outlets	
Not suited to tilled crops-----	Used as woodland or pasture----	Terraces are not applicable-----	Tillage for renovation of pasture is difficult because of the stones; excellent for wildlife food and cover; use specialized management W and C in wooded areas.
Generally not suited to tilled crops.	Used as woodland or pasture----	Terraces are generally not applicable; diversion terraces may be applicable in some places.	Tillage for renovation is difficult because of the chert; use specialized management W and C in wooded areas.
Generally not suited to tilled crops.	Used as woodland or pasture; renovation and harvest operations should be on the contour where feasible.	Diversion terraces may be applicable in critical areas.	Gully erosion is common; stabilization structures are needed in many places; silt that is washed from these areas to adjacent colluvial areas is a problem.
Not suited to tilled crops-----	Used as woodland or pasture----	Terraces are not applicable-----	Tillage for renovation of pasture is generally not feasible; mowing of pastures is generally not feasible, because of the rocks and escarpments.
No productive vegetation-----	No productive vegetation-----	No productive vegetation-----	Sand and gravel bars are subject to shifting as the result of stream action.

time. If no mechanical practices are used to control erosion, row crops should not be grown or should be grown only 1 year in 4. These soils are well suited to corn, soybeans, small grains, ladino clover, and fescue. They are generally not suited to trees. The only trees growing on these soils are in fence rows, drainage channels, and odd areas.

CAPABILITY UNIT IIIe-6

The soils of this unit are moderately well drained, and they have a light-colored, silty surface layer and a moderately fine textured subsoil. Their slopes range from 2 to 10 percent, but in most places the slopes are between 5 and 10 percent. Runoff is rapid because of the strong slopes and the somewhat restricted internal drainage.

Erosion is the main limitation to obtaining high yields. If these soils are well managed, however, moderate to high yields can be expected. The soils need to have lime and fertilizer applied properly, to have mechanical practices used to control erosion, and to have crop residues turned under. The following soils are in this unit:

- Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded (BeB2).
- Freeburg silt loam, dark surface variant, 2 to 10 percent slopes (FrB).
- Union silt loam, 2 to 10 percent slopes, eroded (UnB2).

- Winfield silt loam, 2 to 10 percent slopes, eroded (WfB2).
- Winfield silt loam, terrace phase, 2 to 10 percent slopes (WfB).
- Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded (WfB2).

In these soils the pattern of slopes is generally irregular. Between the slopes there are drainageways and short spur ridges in many places. Erosion is common in many of the areas, and in some of these areas the subsoil is exposed. Practices are needed to prevent an excessive amount of soil material from being lost through erosion.

These soils are suited to corn, small grains, grasses, and legumes, and tobacco is grown to some extent. If good management is practiced, a cropping system can be used in which row crops are grown 2 years, a small grain is grown 1 year, and meadow crops are grown 2 years. If such a cropping system is used, properly installed terraces with suitable outlets need to be provided and other good management should be used. If no practices are used that will control erosion, row crops should not be included in the cropping system.

Crops grown on these soils respond well if fertilizer is added. Waterways ought to have a protective cover of grass, and tillage implements should be lifted when the waterways are crossed.

CAPABILITY UNIT IIIw-3

The soils of this unit are poorly drained. Their surface layer is light gray and silty, and their subsoil is mottled and is fine textured or moderately fine textured. These soils are nearly level to gently sloping and are on uplands, stream terraces, and bottom lands. They are moderate to low in productivity. Their main limitation is excessive wetness. The following soils are in this unit:

Melvin silt loam (Me).
Raccoon silt loam, 1 to 2 percent slopes (RcA).
Weir silt loam (We).

Improved drainage, enough fertilizer and lime to raise fertility to a high level, and good management of crop residues are required if row crops are to be grown on these soils year after year. A year of small grains seeded to a cover crop, following each 3 or 4 years of row crops, helps provide crop residues. Tillage should also be managed carefully. If these practices are not used, the areas are best used to grow meadow and pasture crops. Growing a row crop 2 or 3 years and then seeding a small grain in a meadow crop is a common use of these soils. Soybeans are a more suitable row crop than corn.

CAPABILITY UNIT IIIw-14

Only one soil, Dunning silty clay (Du), is in this unit. This poorly drained or imperfectly drained soil has a clayey surface layer and subsoil. It is nearly level or in depressions, and it generally occupies small, scattered areas of bottom lands along the smaller streams of the county. Natural fertility is moderate to high.

Seep water or sediments from adjacent areas of limestone bluffs have influenced the formation of this soil. Excess water that has accumulated on the surface as a result of the clayey texture of the surface layer and the poor drainage of the subsoil is the major hazard.

If this soil is to be used economically for cultivated crops, it needs to be drained. Growing a row crop year after year is feasible if the crop tolerates water and if crop residues are managed properly. If specialized management is not used, growing a meadow crop once every 4 to 6 years helps to maintain good tilth and to improve aeration. Soybeans are better suited than corn. Pasture crops and small grains are well suited.

CAPABILITY UNIT IIIs-4

Sarpy loamy sand (Sb) is the only soil in this unit. It is a light-colored, gently sloping or undulating, sandy, droughty soil that was formed in recent deposits on the flood plains of the Missouri River. The texture is loamy sand throughout the profile, but there are occasional lenses of finer textured material that was left by past floods.

This soil contains a large amount of plant nutrients, but it is low in productivity because of the low available moisture-holding capacity. It can be irrigated, but the areas are not large enough for irrigation to be profitable. Erosion by wind is a problem early in spring when the fields are bare.

Alfalfa is well suited to this soil. It makes fairly high yields, but the yields are reduced during periods of drought. Corn is also suitable, but it is often damaged by dry weather. Row crops can be grown, but a cover crop that protects the soil in fall and in winter should be seeded and turned under as green manure each spring. Managing crop residues, controlling wind erosion, conserving mois-

ture, selecting the proper variety of crop to grow, and using other special management practices are important on this soil. If special management practices are not used, small grains should be grown the year after a row crop.

CAPABILITY UNIT IVe-3

This unit is made up of grayish-brown and dark grayish-brown, nearly level to rolling soils that have cherty material in or near the surface. In many places more than half of the surface layer is chert. Below a depth of 20 to 30 inches, however, where the material is mainly reddish clay, only 10 to 20 percent of the soil material is chert. These rolling soils have good surface drainage and moderately good to imperfect internal drainage. The natural vegetation in the prairie areas is bluestem, sumac, and persimmon. Oak and hickory predominate in the wooded areas. The following soils are in this unit:

Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes (BoB).
Craig silt loam, 2 to 10 percent slopes, eroded (CgB2).
Eldon cherty loam, 2 to 10 percent slopes (EnB).

Much of the acreage was once cleared, and cultivation was attempted. Later, these areas returned to broomsedge, brush, and wild grass, and now few of them are cultivated. Erosion is the major hazard that causes the soils to deteriorate, but droughtiness is a major hazard that affects the use of the soils.

Hay and pasture crops are probably more suitable to grow on these soils than cultivated crops, but wheat can be grown on the more favorable sites. If proper management is practiced, a cropping system in which small grains are grown for 2 years and meadow crops are grown for 2 years can be used without excessive loss of soil material through erosion. The management should include construction of terraces, practices to control erosion, returning crop residues to the soils, adding proper kinds and amounts of fertilizer, and selecting the proper varieties of adapted crops. Under average management, these soils are probably best suited to grass and hay crops. Constructing terraces presents a problem because of the large amount of chert. The chert also causes difficulty where ponds are to be constructed and outlets developed.

CAPABILITY UNIT IVe-5

Silty, gently sloping, poorly drained, eroded soils that have a claypan subsoil make up this unit. The soils are on uplands. The original surface layer, which had more favorable moisture-storing capacity than the subsoil, has been lost through erosion. The present surface layer is generally less than 6 inches thick and contains some plastic clay from the subsoil. In many places plastic clay is at the surface, and in those areas the soil is wet and sticky in wet seasons and hard and dry in dry seasons. As a result, preparation of the seedbed is difficult.

Crops grown on the soils of this unit respond well if fertilizer is added and if crop residues are well managed. The long, gentle slopes are favorable for cultivation. These long slopes, the slow rate of infiltration, and the slow permeability make the hazard of further erosion serious. The capacity for storing available moisture is low and productivity is low to moderate. The following soils are in this unit:

Edina silt loam, 2 to 5 percent slopes, eroded (EdB2).
Glensted silt loam, 2 to 5 percent slopes, eroded (GsB2).

McGirk silt loam, 2 to 5 percent slopes, eroded (McB2).
Seymour silt loam, 2 to 5 percent slopes, eroded (SeB2).

