

SOIL SURVEY

Daviess County, Missouri



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 Daviess County 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, drainage structures, and other structures; aid owners and managers in establishing or improving woodland; and add to our general knowledge about soils.

Locating the soils

Use the index to map sheets to find out which sheet of the large detailed map covers the area you wish to study. The index is a small map of the county on which numbered rectangles have been drawn to indicate what part of the county is shown on each sheet of the large map. The sheets comprising the large map are in the back of the report. Boundaries of the soils are outlined on each sheet, and each kind of soil has a special symbol. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Finding information

This soil survey report has special sections that will be of interest to different groups of readers.

Farmers and those who work with farmers can learn about the soils from the section "Descriptions of the Soils," and in the section "Use and Management of the Soils," which includes a part entitled "Estimated Yields." In this way they can first identify the soils on their farms and then learn how these soils can be managed and what yields can be expected.

The soils are grouped into capability units; that is, groups of soils that need similar management and respond in about the same way. For example, Shelby loam, 4 to 8 percent slopes, is in capability unit IIIe-6. The management this soil needs will be described under the heading "Capability Unit IIIe-6" in the section "Management by Capability Units."

Soil scientists can find information about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of the Soils."

Engineers will want to refer to the section "Engineering Properties of the Soils." The table in that section shows characteristics of the soils that affect engineering.

Teachers, real estate brokers, businessmen, newcomers to the area, and other users will find information on population, climate, vegetation, land use, flood control, wildlife and recreation, and other characteristics of the county in the section "General Nature of the Area."

Soil terms that may be unfamiliar to some readers are defined in the Glossary in the back part of the report. Following the Glossary, there is a "Guide to Mapping Units and Capability Units." This guide gives the name and map symbol for each soil mapped in the county and the page on which each soil is described. It also gives the capability unit in which each soil has been placed and the page on which the capability unit is described.

* * * * *

This soil survey is a part of the technical assistance furnished to the Daviess County Soil and Water Conservation District.

Cover picture: Aerial view showing pattern of native vegetation that originally covered most of Daviess County. Trees grew mainly on the rolling slopes, and prairie vegetation covered the gentle slopes and ridges between timbered areas. The Shelby and Gara soils are closely associated in these prairie-timber areas.

Contents

	<i>Page</i>		<i>Page</i>
How soils are named, mapped, and classified	1	Use and management of the soils—Con.	
General soil map	2	Estimated yields.....	26
1. Edina association.....	2	Engineering properties of the soils.....	26
2. Grundy-Seymour-Shelby association.....	2	Genesis, classification, and morphology of the soils	30
3. Lacona-Sampsel-Snead association.....	3	Factors of soil formation.....	30
4. Gara association.....	3	Climate.....	31
5. Mandeville-Keytesville-Snead association.....	3	Living organisms.....	31
6. Shelby association.....	3	Parent material.....	32
7. Wabash-Nodaway association.....	3	Relief.....	33
Descriptions of the soils	4	Time.....	33
Blockton series.....	5	Classification of the soils.....	33
Burrell series.....	6	Morphology of the soils by great soil groups.....	34
Edina series.....	8	Gray-Brown Podzolic soils.....	34
Gara series.....	9	Brunizems.....	34
Gosport series.....	9	Planosols.....	34
Grundy series.....	10	Humic Gley soils.....	34
Keytesville series.....	11	Rendzinas.....	35
Lacona series.....	11	Lithosols.....	35
Lagonda series.....	12	Alluvial soils.....	35
Mandeville series.....	13	General nature of the area	35
Nodaway series.....	13	Organization and population.....	35
Sampsel series.....	14	Physiography.....	35
Sandy terraces.....	14	Climate.....	35
Seymour series.....	15	Flood control.....	36
Shelby series.....	15	Vegetation.....	36
Snead series.....	17	Land use.....	36
Wabash series.....	17	Water supply.....	37
Use and management of the soils	18	Wildlife and recreation.....	37
Capability groups of soils.....	18	Glossary	37
Management by capability units.....	19	Guide to mapping units and capability units	39

i

SOIL SURVEY OF DAVIESS COUNTY, MISSOURI

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

DAVIESS COUNTY is in the northwestern part of Missouri (fig. 1). It has a total area of 360,320 acres, or 563 square miles. Gallatin is the county seat.

Agriculture is the principal enterprise in the county, and about 91 percent of the land area is in farms. A general livestock type of farming is commonly followed. The sale of livestock and livestock products accounts for nearly 70 percent of the total farm income.



Figure 1.—Location of Daviess County in Missouri.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soil are in Daviess 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 or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, one needs 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. Grundy and Shelby, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference 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. Wabash clay and Wabash silty clay loam are two soil types in the Wabash series. The difference in texture of their surface layers 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. In Daviess County some soil types are divided into phases, primarily on the basis of differences in slope, because these differences affect management. For example, Shelby loam, 4 to 8 percent slopes, is one of two phases of Shelby loam, a soil type that ranges from gently sloping to moderately steep.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because they show woodland, buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The detailed 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 the map of Daviess County, the soil scientists had a problem of delineating areas so intricately mixed, so small in size, or so worked by wind and water that they could not be called soils. These areas are shown on the soil map like other mapping units, but they are given the descriptive name Sandy terraces, and they are called a miscellaneous land type rather than a soil.