Most of the acreage was once cultivated, but much of it has returned to broomsedge and brush. The slopes are favorable for tillage, and cultivated crops can be grown if practices are used to control erosion. Such practices consist of constructing terraces and suitable outlets, applying the proper kinds and amounts of fertilizer, turning under crop residues, and using proper tillage methods. If cultivated crops are grown, a suitable cropping system is one in which row crops, small grains, and meadow crops are grown for 1 year each. The cost of growing cultivated crops may be too great to be worth while. If the areas are large enough, they are better used to grow grass for hay or pasture.

CAPABILITY UNIT IVe-6

This unit is made up of light-colored, moderately well drained, eroded, rolling soils in the forested parts of the county. These soils have a silty surface layer and a moderately fine textured subsoil. In places much of the original surface layer has been lost and material that was formerly part of the subsoil makes up most of the present surface layer. Further erosion is the main hazard. These soils are suited to a number of different crops, and the crops respond well to good management. Because of the steep, irregular slopes and the present erosion, however, the soils are not well suited to regular cropping. The following soils are in this unit:

Union silt loam, 2 to 10 percent slopes, severely eroded (UnB3).
Union silt loam, 10 to 15 percent slopes, eroded (UnC2).
Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded (U1B2).
Winfield silt loam, 10 to 15 percent slopes, eroded (W1C2).
Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded (W1C2).

The areas where slopes are between 2 and 10 percent are generally long and narrow and are adjacent to the more sloping areas. The fields are normally irregular in shape and are spotted because of differences in the amount of erosion. Planning mechanical practices to control erosion is a problem because the practices are not always effective. If such practices cannot be used, crops grown year after year for pasture or meadow are the most suitable. If mechanical control of erosion is feasible, a cropping system that can be used without causing excessive erosion is one in which a row crop is grown for 1 year, a small grain for 1 year, and a meadow crop for 3 or more years. Adding the proper kinds and amounts of fertilizer, returning crop residues to the soil, and using favorable tillage practices are essential. Row crops should be planted only where mechanical practices are used to control erosion.

The soils of this unit are favorable for trees if good timber management is used. Timber was the native cover, and some blackjack oak, white oak, black oak, and hickory remain. Most areas have been cleared, however, and the present wooded tracts are scattered and consist of mixed, second-growth stands.

CAPABILITY UNIT IVs-4

Sarpy sand (Sc) is the only soil in this unit. It is nearly level or undulating and consists of recent deposits of sand on the bottom lands along the Missouri River. Overflow

occurs occasionally, and the floodwaters often deposit finer textured material that improves this soil.

This soil is droughty, and many of the areas are idle. Willows and cottonwoods quickly become established and grow rapidly. Cropping is feasible in favorable years, when the water table is high. Then, fair and sometimes even high yields are obtained, although, in general, productivity is low.

Alfalfa and specialized crops are suited to this soil, but irrigation is essential for growing such crops. If complete conservation practices are applied, the areas that are large enough can be used for row crops and specialized crops. Each crop year, a fall and winter cover crop should be plowed under for green manure. If such a cropping system is used, the practices needed consist of selecting crops carefully, planting, cultivating, and harvesting at the proper times, adding the proper kinds and amounts of fertilizer, protecting the soil from wind erosion, managing crop residues carefully, and using proper methods for tilling and irrigating. If average management is used, favorable uses of this soil are small grains, legumes, and meadow crops.

CAPABILITY UNIT VIe-6

Light-colored soils that have a silty surface layer and a subsoil of silty clay make up this unit. The subsoil is moderately well drained. The soils are eroded and are rolling to steep.

Erosion is the main limitation to use, but in most places the steep slopes prevent tillage. These soils are suited to a number of different kinds of trees and grasses commonly grown in the county. The following soils are in this unit:

Union silt loam, 10 to 15 percent slopes, severely eroded (UnC3).
Winfield silt loam, 15 to 25 percent slopes, eroded (W1D2).

Diversion terraces are needed to protect these soils from runoff from higher areas. Developing good outlets presents a problem because of the steep slopes and the rocky material at the lower end of the outlets.

These soils are well suited to pasture grasses and to trees that are commonly grown in the county. Pastures need to be renovated and good varieties of grass established. Trees should also be planted. White oak and black oak are suitable trees for planting, and they grow well if they are properly managed. Some areas are in walnut trees, which also grow well.

CAPABILITY UNIT VIe-6

This unit is made up of dark-colored, stony, rolling to steep soils. The soils have a thin surface layer. In some places limestone is near the surface or massive limestone ledges outcrop. The mantle of soil material is only 6 to 18 inches thick in most places, but it is as thick as 30 inches in other places. These soils are fertile, but they are very low in capacity to store available moisture. The following soils are in this unit:

Gasconade stony silty clay, 2 to 10 percent slopes (GcB).
Gasconade stony silty clay, 10 to 20 percent slopes (GcE).

The soils of this unit are not suitable for cultivation, and nearly all of the acreage is in pasture or trees. Grazing is limited during the dry months in summer. Post oak, blackjack oak, and cedar are the most common trees. Redcedar and white oak grow well if the competing low-quality oaks are removed.

CAPABILITY UNIT VIIe-3

This unit is made up of light-colored, rolling to steep soils in which chert makes up more than 50 percent, by volume, of the upper 30 to 40 inches of soil material. Below a depth of 30 to 40 inches is residual red clay. Because of the steep slope, erosion is a major hazard. The low available moisture supply limits yields. The following soils are in this unit:

- Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes (BoE).
- Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes (BoF).

Most areas of these soils have been left in native forest of post oak, black oak, white oak, and hickory, but there is some walnut. White oak, red oak, and walnut are the most desirable species. The temperature and supply of moisture on the north- and east-facing slopes are more favorable for trees than on the south- and west-facing slopes. The most important management practices consist of improving the stand, protecting the areas from fire and insects, and cutting selectively. Pasture grasses grow well where they do not have to compete with trees and where good pasture management is used.

CAPABILITY UNIT VIIe-6

This unit is made up of rolling to steep, eroded, light-colored soils that have a surface layer of silt loam and a subsoil of silty clay loam. Erosion is the main hazard. The irregular slopes make these soils unsuitable for cultivated crops and for establishing practices to control erosion. The following soils are in this unit:

- Union silt loam, 15 to 25 percent slopes, eroded (UnD2).
- Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded (U1C2).
- Winfield silt loam, 25 to 40 percent slopes, eroded (W1F2).

These soils are well suited to the pasture grasses and trees commonly grown in the area. White oak and black oak are good species to grow. Diversion levees are needed that will keep water from concentrating.

CAPABILITY UNIT VIIs-6

Only one soil, Gasconade stony silty clay, 20 to 60 percent slopes (Gaf), is in this unit. This stony soil is not suited to field crops. It is mainly in trees, but native grasses grow well in the glade areas. Practices for managing pasture and timber are difficult to use because of the steep, precipitous slopes. Redcedar and white oak are desirable species.

CAPABILITY UNIT VIIIs-6

Only Riverwash (Rw) is in this unit. This miscellaneous land type consists of undulating areas of coarse sand and gravel deposited along the Missouri River and along secondary streams. Annual overflow is a serious threat, but droughtiness is also a major problem. The soil material is very low in moisture-holding capacity, and it does not support productive vegetation.

This land type has no agricultural value at the present time. The soil material is a source of gravel for roads, but in an area where there are many gravelly soils, even this use is not a profitable one.

Estimated yields

Estimated average acre yields of the principal crops grown on the soils of Moniteau County are given in table 3. The yields are influenced by the properties of the soils. Inherent fertility, aeration, and the capacity for storing water available for plants are examples of such properties, and all of these have been taken into account in estimating the yields given. Variations in management also cause differences in the yields obtained on a soil. Therefore, the estimates given in table 3 are for two levels of management. In columns A are yields to be expected under average management, and in columns B are yields to be expected under improved management.

The yields are estimates of average yields received over a 10-year period. They do not take into account abnormal seasons or the past management of a soil on a particular farm. The yields are based on the results of field trials and on interviews with farmers, members of the staff of the Missouri Agricultural Experiment Station, and representatives of the Soil Conservation Service.

To obtain the yields shown in columns B of table 3, farmers use the following practices:

1. Lime and fertilizer are applied according to the needs indicated by soil tests. The amounts added are large enough so that maximum yields can be obtained in a favorable season. For example, enough fertilizer is applied to corn so that the yield will be more than 100 bushels per acre in a favorable season.
2. If there is a hazard of erosion on the particular soil, a cropping system is used that will keep erosion to a minimum, or terracing, contouring, mulching, or similar practices are used. Crop residues are also returned to the soil, and tillage is kept to a minimum.
3. Surface drainage is provided in wet, nearly level areas or in depressions by leveling or by surface ditching. Soils that receive seep water or runoff from adjoining soils are protected by diversion channels or tile lines.
4. Weeds, diseases, and insects are controlled.
5. Recommended varieties and rates of planting are used.

To obtain the yields shown in columns A, farmers use only 70 percent of the lime and fertilizer for which soil tests have indicated a need. In addition, most of the crop residues are removed from the field; erosion-control practices and drainage practices are not used or are not effective.

Engineering Properties of Soils

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for storing water, erosion control structures, drainage systems, and sewage disposal systems. Among the most important of these soil properties are permeability, drainage, texture, plasticity, and depth to hard rock and to the water table.

Estimates of some of the engineering properties of the soils and of their suitability for engineering construction are given in this section. Estimates of other properties

are provided in the section "Descriptions of the Soils" and in other parts of the report.

The information in the report and the detailed soil map in the back of the report will help engineers to—

- (1) Make soil and land use studies that will aid in selecting and developing industrial, business, residential and recreational sites, and roads.
- (2) Make preliminary estimates of the engineering properties of soils that will help in planning agricultural drainage systems, farm ponds, terraces, waterways, irrigation systems, and the layout of farm buildings.

- (3) Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways.
- (4) Locate probable sources of gravel, sand, limestone, material for fill or for topdressing, and other kinds of material to be used in construction.
- (5) Correlate performance of engineering structures with soil conditions and thus develop information that will be useful in designing and maintaining the structures.
- (6) Supplement information from other published maps, reports, and aerial photographs for the

TABLE 3.—Estimated average acre yields of principal crops under two levels of management

[Yields in columns A are those expected under average management, and yields in columns B are those expected under improved management. Absence of a yield figure indicates the crop is not commonly grown at the management level indicated]

Map symbol	Soil	Corn		Wheat		Soybeans		Alfalfa	
		A	B	A	B	A	B	A	B
BeB2	Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded	20	50	10	25			1.0	2.5
BoB	Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes								
BoE	Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes								
BoF	Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes								
CaA	Chauncey silt loam, 0 to 1 percent slopes	30	60	15	30	20	30	1.0	2.5
CgB	Craig silt loam, 2 to 10 percent slopes	25	55	15	30			.8	2.5
CgB2	Craig silt loam, 2 to 10 percent slopes, eroded	15	40	9	20			.5	1.0
CrB	Craig silt loam, thick solum phase, 3 to 7 percent slopes	35	65	15	30			1.0	3.5
CrB2	Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded	20	50	12	25			.7	1.5
Dg	Dunning silt loam	40	65	18	30	20	30	2.5	4.0
Du	Dunning silty clay	20	50	15	25	20	30		
EdB	Edina silt loam, 2 to 5 percent slopes	25	60	15	30	15	30	1.5	2.8
EdB2	Edina silt loam, 2 to 5 percent slopes, eroded	20	50	15	30	15	30	1.5	2.6
EnB	Eldon cherty loam, 2 to 10 percent slopes								
FrA	Freeburg silt loam, dark surface variant, 1 to 2 percent slopes	30	60	15	30	15	30	1.0	2.5
FrB	Freeburg silt loam, dark surface variant, 2 to 10 percent slopes	30	60	15	30	15	30	1.0	2.5
GaB	Gasconade stony silty clay, 2 to 10 percent slopes								
GaE	Gasconade stony silty clay, 10 to 20 percent slopes								
GaF	Gasconade stony silty clay, 20 to 60 percent slopes								
GsB	Glensted silt loam, 2 to 5 percent slopes	30	60	12	28	15	30	1.0	2.5
GsB2	Glensted silt loam, 2 to 5 percent slopes, eroded	15	45	9	20	12	25	.8	1.3
Hu	Huntington silt loam	50	80	18	30	13	30	2.5	4.0
Ls	Lindside silt loam	40	65	15	30	15	30	1.3	3.0
McB	McGirk silt loam, 2 to 5 percent slopes	15	40	8	20	10	20	1.0	2.5
McB2	McGirk silt loam, 2 to 5 percent slopes, eroded	8	30	5	15	8	15		
Me	Melvin silt loam	20	45	10	20	10	20		
On	Onawa silty clay	50	70	25	35	25	30	2.5	3.5
RaA	Raccoon silt loam, 1 to 2 percent slopes	20	50	8	20	10	20	.3	2.0
Rw	Riverwash								
Sa	Sarpy fine sandy loam	50	80	20	35	20	30	3.5	4.0
Sb	Sarpy loamy sand	35	55	15	25	15	25	3.0	3.5
Sc	Sarpy sand			5	10			1.0	2.3
SeA	Seymour silt loam, 0 to 2 percent slopes	35	65	15	30	18	30	1.3	2.8
SeB	Seymour silt loam, 2 to 5 percent slopes	30	65	15	30	18	30	1.5	3.0
SeB2	Seymour silt loam, 2 to 5 percent slopes, eroded	20	50	12	25	14	25	1.0	1.5
UnB2	Union silt loam, 2 to 10 percent slopes, eroded	20	50	12	28			1.0	2.5
UnB3	Union silt loam, 2 to 10 percent slopes, severely eroded	12	35	19	20				
UnC2	Union silt loam, 10 to 15 percent slopes, eroded	40	50	10	18			1.0	2.0
UnC3	Union silt loam, 10 to 15 percent slopes, severely eroded								
UnD2	Union silt loam, 15 to 25 percent slopes, eroded								
UtB2	Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded	15	40	7	20			.5	2.0
UtC2	Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded	12	35	15	20			.5	2.0
We	Weir silt loam	20	50	8	20	10	20	.3	2.0
WdB2	Weldon silt loam, 2 to 10 percent slopes, eroded	15	45	8	20			.5	2.0
WfB2	Winfield silt loam, 2 to 10 percent slopes, eroded	30	60	15	30			1.2	3.2
WfC2	Winfield silt loam, 10 to 15 percent slopes, eroded	15	40	12	18			1.2	3.2
WfD2	Winfield silt loam, 15 to 25 percent slopes, eroded								
WfF2	Winfield silt loam, 25 to 40 percent slopes, eroded								
WtB	Winfield silt loam, terrace phase, 2 to 10 percent slopes	40	80	13	30	15	30	1.5	3.5
WtB2	Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded	30	60	15	30	10	20	1.2	3.2
WtC2	Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded	25	55	15	30			1.2	3.2

purpose of making maps and reports that will be useful to engineers.

It is not intended that this report will eliminate the need for on-site sampling and testing of soils for the design and construction of specific engineering works and uses. The report will be helpful primarily in planning more detailed field investigations to determine the in-place condition of the soil at the proposed construction site.

Some terms used by the soil scientist may be unfamiliar to the engineer. Most of these terms, as well as other special terms used in this report, are defined in the Glossary at the back of the report.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO).¹ In this system soil materials are classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clayey soils that have low strength when wet. For the soils tested, these groups are shown in table 4. Within

¹ AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus., Washington, D.C., 1961.

TABLE 4.—Engineering test data¹ for soil samples

Soil name and location	Parent material	Bureau of Public Roads report No.	Depth	Horizon	Moisture-density ²	
					Maximum density	Optimum moisture
Craig silt loam: SE¼NE¼ sec. 10, T. 43 N., R. 15 W.-----	Material weathered from cherty limestone and shale.	88927	Inches 0-10	A-----	Lb. per cu. ft. 108	Percent 16
		88928	12-18	B2-----	109	16
Craig silt loam, thick solum phase: NE¼NE¼ sec. 16, T. 45 N., R. 17 W.-----	Material weathered from cherty limestone and shale.	88929	0-10	A-----	97	22
		88930	14-22	B-----	99	22
		88931	36-42	C-----	98	23
Glensted silt loam: NE¼SE¼ sec. 9, T. 43 N., R. 15 W.-----	Material weathered from shale.	88932	0-9	A1-----	108	17
		88933	12-24	B-----	93	23
		88934	24-40+	C-----	105	20
Huntington silt loam: SW¼SW¼ sec. 11, T. 44 N., R. 15 W.-----	Local alluvium-----	88935	0-20	A1-----	108	16
McGirk silt loam: SE¼NE¼ sec. 20, T. 44 N., R. 14 W.-----	Material weathered from shale.	88936	0-10	A1-----	105	17
		88937	18-36	B1-----	96	24
Seymour silt loam: SW¼NE¼ sec. 7, T. 45 N., R. 17 W.-----	Loess-----	88938	0-10	A1-----	99	20
		88939	16-35	B1 and B2--	92	27
		88940	40-50	C-----	102	21
Union silt loam: SE¼SE¼ sec. 3, T. 44 N., R. 15 W.-----	Loess and material weathered from limestone.	88941	0-8	A1-----	104	17
		88942	12-30	B-----	104	20
		88943	30-42	C-----	108	18
SW¼NE¼ sec. 26, T. 44 N., R. 15 W.-----	Loess and material weathered from limestone.	88944	0-8	A1-----	107	16
		88945	12-26	B-----	101	22
		88946	26-40	C-----	107	19
Winfield silt loam: NW¼NW¼ sec. 1, T. 47 N., R. 15 W.-----	Loess-----	88947	0-10	A-----	106	16
		88948	15-30	B-----	102	21
		88949	30-46	C-----	104	20

¹ Tests performed by the Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

² Based on the Moisture-Density Relations of Soils Using a 5.5 pound Rammer and a 12-inch Drop, AASHO Designation T99-57, Method A.