Only part of the soil survey was done when the soil scientists had named and described the soil series and mapping units and had shown the location of the mapping units on the soil map. The detailed information they had recorded then needed to be presented in different ways for farmers, engineers, and others.

To do this efficiently, the soil scientists had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units designed primarily for those who want to plan cropping systems.

General Soil Map

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

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

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

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

The seven soil associations, or kinds of soil patterns, in Daviess County are shown on the colored map in the back of this report. The associations are named after the major soil series in them and are also given local descriptive names.

The most important agricultural sections are in the Grundy-Seymour-Shelby association, which occurs throughout the county, and in the Wabash-Nodaway association, which extends diagonally across the county, along the flood plains of the Grand River. The other soil associations are less extensive, but each has a distinct pattern of soils, and the differences in the soils are important on the farms within each association.

1. Edina association: Level or nearly level, very poorly drained or poorly drained claypan soils formed from loess

The soils of this association occur in the northeastern part of the county on a fairly broad ridge that extends from near Jamesport to Gilman City (Harrison County). This association covers approximately 3 percent of the county.

The Edina soils cover nearly all of the area. They normally occur on nearly level parts of the broadest, most extensive divides. They have formed from windblown deposits about 60 inches thick. The native vegetation was prairie grass.

The Edina soils have a dark grayish-brown surface layer about 8 inches thick and a gray to nearly white sub-surface layer about 6 or 7 inches thick. The subsurface layer changes abruptly to a very dark gray silty clay sub-soil about 15 inches below the surface.

This association includes small acreages of Seymour and Shelby soils, which are on the slopes below the Edina soils.

Nearly all of this soil association is used for crops, mainly soybeans, corn, and rotation meadow. The soils are above average in productivity. They remain wet following heavy rains, and planting and harvesting of crops are frequently delayed. Protection against excess water is the main management need.

2. Grundy-Seymour-Shelby association: Gently rolling to strongly rolling, poorly drained to moderately well drained soils formed from loess or till

This is the most extensive soil association, and it covers approximately 35 percent of the county. It is well distributed and occupies narrow ridgetops and adjacent sloping to steep areas.

The Shelby soils occupy the largest acreage. They are moderately well drained and have developed from glacial drift of Kansan age. They have a very dark grayish-brown loamy surface layer over a mottled yellowish-brown clay loam subsoil.

The Grundy soils are also extensive but normally are less rolling than the associated Shelby soils. Grundy soils have developed in 40 to 50 inches of windblown material that overlies glacial till. They have a very dark brown silt loam surface layer and a very dark grayish-brown, plastic silty clay subsoil.

The Seymour soils are primarily in the northeastern part of the county, adjacent to Edina silt loam. Seymour soils are similar to Grundy soils, but they differ primarily in that they have a slightly lighter colored surface soil,

a grayer subsurface layer, and a somewhat grayer, more mottled and finer textured subsoil.

Most areas of this association are used for crops, but large areas are in timber or pasture.

3. Lacona-Sampsel-Snead association: Dark-colored, rolling to steep, poorly drained to well-drained soils over shale or limestone

This soil association covers about 10 percent of the county. Most of the areas are on the south bluff of the Grand River and are generally rolling to steep. There are some small, gently sloping areas. The soils of this association are dark grayish brown to nearly black. They have formed mainly from the residuum of limestone and shale of Pennsylvanian age.

The main soils of this association are the Lacona, Sampsel, and Snead. The Lacona soils have a dark grayish-brown silty surface soil and a uniform yellowish-brown silty clay subsoil. They have formed in a thin covering of silt over clayey material derived from limestone and shale. These soils are moderately well drained to well drained and are highly productive. Erosion is the main hazard when they are used intensively.

The Sampsel and Snead soils have a very dark brown to black silty surface layer and a dark-gray to light olive-gray, plastic silty clay and clay loam subsoil. Partly weathered limestone and shale are generally at a depth of more than 36 inches in the Sampsel soils and 24 inches or less in the Snead soils. Slopes are generally rolling to steep. On steep, precipitous slopes, the soils have stones on the surface and throughout the profile.

The Snead and Sampsel soils were originally forested. Nearly all of the Sampsel soils are now farmed, and most of the Snead soils are now in grass or trees. These soils are rich in calcium, have an accumulation of organic matter, and are dark in color. They are highly fertile and produce good yields of suitable crops. Erosion and the steep, inaccessible slopes, which are stony in some places, limit the use of these soils.

4. Gara association: Moderately dark colored, rolling to steep, moderately well drained soils formed from till

This soil association consists of several small areas scattered throughout the county, mainly on the steeper slopes of the prairie. It covers about 4 percent of the county.

The Gara are the main soils of this association. They have formed from glacial till. Timber encroached on the original prairie grass, and the Gara soils that formed under this vegetation have a dark grayish-brown loamy surface layer and a yellowish-brown, mottled clay loam subsoil.