³ Mechanical analyses according to the American Association of State Highway Officials Designation: T 88. Results by this

procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter

each of the principal groups, the relative engineering value of the soil material is indicated by a group index number. These numbers range from 0 for the best material to 20 for the poorest. For the soils tested, the group index number is shown in parentheses, following the soil group symbol in the next to last column of table 4.

Some engineers prefer to use the Unified soil classification system.² In this system the soils are identified according to their texture and plasticity and are grouped

according to their performance as engineering construction material. The system establishes 15 soil groups, which are divided as (1) coarse-grained soils (eight classes), (2) fine-grained soils (six classes), and (3) highly organic soils. The classification of the soils that were tested according to the Unified system is given in table 4.

Engineering test data

Samples from soils of eight of the principal soil series of Moniteau County were tested by standard AASHO procedures to help evaluate the soils for engineering purposes. The results of these tests, as well as the engineering classifications of the soils, are given in table 4.

² WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3-357, 2 v. Vicksburg, Miss., 1953.

taken from nine soil profiles, Moniteau County, Mo.

Mechanical analyses ³									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—				AASHO ⁴			Unified ⁵	
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.					0.002 mm.
100	99	100 98	98 94	93 89	87 88	64 80	24 30	18 24	30 35	9 14	A-4(S)----- A-6(10)-----	ML-CL. CL.
		100	99	99	97	78	37	29	41	13	A-7-6(9)-----	ML.
		100	99	98	97	85	45	37	47	21	A-7-6(14)-----	ML-CL.
		100	99	98	97	87	47	39	55	27	A-7-6(18)-----	MH-CH.
		100	96	92	87	66	24	20	31	9	A-4(S)-----	ML-CL.
		100	99	96	95	88	55	49	57	27	A-7-5(18)-----	MH-CH.
⁶ 97	96	94	92	89	87	78	46	40	58	37	A-7-6(20)-----	CH.
			100	98	91	62	22	17	29	7	A-4(S)-----	ML-CL.
		100	97	95	89	64	23	16	27	5	A-4(S)-----	ML-CL.
		100	99	96	93	81	53	48	60	34	A-7-6(20)-----	CH.
		100	99	99	94	72	29	22	36	11	A-6(S)-----	ML-CL.
		100	99	99	98	90	60	54	73	42	A-7-5(20)-----	CH.
		100	99	98	97	83	45	37	56	33	A-7-6(19)-----	CH.
			100	98	94	68	27	20	31	8	A-4(S)-----	ML-CL.
		100	99	97	95	84	48	39	51	26	A-7-6(16)-----	CH.
⁷ 97	97	96	93	89	85	68	35	27	37	16	A-6(10)-----	CL.
		100	97	95	89	65	22	16	27	6	A-4(S)-----	ML-CL.
		100	100	98	96	80	47	39	47	22	A-7-6(14)-----	CL.
100	99	98	95	89	86	74	36	29	37	16	A-6(10)-----	CL.
100	100	100	100	99	89	60	21	14	25	4	A-4(S)-----	ML-CL.
100	100	100	100	100	98	84	48	41	60	37	A-7-6(20)-----	CH.
100	100	100	100	100	96	75	36	28	41	21	A-7-6(13)-----	CL.

is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

⁴ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. AASHO Designation M: 145-49.

⁵ Based on the Unified Soil Classification System, Tech. Memo.

No. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers. March 1953.

⁶ In this layer 100 percent passed through a 1-inch sieve, and 99 percent passed through a ¾-inch sieve.

⁷ In this layer 100 percent passed through a 1½-inch sieve; 97 percent passed through a 1-inch sieve; and 97 percent passed through a ¾-inch sieve.

In this table moisture-density, or compaction, data are given for the soils that were tested. If a soil material is compacted at a successively higher moisture content, the density of the compacted material increases until the optimum moisture content is reached, provided the compactive effort remains the same. After that, the density decreases with increase in moisture content. The highest density obtained in the compaction test is termed maximum density. Moisture density data are useful in earthwork, for, as a rule, a soil is more stable if it is compacted to about the maximum dry density. This is done when the soil material is at approximately the optimum moisture content.

In this table the liquid limit and plasticity index are also given for the soils tested. The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid or plastic state. As the content of moisture is further increased, the material changes from

a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition.

Soil factors affecting engineering work

Table 5 shows some estimated physical properties of the soils in the county and gives estimates of their suitability for particular engineering uses.

In this table the soils of the Edina, Freeburg, Glensted, McGirk, Racoon, Seymour, Weir, and Weldon series have restricted internal drainage. They have a silty surface layer. Their subsoil is clayey, and the clay shrinks or swells when the content of moisture changes. These soils also have silty material below the clayey subsoil.

TABLE 5.—*Engineering interpretations for soils of Moniteau County*

Soil series and map symbols	Internal drainage ¹	Depth to seasonally high water table ²	Kind of material below solum	Suitability of subsoil and substratum for the growth of plants	Suitability as a source of sand or gravel	Suitability for farm ponds, and hazards if used for that purpose
Bewleyville (BeB2) -----	Medium -----	Inches (³)	Red clay and limestone.	Poor -----	Not suitable ----	Moderate; underlain by permeable, red clay.
Bodine (BoB, BoE, BoF) ----	Rapid -----	(³)	Red clay and limestone.	Poor -----	Not suitable ----	Poor; underlain by permeable, red cherty clay.
Chauncey (CaA) -----	Very slow -----	24	Gray, wet clay loam.	Moderate ----	Not suitable ----	Good.
Craig (CgB, CgB2, CrB, CrB2).	Medium -----	20	Red cherty clay and limestone.	Poor -----	Not suitable ----	Moderate; underlain by layers of chert.
Dunning (Dg, Du) -----	Medium to very slow.	20	Gray clay loam.	Moderate ----	Not suitable ----	Good.
Edina (EdB, EdB2) -----	Very slow -----	14	Medium-textured loess.	Moderate ----	Not suitable ----	Good.
Eldon (EnB) -----	Medium to rapid.	(³)	Red cherty clay and limestone.	Poor -----	Not suitable ----	Poor; underlain by permeable, red clay.
Freeburg (FrA, FrB) -----	Slow -----	24	Medium-textured sediments.	Moderate ----	Not suitable ----	Good.
Gasconade (GaB, GaE, GaF).	Very slow -----	6	Limestone or dolomite bedrock.	Moderate ----	Stone or gravel can be quarried.	Poor; bedrock is near the surface
Glensted (GsB, GsB2) ----	Slow -----	12	Shale and clayey material weathered from limestone.	Poor -----	Not suitable ----	Good.
Huntington (Hu) -----	Rapid -----	(³)	Loamy sediments.	Good -----	Gravel in streambeds.	Moderate; contains sandy strata.
Lindside (Ls) -----	Medium -----	(³)	Loamy sediments.	Moderate ----	Gravel in streambeds.	Good.

See footnotes at end of table.