Most of the less rolling slopes of the Gara soils are cultivated. The steeper slopes, which are not suited to cultivation, are in grass and trees. The Gara soils are of medium productivity. Susceptibility to erosion is their main limitation.

5. Mandeville-Keytesville-Snead association: Moderately sloping to steep, poorly drained or moderately well drained soils over shale and limestone

This soil association covers about 8 percent of the county. It occurs in a spotted pattern along the major streams, primarily in the southeastern and northwestern parts of the county.

The Mandeville, Keytesville, and Snead are the main soils in this association. The Mandeville soils are dark grayish brown, moderately well drained, and moderately sloping. They are underlain by unweathered shale, generally at a depth of 20 to 40 inches below the surface.

The Keytesville soils are on low slopes or benches. They have a light-colored surface soil, a pale-brown subsurface layer, and a plastic silty clay subsoil. These soils have formed from a mixture of residual, glacial, and loessal material, and they are of low productivity.

The Snead soils have a very dark brown to black surface layer and a grayish-brown or olive, plastic subsurface layer that grades to unweathered shale at a depth of 20 to 30 inches. They are generally high in calcium and, in many places, fragments of limestone are scattered throughout their profile.

Most of the Keytesville soils are cultivated. These soils occur as small, scattered areas and are intermingled with other soils. Consequently, they are better suited to hay, grass, or wood crops than to legumes and grain crops.

The Mandeville soils are better drained and somewhat more productive than the Keytesville soils. They generally lack mineral nutrients, however, because these minerals were deficient in the shale parent rock. Erosion is a severe hazard on the Mandeville soils.

The Snead soils were derived from calcareous shale and limestone and are productive of trees and grass. Erosion is severe in areas unprotected by living vegetation.

6. Shelby association: Gently rolling to strongly rolling, moderately well drained soils formed from till

This soil association, the second most extensive in the county, covers about 20 percent of the acreage. It is made up mainly of the Shelby soils.

The Shelby soils have formed in a thick mantle of glacial till. They have a very dark grayish-brown surface layer and a mottled brown and yellowish-brown, gritty clay loam subsoil. The thickness of the surface layer varies from place to place, because of erosion or deposition of material. The subsoil varies in texture, because of differences in the material from which it has formed.

Where uneroded, the Shelby soils are productive. Corn and grass are the major crops, but yields differ greatly. Most of the soils with slopes of more than 10 percent are used for pasture. In many places the slopes are short and irregular, and many fields are divided by gullies that cannot be crossed with farm machinery.

7. Wabash-Nodaway association: Dark or moderately dark colored, poorly drained to well-drained soils of the flood plains

This soil association covers nearly 20 percent of the county and occurs in the valleys of the major streams and their tributaries. The most extensive areas are along the Grand River in the southeastern and northwestern parts of the county. These areas are connected by a thin band of alluvial soil where the river valley narrows in the central part of the county. Slopes are gentle to nearly level, and flooding is a hazard in some places during seasons of heavy rainfall.

The Nodaway and Wabash are the principal soils in this association. Nodaway soils are extensive throughout the bottom lands. They are made up of recent alluvium and receive fresh sediments during floods or through stream-

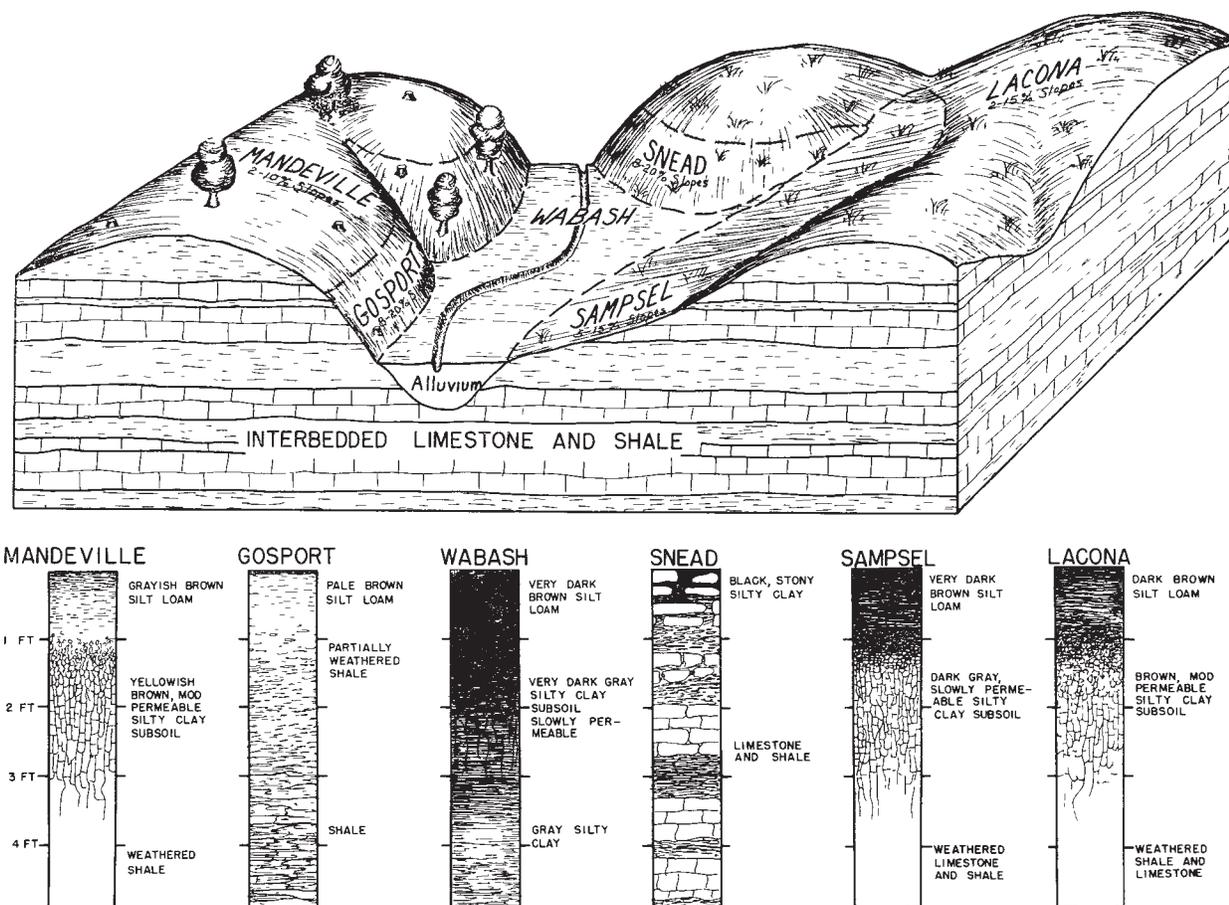


Figure 2.—Relationship of some soils to parent material, topography, and native vegetation. The diagram and profiles at left

bank erosion. They are mainly well-drained fine sandy loam to silt loam. Some of the Nodaway soils are on low alluvial fans that have formed where small streams enter the larger valleys.

The Wabash soils are darker than the Nodaway soils, and they contain more clay and are more poorly drained. The Wabash soils have a silt loam, silty clay loam, or clay surface layer.

The silty soils of the bottom lands—Nodaway silt loam, Wabash silt loam, and Wabash silty clay loam—are highly productive. Corn, wheat, and soybeans are the main crops. Much of the area along the flood plain is subject to flooding, but some areas are not flooded. Flooded areas are generally left in timber or are used for pasture. The other areas are farmed extensively.

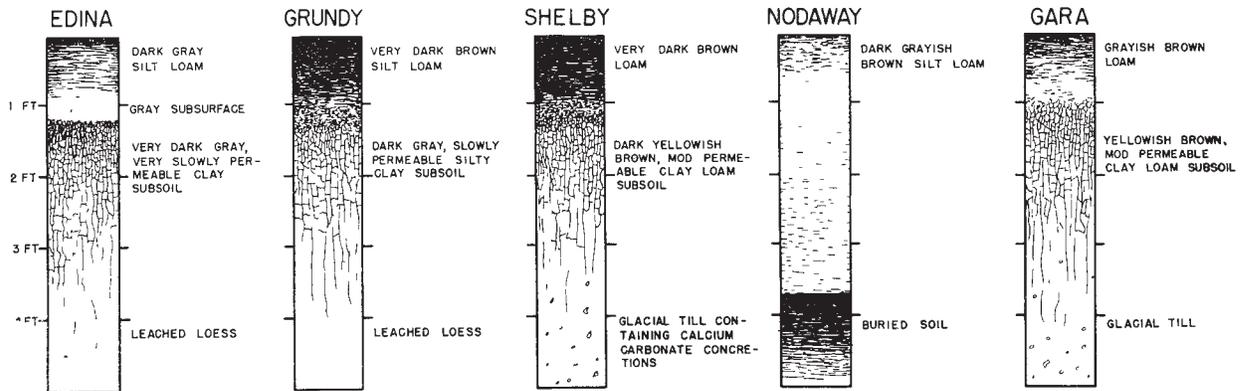
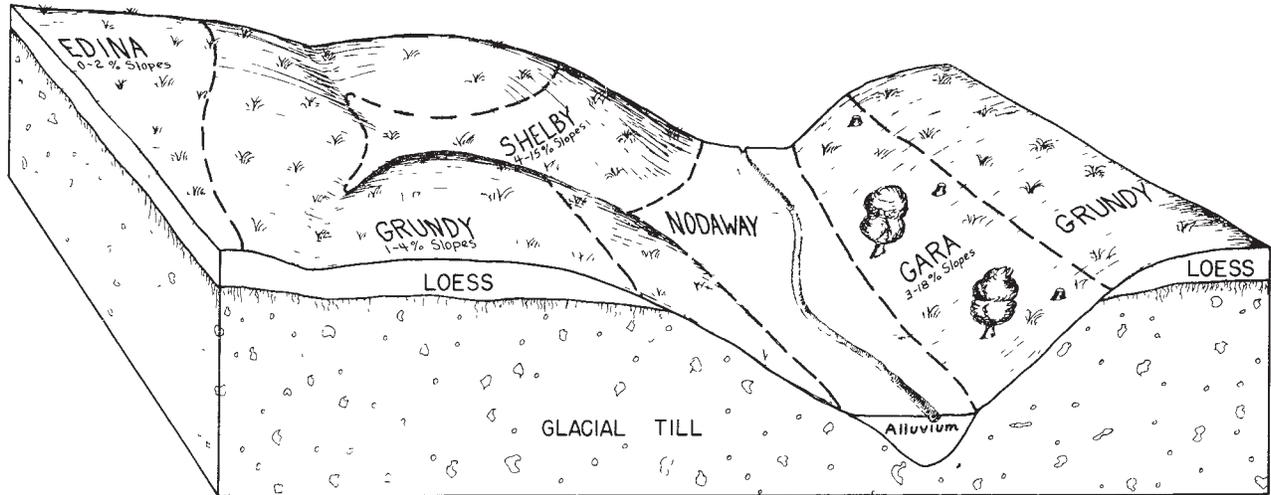
The clayey Wabash soils occupy large, uniform areas of broad bottom lands along the Grand River. These soils are sticky and plastic when wet, but they shrink and crack to a great depth when dry. Their original vegetation was swamp grass, and there are still some extensive areas in this kind of vegetation. These clayey soils are commonly cultivated, but yields are irregular because the soils are likely to be either too wet or too dry.