TABLE 5.—*Engineering interpretations for soils of Moniteau County—Continued*

Soil series and map symbols	Internal drainage ¹	Depth to seasonally high water table ²	Kind of material below solum	Suitability of subsoil and substratum for the growth of plants	Suitability as a source of sand or gravel	Suitability for farm ponds, and hazards if used for that purpose
McGirk (McB, McB2)-----	Very slow-----	<i>Inches</i> 12	Clayey material or medium-textured sediments.	Moderate-----	Not suitable----	Good.
Melvin (Me)-----	Slow-----	24	Medium-textured sediments.	Moderate-----	Not suitable----	Good.
Onawa (On)-----	Medium to slow--	8	Stratified sand and clay.	Good-----	Not suitable----	Good.
Racoon (RaA)-----	Very slow-----	18	Clayey sediments--	Moderate-----	Not suitable----	Good.
Riverwash (Rw)-----	(⁴)-----	(⁴)	Stratified sand and clay.	Moderate-----	Good for sand---	Poor; hazard of overflow.
Sarpy (Sa, Sb, Sc)-----	Rapid to very rapid.	(³)	Loamy or sandy sediments.	Good-----	Good for sand---	Poor; sandy and permeable.
Seymour (SeA, SeB, SeB2)-----	Slow-----	15	Medium-textured loess.	Moderate-----	Not suitable----	Good.
Union (UnB2, UnB3, UnC2, UnC3, UnD2, UtB2, UtC2).	Medium-----	20	Material weathered from cherty limestone.	Moderate-----	Not suitable----	Moderate; cherty substratum.
Weir (We)-----	Slow-----	24	Medium-textured loess.	Moderate-----	Not suitable----	Good.
Weldon (WdB2)-----	Slow-----	12	Medium-textured loess.	Moderate-----	Not suitable----	Good.
Winfield (WfB2, WfC2, WfD2, WfF2, WtB, WtB2, WtC2).	Medium-----	(³)	Medium-textured loess.	Good-----	Not suitable----	Good.

¹ Terms used to describe internal drainage are defined in the Glossary.

² Depth at which free water or seep zones occur during wet seasons.

³ Five feet or more.

⁴ Variable.

Depth to a seasonally high water table is shown in table 5 because some soils have a zone that is saturated during part of the year. Drainage of this zone must be provided if a road is to be built across the soil. The Glensted, McGirk, and Seymour soils have a claypan subsoil. In these soils a temporary water table rises to a height above the subsoil in spring. In some years the Craig and Union soils have a similar water table that stands above the fragipan.

The kind of material below the solum is described because this information is needed where an excavation is to be deeper than 3 to 4 feet.

The suitability of the subsoil and substratum for the growth of plants is estimated for assistance in planning for the stabilization of banks and fills.

Few of the soils in the county are suitable as a source of sand or gravel. The Bodine, Eldon, and Gasconade soils, however, have cherty or stony material near the surface, and they are thus poor as a site for a farm pond.

Use of the Soils for Woodland

In the early 1800's, when white men first settled in large numbers in this county, about one-third of the area was covered by prairie vegetation and about two-thirds was covered by forest. The soils in the part covered by prairie were dark colored, and those in the part covered by forest were light colored (fig 13).

Since the early days, many of the forested areas have been cleared. Approximately 65,000 acres, or only about 25 percent of the total acreage in the county, was woodland in 1959. The wooded areas consist mainly of the steeper Bodine, Union, Gasconade, and Winfield soils. Most of these wooded areas are poorly suited to pasture or grain but are well suited to trees. In addition, the soils on the Missouri River bottom lands and on other bottom lands throughout the county have high potential for timber. The bottom-land soils are also desirable for crops and pasture, however, and most of the acreage has been cleared.

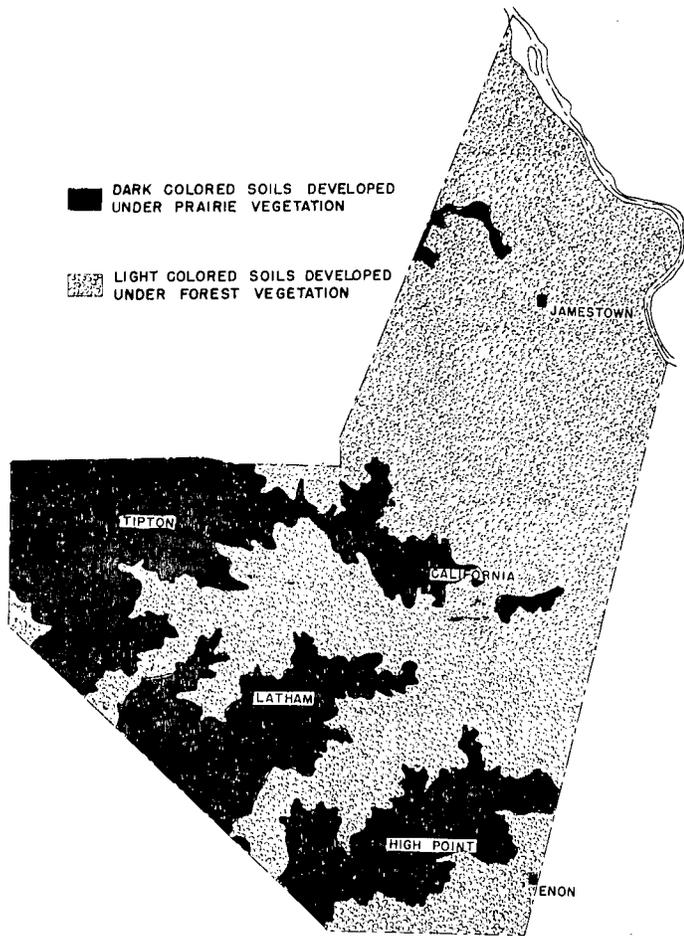


Figure 13.—Map showing the distribution of the soils formed under prairie and of the soils formed under forest.

The following listing gives the names of the major series in which the soils are used for timber, and suggests management needed for the soils of each series.

- | Soil series: | <i>Suggested management</i> |
|----------------------|--|
| Bodine and Union --- | The basic management needed for growing timber on the Bodine and Union soils consists of controlling grazing and using practices to improve the composition of the stand. A suitable practice consists of harvesting the mature trees in a way that favors the reproduction of desirable species. Another good practice that improves the stand is to remove or kill weak or cull trees. Some walnut trees may be planted on the Bodine soils, but walnut is generally not planted on the Union soils. |
| Gasconade----- | These soils are less desirable for trees than the other soils used for timber. Basic management consists of controlling grazing and improving the composition of the stand while investing the minimum amount of money. A suitable practice is to harvest the mature trees in a way that will encourage desirable species to reproduce. The stand may be improved by cutting weak or cull trees. |
| Winfield----- | The Winfield soils are the best soils for timber in this county. They are less subject to invasion by elm and redcedar than the other soils, but maple is a desirable species to encourage. A suitable practice consists of harvesting mature trees in a way to encourage desirable species and to improve the stand. Walnut may be planted on these soils. |

Table 6 gives some facts about the soils used for woodland. Growing Christmas trees and planting windbreaks to protect farmsteads are potential uses of the soils.

TABLE 6.—Estimated site class, species suggested for planting, and facts about species to favor in existing stands on the soils of four series

[Dashed lines indicate trees are not commonly planted on the soil]

Soil series	Site class (estimate) ¹	Species suggested for planting ²	Existing stands		
			Species to favor	Acceptable species	Least desirable species
Bodine-----	2	Walnut (on the lower slopes and in drainageways).	White oak, red oak, walnut.	Ash, chinkapin oak, redcedar.	Hickory, post oak, shingle oak.
Gasconade-----	1-1½	-----	Redcedar, white oak.	Walnut, red oak-----	Post oak, chinkapin oak, ash.
Union-----	2-2½	-----	White oak, black oak.	Cedar, ash, chinkapin oak.	Hickory, post oak, shingle oak.
Winfield-----	2½-3	Walnut-----	White oak, red oak, black oak, walnut.	Ash, cedar, chinkapin oak.	Hickory, maple.

¹ Number of 16-foot logs having a maximum diameter of 8 inches. The trees in site class 1 are capable of producing a maximum average annual growth of 90 board feet per acre in an unmanaged stand; the trees in site class 2 are capable of producing a maximum average annual growth of 150 board feet in an unmanaged stand; and those in site class 3 are capable of producing a maximum

average annual growth of 210 board feet in an unmanaged stand. Definitions of these site classes are from USDA Tech. Bul. 560, "Yield, Stand, and Volume Tables For Even-Aged Upland Oak Forests", by G. L. Sehnur, published in 1937.

² Does not include trees planted for windbreaks or Christmas trees.

Formation and Classification of Soils

In this section the factors of soil formation are discussed. Also discussed is the classification of the soils.

Factors of Soil Formation

In Moniteau County there are great differences in the morphological features of the soils, even though the number of soil series is small. The major differences among the soils are related to the following:

CLIMATE.—The climate of Moniteau County is such that the amount of moisture from precipitation exceeds that lost by evapotranspiration. Therefore, leaching takes place. The excess water percolates downward through the soil. As it passes through, it dissolves the bases and carries them out of the soil. As a result, most of the soils in this county are acid. Also, clay has been moved downward and has accumulated, to a varying degree, in the subsoils.

VEGETATION.—Part of this area was originally covered by prairie grasses, and part was covered by forest. The prairie vegetation on the nearly level uplands gave rise to dark-colored soils. The forest vegetation on the sloping, dissected areas gave rise to lighter colored soils. The parent material seems to affect the vegetation. Following is a listing of the soil series in the county according to the kind of parent material and the vegetation under which the soils formed:

Kind of parent material:	<i>Kind of vegetation</i>
Thick deposits of loess—	
Edina (8 feet thick)-----	Prairie.
Seymour (6 feet thick)-----	Prairie.
Weir (8 feet thick)-----	Forest.
Weldon (8 feet thick)-----	Forest.
Winfield (More than 10 feet thick)-----	Forest.
Thin deposits of loess over material weathered from cherty limestone—	
Bewleyville-----	Forest.
Craig-----	Prairie.
Glensted-----	Prairie.
McGirk-----	Forest.
Union-----	Forest.
Material weathered from limestone—	
Bodine-----	Forest.
Eldon-----	Prairie.
Gasconade-----	Forest.
Loess over alluvium—	
Chauncey-----	Prairie.
Freeburg-----	Forest.
Racoon-----	Forest.
Alluvium—	
Dunning-----	Forest.
Huntington-----	Forest.
Lindside-----	Forest.
Melvin-----	Forest.
Onawa-----	Forest.
Sarpy-----	Forest.

PARENT MATERIAL.—During the Pleistocene period, the entire area that is now Moniteau County was covered by loess. Prior to the time the loess was deposited, the soils in the area had formed mainly in products weathered from cherty limestone and dolomite. The loess buried these old soils. Later, erosion removed the loess from some areas so that the surface layer of the old soil is now the present surface layer. In other areas erosion cut even deeper, and in those areas part of the old soil is gone. In still other places a layer of loess remains over the old soils.

Many of the soils in the county were formed entirely or partly in loess, which is believed to have originated largely from the flood plains of the Missouri River. The deposit of loess is more than 20 feet thick on the bluffs along the river. It is thinner in areas back from the bluffs and is only about 6 feet thick near Tipton. Erosion has removed much of the loess from the slopes throughout the county, and the underlying material is exposed. Of the soils on uplands, however, those in three series only are believed to be free of loessal parent material throughout the entire profile. These are the Bodine, Eldon, and Gasconade soils.

The land surface that was buried by loess and that was later partly exposed or was removed by erosion is of special significance in some soils. The soils that made up this old land surface were largely derived from products weathered from limestone. Chert, or flint rock, accumulated as the limestone weathered. Hence, many of the soils were cherty.

The sloping soils of the old land surface contained the most chert, apparently because, when erosion took place, the coarser fragments of chert were left behind. These coarser fragments accumulated on or near the surface. In present-day roadcuts or other cuts that expose the soil material to a great depth, the abrupt boundary between the band of chert and the overlying loess can be seen. Also evident below the band of chert is the red, or gray and red cherty clay that is underlain by limestone or dolomite. The buried cherty material is present in the lower horizons of the Union, Craig, and Glensted soils. In all of these soils, the upper part of the profile formed almost entirely in loess.

The soils of the Eldon and Bodine series appear to be typical of soils in which an old, cherty soil was once buried but has since been exposed as the result of erosion. The old, cherty soil forms the present surface layer of these soils. Evidence of this can be found in the soils that adjoin the Eldon and Bodine soils. The Eldon soils adjoin areas of Craig soils. The cherty layer that is at the surface in the Eldon soils can be traced laterally and is found to be continuous with the cherty layer that is covered by approximately 20 inches of loess in the Craig soils. Likewise, the cherty layer that is the surface layer of the Bodine soils can be traced laterally to the adjoining Union soils, where it is covered by at least 30 inches of loess.

Table 7 gives the results of mechanical and chemical analyses of an Eldon cherty loam. The concentration of coarse chert fragments is evident in this soil. The low base saturation and low pH values indicate that this soil is highly leached.

Classification of the Soils

Soils can be classified in several ways to bring out their relationship to one another. In the highest category of the classification scheme are the three orders—the zonal, intrazonal, and azonal. The zonal order is made up of soils that have evident, genetically related horizons that reflect the predominant influence of climate and plant and animal life in their formation. The intrazonal order is comprised of soils that have evident, genetically related horizons that reflect the dominant influence of a local factor, such as relief or parent material, over the effects of climate and plant and animal life. The azonal order is made up of soils that lack distinct, genetically related hori-

TABLE 7.—*Mechanical and chemical analyses of an Eldon cherty loam*

[Samples taken in Moniteau County SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 44 N., R. 17 W., 3 $\frac{1}{2}$ miles S. and $\frac{1}{4}$ mile W. of Tipton]

Sample and laboratory number	Horizon	Depth from surface Inches	pH	Organic carbon Percent	Size class and diameter of particles (in millimeters)								Other classes (in millimeters)		Exchangeable cations (milliequivalents per 100 grams of soil material)						Base Saturation Percent
					Very coarse sand (2.0-1.0)	Coarse sand (1.0-0.5)	Medium sand (0.5-0.25)	Fine sand (0.25-0.1)	Very fine sand (0.1-0.05)	Silt (0.05-0.002)	Clay less than (0.002)	0.02-0.002 Percent	Greater than 2 Percent	Ca	Mg	K	Na	H	Sum		
51Mo-68-1-1:	A1	0-11	5.4	2.27	2.9	5.9	11.1	4.8	38.2	27.0	20.8	79	6.2	2.2	0.5	0.2	8.5	17.6	52		
51732	A3	11-18	5.2	.92	5.1	10.4	4.4	4.4	29.1	28.5	17.5	83	4.4	1.7	.4	.2	6.1	12.8	52		
51733	B21	18-25	4.7	.51	1.9	6.3	3.8	3.8	18.2	66.6	13.6	18	7.7	5.6	.4	.2	12.8	26.7	52		
51734	B22	25-38	4.7	.44	6.0	8.7	1.9	1.9	11.7	65.9	9.0	37	6.9	6.0	.2	.2	16.8	30.4	45		
51735	B22	38-46	4.7	.23	3.8	10.6	4.7	4.7	16.1	58.2	11.7	26	5.7	5.1	.5	.2	13.6	25.1	46		

zons, commonly because of youth, resistant parent material, or steep topography.

Below the soil orders are the great soil groups, the soil series, and the soil type. All the soils of a great soil group have major features of their profile in common. The horizons in the profile are arranged in the same way, but they may differ in such characteristics as the thickness of the profile and in degree of development of the different horizons.

Most soil series have characteristics that are within the range of those of a particular great soil group, and, as a result, they are classified in that group. A few soil series, however, have some characteristics of two great soil groups. Such soil series are placed in the great soil group they most nearly resemble, but they are considered to be intergrading toward the other great soil group. The Seymour soils, for example, have a dark A1 horizon and other characteristics similar to those of Brunizems. They also have a high content of clay in the B horizon, a weakly expressed A2 horizon, and an abrupt boundary between the A and B horizons, which are characteristics of Planosols. The Seymour soils are therefore classified as Brunizems that are intergrading toward Planosols.

The classification of the soils in the county is based largely on characteristics observed in the field. It may be revised as knowledge about the soil series and their relations increases. The great soil groups recognized in this county are the Brunizem, Gray-Brown Podzolic, Red-Yellow Podzolic, Humic Gley, Planosol, Alluvial, and Lithosol. Table 8 gives the names of the soil series in each great soil group.

TABLE 8.—*Classification of the soil series by higher categories*

ZONAL	
Great soil group	Soil series
Brunizem.	Craig. ¹ Eldon. Seymour. ²
Gray-Brown Podzolic.	Freeburg. Union. Weldon. Winfield.
Red-Yellow Podzolic.	Bewleyville. Bodine.
INTRAZONAL	
Humic Gley. Planosol (claypan).	Dunning. Chauncey. Edina. Glensted. McGirk. Racoon. Weir.
AZONAL	
Alluvial.	Huntington. Lindside. Melvin. Onawa. Sarpy.
Lithosol.	Gasconade.

¹ Intergrading toward the Red-Yellow Podzolic great soil group.
² Intergrading toward the Planosol great soil group.

Fragipan horizons.—Some soils of this county have a compact, brittle, acid layer, called a fragipan, below the B2 horizon. The fragipan has a weak, platy structure and a polygonal network of cracks that are filled with gray, silty material. Some roots penetrate the fragipan, but they are not present in large numbers.

The soils of the Union and Craig series have a fragipan. The soils of both of these series formed in loess over cherty material that, in many places, is an old, buried soil. The presence of this old soil at a depth of 20 to 36 inches has apparently encouraged the formation of a fragipan. Soils that contain a fragipan are apparently much less likely to occur where the thickness of the loessal deposit is less than 20 inches or is greater than 36 inches than where it is between 20 and 36 inches.