Descriptions of the Soils

In this section each soil series in the county is described. Generally, only one soil (mapping unit) in each series is described in detail. If there are other soils in a particular series, these are normally described by comparing them with the soil that is described in detail. There is also a description of the miscellaneous land type, Sandy terraces.

The soil descriptions contain information about the present use of the soils and their suitability for various crops. The need for lime and fertilizer is mentioned only in general terms. Soil samples from each field should be tested to determine the amounts of lime and fertilizer needed. Farmers can get help in taking soil samples from the local office of the Agricultural Extension Service. Additional information about the soils is given in the section "Use and Management of the Soils."

The location and distribution of each soil in the county is shown on the detailed map in the back of the report. The approximate acreage and proportionate extent of each soil are given in table 1. A summary of the features and properties of each soil is given in table 2. In figure 2 the relationship of some soils to parent material, topography, and native vegetation is shown.



are of soils formed from residual materials, and the diagram and profiles at right are of soils formed from loess and till.

Each soil name indicates the soil series to which the soil belongs and the texture of its surface layer. The name also shows, for most of the soils, the range of slope. Erosion is not indicated in the name of a soil, but the approximate amount of erosion that has occurred is mentioned in the soil description.

An important part of the description is the soil profile, a record of what the soil scientist saw and learned when he dug into the ground. All soils of one series have essentially the same kind of profile. The differences, if any, are explained in the descriptions of the soils. Following the name of each soil is a set of symbols in parentheses; for example, Shelby loam, 4 to 8 percent slopes (Sh) (Capability unit IIIe-6). The symbol Sh identifies the soil on the detailed map. The second symbol gives the capability unit designation for this particular soil.

In describing the soils, the scientist assigns a symbol, for example "A1" to the various layers. These symbols have special meanings that concern soil scientists and others who desire to make a detailed study of soils. Most readers will need to remember only that all letter symbols beginning with "A" indicate surface layer; those beginning with "B" indicate subsoil; and those beginning with "C" indicate substratum, or parent material.

The color of the soil can be described in words, such as "yellowish brown," or can be indicated by symbols for the hue, value, and chroma, such as (10YR 5/4). These symbols, called Munsell color notations,¹ are used by soil scientists to evaluate soil colors precisely. Standard soil terminology is used in describing soil texture, structure, and other characteristics of the soil.

Definitions of technical terms used in the soil descriptions are given in the Glossary at the back of this report.

Blockton Series

The Blockton series is made up of deep, dark-colored silty soils that have a dark-gray, plastic silty clay subsoil. These soils occur on terraces along the larger streams and are above areas that are normally overflowed. They consist of medium-textured alluvium and have nearly level to gentle slopes. They are very minor in extent and make up less than 1 percent of the acreage of the county.

Runoff is slow to medium, and internal drainage is slow. Erosion has been slight, except on some sharply breaking slopes between the bottom lands and the terraces. In some

¹ SOIL SURVEY STAFF. SOIL SURVEY MANUAL U.S. Dept. Agr. Handbook 18, 503 pp., illus. 1951.