General Nature of the Area

This section gives facts about the climate, physiography, relief, and drainage in Moniteau County. It also describes the vegetation and water supply and gives facts about the agriculture and wildlife. Statistics used are mainly from the U.S. Bureau of the Census.

The county was originally occupied by the Osage Indians. Its name came from the Indian word "monitou," which was the Indians' name for God. In 1812, white settlers, primarily from Kentucky and Tennessee and from other parts of Missouri, came to the area. The county was formed in 1845. In 1960, the county had a population of 10,500, and in the same year California, the county seat and the largest town, had a population of 2,627. There were 588 miles of county roads and 150 miles of State roads in the county in 1959, and there were 39 miles of railroad.

Climate

Moniteau County has a temperate, continental climate typical of that in central Missouri. The winters are short and moderate, except for short, cold periods. The summers are generally hot, although the temperature rarely rises higher than 95° F. In winter, the average temperature is 32°; in spring, 54°; in summer, 76°; and in fall, 57°. Table 9 gives data about the temperature and precipitation for Columbia, which lies 30 miles to the north of the county. The temperature and precipitation at Columbia are considered to be typical of those in Moniteau County.

The growing season in this county lasts for 183 days. The average date of the last killing frost in spring is April 12, and the average date of the first killing frost in fall is October 20. Frost has occurred as late as May 25, however, and as early as September 13. The average number of days of sunshine is 280.

Rainfall is well distributed throughout the year. About 84 percent of the moisture from rainfall is received in the spring, summer, and fall months. Moisture is usually plentiful for crops, but crops are sometimes damaged during dry periods, especially on the shallow soils that have low water-holding capacity. During wet periods, crops on the more poorly drained soils are occasionally injured by too much moisture. Sometimes the precipitation is in the form of slow, steady rains, but at other times

TABLE 9.—*Temperature and precipitation at Columbia, Boone County, Mo.*
[Elevation, 778 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1953)	Wettest year (1927)	Average snowfall
January-----	° F. 30.3	° F. 77	° F. -18	<i>Inches</i> 1.89	<i>Inches</i> 1.36	<i>Inches</i> 1.75	<i>Inches</i> 4.4
February-----	33.1	76	-9	1.82	1.51	.57	2.6
March-----	43.3	85	-5	2.89	3.66	7.65	4.7
April-----	54.9	90	20	3.68	2.86	5.17	.5
May-----	64.5	93	33	4.73	2.66	6.68	(³)
June-----	73.7	102	41	4.73	1.06	6.11	0
July-----	78.0	113	49	3.47	2.60	3.07	0
August-----	76.7	103	46	3.85	2.82	5.01	0
September-----	69.1	102	29	4.29	2.72	2.38	0
October-----	57.9	92	21	2.90	2.31	5.08	(³)
November-----	44.0	82	4	2.24	1.42	4.29	1.3
December-----	33.9	75	-12	1.82	1.06	1.94	3.2
Year---	54.9	113	-18	38.31	25.12	49.70	16.7

¹ Average temperature based on a 55-year record, through 1959; highest and lowest temperatures on a 20-year record, through 1959.

² Average precipitation based on a 55-year record, through 1959; wettest and driest years based on a 55-year record, in the period 1905-1959; snowfall, based on a 11-year record, through 1959.

³ Trace.

it comes as a heavy downpour that lasts for only a short period. Thunderstorms and heavy rains that last for only a short time are common in summer.

There are some local variations in climate. These are apparently caused by the heavy rains that last for only a short period. When such rains occur, one part of the county may receive plenty of moisture, but another may need rain. Local variations in temperature are minor, for, as a rule, the temperature is only slightly affected by differences in elevation and in relief or air drainage. The crops in small valleys are sometimes damaged by frost, however, before the crops on the ridges.

Physiography, Relief, and Drainage

Moniteau County is divided into four major physiographic areas. These are the flood plain of the Missouri River; the part of the county, called the river-hill area, which is underlain by loess; the prairie area near Tipton, where many of the soils contain a claypan; and the area that borders the Ozarks in the southern part of the county.

The broad upland plain that once made up this county has been altered as the result of erosion. Now all that remains of the plain are gently sloping interstream divides. On these divides are the major towns—James-town, California, Tipton, and High Point.

The tops of the interstream divides, which are higher than other areas in the county, have an elevation of 850 to 960 feet. The flood plain of the Missouri River is lower than other places in the county and has an elevation of about 560 feet. The elevation at Fortuna is 958 feet; at Tipton, 921 feet; and at California, 888 feet. The valleys

of the creeks are generally less than one-half mile wide, and the areas bordering these valleys are sloping to steep.

The broad interstream divides are occupied by the Edina, Seymour, and Weldon soils, which formed in loess that is 30 to 60 inches thick. Toward the bluffs along the Missouri River are areas of Winfield soils, which formed in a deposit of loess that in some places is as thick as 10 to 12 feet. In the southern two-thirds of the county, the loess is underlain by silty and cherty material from dolomite of Ordovician age. In the northern part it is underlain by cherty limestone and by siltstone and shale of Mississippian age.

Drainage is generally toward the east in this county. North Moreau Creek and Moniteau Creek drain most of the county. Moniteau Creek empties into the Missouri River near the county line.

Vegetation

Two-thirds of the county was once under forest, according to estimates, and the rest was covered by prairie grasses or by mixed prairie and timber vegetation. Forests covered nearly all of the northern and eastern parts of the county and the areas along the major streams in the southern part. Prairie grasses covered the major stream divides in the southern part of the county.

Clearing of the forested areas began when the area was first settled, and it continued into the 1920's. In 1959, about 65,000 acres was in forest, according to the Missouri Soil and Water Conservation Needs Inventory for that year. That acreage is less than one-third of the total acreage estimated to have originally been covered by forest.

Water Supply

This county is in an area that has a favorable water supply. Wells or cisterns are used primarily to provide water for domestic use, and deep wells or reservoirs are used to supply water for municipal use.

The soils on the major divides and in the gently rolling parts of the county have a clayey subsoil that holds water well. In those areas ponds and reservoirs provide a dependable supply of water. The stony soils and soils formed in deep loess are less suitable for ponds and reservoirs. It is estimated that there are approximately 1,200 farm ponds in the county and that these have a total surface area of about 800 acres.

The Missouri River and Moreau and Moniteau Creeks provide a good supply of water where it can be used economically. The valley of the Missouri River is considered to have an unlimited supply of ground water with an estimated yield of 600 to 1,000 gallons per minute. In most of the county, however, there is a moderate yield of ground water; that is, the yield is between 150 and 600 gallons of water per minute at varying depths.³

Agriculture

Agriculture is the leading enterprise in Moniteau County, although there is some mining of zinc, lead, and

coal. In 1959, approximately 88 percent of the county was in farms. Of the acreage in farms, about 10,775 acres was in house lots, roads, wasteland, and similar uses.

There were 1,269 farms in the county in 1959. This represents a decrease of about 15 percent in the number of farms during the period 1954 to 1959. During the same period, the average size of farms increased about 14 percent. In 1959, the average-sized farm contained 186 acres.

Livestock farms other than poultry and dairy farms are more common than other types of farms in the county. In 1959, there were 587 farms in the county, 95 dairy farms, 86 cash-grain farms, and 70 general farms. In addition, there were 10 poultry farms and 421 farms that were miscellaneous and unclassified.

Corn is the crop grown most extensively in this county. In 1959, corn for all purposes was grown on 33,203 acres. In the same year hay was grown on 15,666 acres; small grains, on 20,686 acres; and sorghum, on 11,032 acres. Wheat was grown more extensively than other small grains. It was grown on 12,125 acres.

Wildlife and Recreation

Moniteau County has many areas that are suitable for game animals and birds. Many irregularly shaped areas that are well suited to wildlife form a border along fields, and there are scattered tracts of timber. In addition, narrow strips covered by brushy vegetation occur along drainageways and between the fields.

The Missouri River and Moreau and Moniteau Creeks provide water for fishing and for aquatic birds and animals. Clear pools in these creeks provide a favorable habitat for game fish. Catfish and rough fish inhabit the waters of the Missouri River, which are normally heavily laden with silt.

Most of the farm ponds have been stocked with bass and bluegill. The areas adjacent to the ponds have been fenced and seeded to plants that are suitable for food and cover for wildlife. Deer are not numerous in this county, but they are fairly common and are increasing.

The county has many valuable recreational areas. Areas of productive prairies, where there are many green pastures and farm ponds, are common. In places there are rolling, wooded hills interspersed with cultivated fields, and in a few places stony bluffs rise above the valley of the Missouri River. All these and the waters of the creeks and larger streams provide good facilities for recreation.

Glossary

Aggregate (soil structure). Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Fine 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.

Boundary, horizon. The division between two adjacent soil layers. An *abrupt* boundary is less than 1 inch wide.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is

³ COLLIER, JAMES E. AGRICULTURAL ATLAS OF MISSOURI. Agr. Expt. Sta. Bul. 645, 75 pp., illus. 1955.

commonly hard when dry and plastic or stiff when wet.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors, consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose. Noncoherent; will not hold together in a mass.

Friable. When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material; 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.

Drainage, natural. Refers to moisture conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. The following seven different classes of natural drainage are recognized:

Excessively drained soils are commonly very porous and rapidly permeable, and they have 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 medium texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately below the solum. They have a uniform color in the A horizon and upper part of the B horizon and have mottling in the lower part of the B horizon and in the C horizon.

Imperfectly, or somewhat poorly drained, soils are wet for significant periods but not all the time; the podzolic soils commonly have mottling below a depth of 6 to 16 inches in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward; mottling may be absent or nearly so, however, 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 lower part of the profile.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported by glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The relative position of the several horizons in a typical soil profile, and their nomenclature, are as follows:

- A0 Organic debris, partly decomposed or matted.
- A1 A dark-colored horizon having a fairly high content of organic matter mixed with mineral matter.
- A2 A light-colored horizon, often representing the zone of maximum leaching where podzolized; absent in wet, dark-colored soils.
- A3 Transitional to the B horizon but more like the A than the B; absent in some profiles.
- B1 Transitional to the B horizon but more like the B than the A; absent in some profiles.
- B2 A horizon that is generally dark colored; often represents the zone of maximum illuviation where podzolized.
- B3 Transitional to the C horizon.
- C Slightly weathered parent material; absent in some soils.
- D Underlying substratum.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid, and very rapid.*

Leaching, soil. The removal of soluble material from soils or other material by percolating water.

Loam. The textural class name for soil that contains a moderate amount of sand, silt, and clay. Loam soils have 7 to 27 percent of clay, 28 to 50 percent of silt, and less than 52 percent of sand.

Overwash material. Deposits from water erosion that lie thick enough on the soil to influence management significantly.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See also Horizon, soil.

Sand. Individual rock or mineral fragments that have a diameter ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sandy loam. Generally, soil of the sandy loam textural class is 50 percent sand and less than 20 percent clay.

Silt loam. Soil material having (1) 50 percent or more of silt and 12 to 27 percent of clay or (2) 50 to 80 percent of silt and less than 12 percent of clay.

Silty clay. Soil of this textural class has 40 percent or more of clay and 40 percent or more of silt.

Silty clay loam. Soil of this textural class has 27 to 40 percent of clay and less than 20 percent of sand.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in a mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent 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 the 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 have rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhere together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches thick.

Terrace (agricultural). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts runoff so that it can 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.

Texture, soil. The relative proportions of sand, silt, and clay particles in a soil. See also Clay; Sand; Sandy loam; Silt loam; Silty clay; and Silty clay loam.

Upland (geologic). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

[See table 1, p. 8, for the acreage and proportionate extent of the soils; table 2, p. 22, for examples of cropping systems and supporting practices; and table 3, p. 31, for estimated yields of crops. For facts about woodland, turn to the section "Use of the Soils for Woodland," p. 35, and for facts significant to engineering, turn to the section "Engineering Properties of Soils," p. 30]

<i>Map symbol</i>	<i>Mapping unit</i>	<i>Page</i>	<i>Capability unit</i>	<i>Page</i>
BeB2	Bewleyville silt loam, shallow phase, 2 to 10 percent slopes, eroded.....	7	IIIe-6	27
BoB	Bodine cherty silt loam, shallow over clay, 5 to 10 percent slopes.....	8	IVe-3	28
BoE	Bodine cherty silt loam, shallow over clay, 10 to 20 percent slopes.....	8	VIIe-3	30
BoF	Bodine cherty silt loam, shallow over clay, 20 to 40 percent slopes.....	9	VIIe-3	30
CaA	Chauncey silt loam, 0 to 1 percent slopes.....	9	IIw-3	21
CgB	Craig silt loam, 2 to 10 percent slopes.....	10	IIIe-2	21
CgB2	Craig silt loam, 2 to 10 percent slopes, eroded.....	10	IVe-3	28
CrB	Craig silt loam, thick solum phase, 3 to 7 percent slopes.....	10	IIIe-2	21
CrB2	Craig silt loam, thick solum phase, 3 to 7 percent slopes, eroded.....	11	IIIe-2	21
Dg	Dunning silt loam.....	11	IIw-1a	21
Du	Dunning silty clay.....	11	IIIw-14	28
EdB	Edina silt loam, 2 to 5 percent slopes.....	11	IIIe-5	26
EdB2	Edina silt loam, 2 to 5 percent slopes, eroded.....	11	IVe-5	28
EnB	Eldon cherty loam, 2 to 10 percent slopes.....	12	IVe-3	28
FrA	Freeburg silt loam, dark surface variant, 1 to 2 percent slopes.....	12	IIw-1a	21
FrB	Freeburg silt loam, dark surface variant, 2 to 10 percent slopes.....	12	IIIe-6	27
GaB	Gasconade stony silty clay, 2 to 10 percent slopes.....	13	VIe-6	29
GaE	Gasconade stony silty clay, 10 to 20 percent slopes.....	13	VIe-6	29
GaF	Gasconade stony silty clay, 20 to 60 percent slopes.....	13	VIIe-6	30
GsB	Glensted silt loam, 2 to 5 percent slopes.....	13	IIIe-5	26
GsB2	Glensted silt loam, 2 to 5 percent slopes, eroded.....	13	IVe-5	28
Hu	Huntington silt loam.....	13	I-1	21
Ls	Lindside silt loam.....	14	IIw-1a	21
McB	McGirk silt loam, 2 to 5 percent slopes.....	14	IIIe-5	26
McB2	McGirk silt loam, 2 to 5 percent slopes, eroded.....	14	IVe-5	28
Me	Melvin silt loam.....	14	IIIw-3	28
On	Onawa silty clay.....	14	IIw-1b	21
RaA	Racoon silt loam, 1 to 2 percent slopes.....	15	IIIw-3	28
Rw	Riverwash.....	15	VIIIe-6	30
Sa	Sarpy fine sandy loam.....	16	I-1	21
Sb	Sarpy loamy sand.....	16	IIIe-4	28
Sc	Sarpy sand.....	16	IVs-4	29
SeA	Seymour silt loam, 0 to 2 percent slopes.....	16	IIIe-5	26
SeB	Seymour silt loam, 2 to 5 percent slopes.....	16	IIIe-5	26
SeB2	Seymour silt loam, 2 to 5 percent slopes, eroded.....	16	IVe-5	28
UnB2	Union silt loam, 2 to 10 percent slopes, eroded.....	17	IIIe-6	27
UnB3	Union silt loam, 2 to 10 percent slopes, severely eroded.....	17	IVe-6	29
UnC2	Union silt loam, 10 to 15 percent slopes, eroded.....	17	IVe-6	29
UnC3	Union silt loam, 10 to 15 percent slopes, severely eroded.....	17	VIe-6	29
UnD2	Union silt loam, 15 to 25 percent slopes, eroded.....	17	VIIe-6	30
UtB2	Union silt loam, thin solum phase, 2 to 10 percent slopes, eroded.....	17	IVe-6	29
UtC2	Union silt loam, thin solum phase, 10 to 15 percent slopes, eroded.....	17	VIIe-6	30
We	Weir silt loam.....	18	IIIw-3	28
WdB2	Weldon silt loam, 2 to 10 percent slopes, eroded.....	18	IIIe-5	26
WfB2	Winfield silt loam, 2 to 10 percent slopes, eroded.....	18	IIIe-6	27
WfC2	Winfield silt loam, 10 to 15 percent slopes, eroded.....	18	IVe-6	29
WfD2	Winfield silt loam, 15 to 25 percent slopes, eroded.....	18	VIe-6	29
WfF2	Winfield silt loam, 25 to 40 percent slopes, eroded.....	19	VIIe-6	30
WtB	Winfield silt loam, terrace phase, 2 to 10 percent slopes.....	19	IIIe-6	27
WtB2	Winfield silt loam, terrace phase, 2 to 10 percent slopes, eroded.....	19	IIIe-6	27
WtC2	Winfield silt loam, terrace phase, 10 to 15 percent slopes, eroded.....	19	IVe-6	29

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