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

Map symbol	Soil name	Acres	Percent
Bk	Blockton silt loam, 1 to 4 percent slopes	2,340	0.6
Bu	Burrell silt loam, 1 to 3 percent slopes	2,320	.6
Ed	Edina silt loam, 1 to 2 percent slopes	4,930	1.4
Et	Edina silt loam, terrace phase, 1 to 3 percent slopes	1,980	.5
Ga	Gara loam, 3 to 8 percent slopes	7,470	2.1
Gb	Gara loam, 9 to 18 percent slopes	12,220	3.4
Gp	Gosport silt loam, 8 to 20 percent slopes	6,920	1.9
Gr	Grundy silt loam, 1 to 4 percent slopes	53,510	14.9
Gt	Grundy silt loam, terrace phase, 1 to 4 percent slopes	2,800	.8
Kv	Keytesville silt loam, 3 to 7 percent slopes	7,210	2.0
La	Lacona silt loam, 2 to 8 percent slopes	10,300	2.9
Lb	Lacona silt loam, 9 to 15 percent slopes	5,060	1.4
Lg	Lagonda silt loam, 2 to 8 percent slopes	29,280	8.1
Ma	Mandeville silt loam, 2 to 5 percent slopes	4,030	1.1
Mb	Mandeville silt loam, 6 to 10 percent slopes	2,170	.6
No	Nodaway silt loam	34,010	9.4
Sa	Sampsel silt loam, 5 to 15 percent slopes	7,130	2.0
Sb	Sandy terraces	490	.1
Se	Seymour silt loam, 1 to 4 percent slopes	13,930	3.9
Sh	Shelby loam, 4 to 8 percent slopes	62,850	17.5
Sm	Shelby loam, 9 to 15 percent slopes	21,360	5.9
Sn	Snead silty clay, 6 to 15 percent slopes	5,380	1.5
Ss	Snead stony silty clay, 8 to 20 percent slopes	14,100	3.9
Wa	Wabash clay	9,760	2.7
Wb	Wabash silt loam	31,570	8.8
Ws	Wabash silty clay loam	7,200	2.0
	Total	360,320	100.0

places colluvial-alluvial material from higher slopes has been deposited on the surface. This material is 2 to 8 inches thick. The Blockton soils are similar to Grundy silt loam, terrace phase, 1 to 4 percent slopes. They differ from this Grundy soil primarily in having a slightly more dense silty clay subsoil and more gray coatings in the subsurface layer.

The fertility of the Blockton soils is high. Most of the acreage is used for corn. The major crop hazard is slightly excessive wetness, caused by the gentle slopes, slowly permeable subsoil, and runoff from fields on adjacent hills. The soils are well adapted to all common crops and are excellent for grass.

Blockton silt loam, 1 to 4 percent slopes (Bk) (Capability unit IIe-6).—This is the only Blockton soil in the county. A profile of this soil observed in a moist legume-grass meadow in the central part of the NE $\frac{1}{4}$ sec. 35, T. 58 N., R. 27 W., is described as follows:

Ap—0 to 8 inches, very dark gray (10YR 3/1), friable silt loam; crumb structure.

A1—8 to 12 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, granular structure; gray silt coatings show when soil is dry.

B1—12 to 17 inches, very dark gray (10YR 3/1) light silty clay loam; moderate, fine, subangular blocky structure; after drying, soil aggregates show thin, gray silty coatings that disappear when aggregates are crushed or moistened; a few, small, dark concretions.

B21—17 to 24 inches, very dark gray (10YR 3/1), plastic silty clay faintly mottled with dark yellowish brown (10YR 4/4); moderate, fine, subangular blocky structure; clay films prominent in pores and on some faces of aggregates; gray silt coatings noticeable on dry aggregates.

B22—24 to 37 inches, mottled dark-gray (10YR 4/1), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/4), very plastic silty clay; weak, medium and coarse, subangular blocky structure; a few, soft, strong-brown and black concretions.

B3—37 to 52 inches, mottled dark grayish-brown (10YR 4/2), yellowish-brown (10YR 5/4), and gray (10YR 5/1), plastic silty clay; massive; firm but becomes slightly more friable with depth.

C—52 to 60 inches +, highly spotted and mottled gray (10YR 5/1), yellowish-brown (10YR 5/8), and brown (10YR 5/3) light silty clay to silty clay loam; sand content and yellowish-brown color increase with depth.

This soil normally has fairly uniform characteristics. Some variations occur in the degree of brown mottling in the subsoil; in the thickness of the B1 horizon; and in the thickness and color of the surface soil, as affected by the deposition of soil material.

The brown mottles in the B horizon increase and the gray colors decrease on slopes where terraces join the bottom lands. The B1 horizon, or the transition from the surface layer to the plastic subsoil, is 1 to 2 inches thick in nearly level areas and as much as 8 inches thick in the gently sloping areas adjacent to sharp breaks in the terrain.

Overwash and erosion may cause the color of the surface layer to vary from the normal color of very dark gray. Much of the Blockton soil is below areas of dark-colored soils derived from limestone. Where colluvial-alluvial material from these higher areas has been deposited, the surface layer of the Blockton soil is darker than normal. Where light-colored timbered soils have contributed to the overwash material, the surface layer is lighter than normal. The surface layer is as much as 15 to 20 inches thick where the colluvial-alluvial deposits occur, but it is very thin or lacking where erosion has been severe. Where erosion has removed the original surface layer, tillage implements reach into the silty clay loam and silty clay subsoil. As a result, the plow layer consists of heavy silt loam to light silty clay loam. Where erosion has been severe, silty clay from the lower part of the subsoil is exposed on the surface.

Burrell Series

The Burrell series is made up of light-colored silty soils that are poorly drained. These soils are on nearly level and gently sloping stream terraces, generally above areas that are subject to overflow. They are not extensive and normally occur as small, scattered areas that make up less than 1 percent of the county.

Burrell silt loam, 1 to 3 percent slopes (Bu) (Capability unit IIIw-3).—This is the only soil of the Burrell series in the county. A profile of this soil observed in a

TABLE 2.—Summary of features and properties of the soils

Map symbol	Soil	Color		Texture of subsoil	Internal drainage	Parent material	Native vegetation	Erosion hazard
		Surface soil	Subsoil					
Bk	Blockton silt loam, 1 to 4 percent slopes	Very dark gray.	Very dark gray.	Silty clay---	Slow-----	Alluvium, or loess over alluvium.	Prairie-----	Slight.
Bu	Burrell silt loam, 1 to 3 percent slopes.	Gray-----	Dark grayish brown	Silty clay---	Slow-----	Alluvium, or loess over alluvium.	Forest-----	Slight.
Ed	Edna silt loam, 1 to 2 percent slopes.	Dark grayish brown	Very dark gray.	Silty clay---	Very slow--	Loess-----	Prairie-----	Slight.
Et	Edina silt loam, terrace phase, 1 to 3 percent slopes.	Dark grayish brown.	Very dark gray.	Silty clay---	Very slow--	Alluvium, or loess over alluvium.	Prairie-----	Slight.
Ga	Gara loam, 3 to 8 percent slopes.	Dark grayish brown.	Yellowish brown.	Clay loam--	Medium to slow.	Glacial till---	Forest and prairie.	Severe.
Gb	Gara loam, 9 to 18 percent slopes.	Dark grayish brown	Yellowish brown.	Clay loam--	Medium to slow.	Glacial till---	Forest and prairie.	Very severe.
Gp	Gosport silt loam, 8 to 20 percent slopes	Dark brown	Yellowish brown.	(1)-----	Slow-----	Silty shale---	Forest-----	Severe.
Gr	Grundy silt loam, 1 to 4 percent slopes	Very dark brown.	Very dark grayish brown.	Silty clay---	Slow-----	Loess-----	Prairie-----	Moderate.
Gt	Grundy silt loam, terrace phase, 1 to 4 percent slopes	Very dark brown	Very dark grayish brown	Silty clay---	Slow-----	Alluvium, or loess over alluvium.	Prairie-----	Slight.
Kv	Keytesville silt loam, 3 to 7 percent slopes.	Grayish brown.	Dark grayish brown	Silty clay---	Very slow--	Shale, loess, and glacial till	Forest-----	Moderate.
La	Lacona silt loam, 2 to 8 percent slopes.	Dark grayish brown	Yellowish brown.	Silty clay---	Medium---	Silty shale and limestone.	Prairie-----	Moderate.
Lb	Lacona silt loam, 9 to 5 percent slopes	Dark grayish brown	Yellowish brown.	Silty clay---	Medium---	Silty shale and limestone.	Prairie-----	Severe.
Lg	Lagonda silt loam, 2 to 8 percent slopes.	Very dark grayish brown.	Very dark gray	Silty clay---	Slow-----	Loess and till.	Prairie-----	Moderate to severe.
Ma	Mandeville silt loam, 2 to 5 percent slopes.	Dark grayish brown.	Dark yellowish brown.	Silty clay---	Medium---	Silty shale---	Forest-----	Moderate.
Mb	Mandeville silt loam, 6 to 10 percent slopes.	Dark grayish brown.	Dark yellowish brown.	Silty clay---	Medium---	Silty shale---	Forest-----	Severe.
No	Nodaway silt loam (0 to 2 percent slopes).	Dark grayish brown	Dark grayish brown.	Silt loam or fine sandy loam	Medium to rapid.	Recent alluvium.	Prairie and forest	None.
Sa	Sampsel silt loam, 5 to 15 percent slopes.	Very dark brown.	Very dark gray.	Silty clay---	Slow-----	Shale and limestone	Prairie-----	Moderate to severe.
Sb	Sandy terraces (0 to 3 percent slopes).	Dark brown.	Dark yellowish brown.	Clay loam and sand.	Rapid to very rapid.	Sandy alluvium.	Forest-----	Slight.
Se	Seymour silt loam, 1 to 4 percent slopes	Very dark grayish brown.	Dark gray--	Silty clay---	Slow-----	Loess-----	Prairie-----	Moderate.
Sh	Shelby loam, 4 to 8 percent slopes.	Very dark grayish brown.	Yellowish brown.	Clay loam--	Medium to slow.	Glacial till---	Prairie-----	Severe.
Sm	Shelby loam, 9 to 15 percent slopes.	Very dark grayish brown.	Grayish brown.	Clay loam--	Medium to slow.	Glacial till---	Prairie-----	Very severe.
Sn	Snead silty clay, 6 to 15 percent slopes.	Black-----	Grayish brown.	(2)-----	Slow-----	Shale and limestone.	Forest and prairie.	Severe.
Ss	Snead stony silty clay, 8 to 20 percent slopes.	Very dark grayish brown to black	Light olive brown.	Stony shale.	Slow-----	Shale and limestone.	Forest-----	Moderate.
Wa	Wabash clay (0 to 2 percent slopes).	Very dark gray.	Very dark gray.	Clay-----	Very slow--	Alluvium-----	Swamp grass.	None.
Wb	Wabash silt loam (0 to 2 percent slopes).	Very dark brown	Very dark grayish brown.	Silty clay---	Medium to slow.	Alluvium-----	Swamp grass.	None.
Ws	Wabash silty clay loam (0 to 2 percent slopes).	Very dark brown	Very dark gray.	Clay-----	Slow-----	Alluvium-----	Swamp grass.	None

¹ Subsoil consists of partly weathered silty shale.

² Subsoil consists of partly weathered shale.

moist area of a forest in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 32, T. 61 N., R. 29 W., is described as follows:

- A1—0 to 6 inches, gray (10YR 5/1), friable silt loam; weak, fine, granular structure; numerous, small, dark concretions.
- A2—6 to 14 inches, gray (10YR 6/1), friable silt loam; weak, medium, platy structure; numerous, small, brown and black concretions.
- B21—14 to 20 inches, dark-gray (10YR 4/1) light silty clay mottled with dark yellowish brown (10YR 4/4); moderate, medium, subangular blocky structure with gray silty coatings on dry aggregates; numerous, small, black and brown concretions.
- B22—20 to 32 inches, highly mottled dark grayish-brown (10YR 4/2), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6), plastic silty clay; massive with indistinct vertical cleavage.
- B3—32 to 55 inches, gray (10YR 6/1) silty clay highly mottled with coarse splotches of yellowish brown (10YR 5/8) and smaller mottles of dark yellowish brown (10YR 4/4); massive; content of fine sand increases with depth.

The color of the surface layer ranges from dark brown (10YR 4/3) to light gray (10YR 7/1). Where this soil adjoins Edina silt loam, terrace phase, 1 to 3 percent slopes, the surface layer and subsoil are darker than normal. In poorly drained or more heavily timbered areas, these layers are lighter in color. The thickness of the A2 horizon ranges from 3 to 4 inches on undulating slopes to 8 inches in areas where the described profile was observed. Where the A2 horizon is less thick, there is normally a 2- to 3-inch transition—a B1 horizon—between the A2 and the B2 horizons. In places the B21 horizon is somewhat yellow—yellowish brown (10YR 5/4) mottled with gray—than that of the profile described. The silty clay texture normally extends to a depth of more than 50 inches, but in some places stratified, gritty clay and clay loam materials occur within 40 inches of the surface.

Edina Series

The Edina series consists of poorly to very poorly drained Planosols. Planosols have a prominent clay layer in the subsoil. The Edina soils occur primarily in the northeastern part of the county on a broad major divide and nearby terraces. The terrain is mainly gently sloping, but there are some nearly level areas. The soils developed under grass, in moderately thick loess of Peorian age. Erosion has generally been slight to moderate, but about 20 percent of the acreage has lost half or more of the original surface soil. All the horizons are moderately acid.

The Edina soils are associated with the Seymour soils and occupy similar positions on slopes. However, the Seymour soils have slightly more relief. The Edina soils have a more strongly developed gray subsurface horizon than the Seymour soils, a slightly denser subsoil, and a more abrupt change from the A2 to the B2.

In some ways the Edina soils resemble the Grundy soils, which occupy similar positions in other parts of the county. They have a lighter colored surface soil and a more compact subsoil than the Grundy soils, and they have a distinct, gray subsurface layer that is not present in the Grundy.

Almost all the Edina soils are cultivated, a use to which they are well suited. They are easily tilled, and the slopes

are gentle and uniform. Lime and fertilizer are needed for most crops, and the amounts should be determined by soil tests. The soils are inclined to be wet in wet seasons and somewhat droughty in dry seasons. Wetness is the major hazard in producing crops, because of the gentle slope and the slow intake and percolation of water. Some small, low, ponded spots are present. Most of them can be improved by simple surface ditches.

Edina silt loam, 1 to 2 percent slopes (Ed) (Capability unit IIIw-3).—This is the most extensive Edina soil in the county. A profile observed in a moist cultivated field, with a 2 percent slope, in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 61 N., R. 26 W., is described as follows:

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; crumb structure; faint featherings of gray (10YR 6/1) on the soil particles; numerous root fibers.
- A2—8 to 15 inches, gray (10YR 6/1), friable silt loam; weak, platy structure; numerous flecks of yellow and brown from very small iron concretions; a few, medium-sized, hard, black concretions.
- B21—15 to 20 inches, very dark gray (10YR 3/1) silty clay mottled with yellowish brown (10YR 5/8); moderate, fine, subangular blocky structure; firm; clay films prominent on ped faces.
- B22—20 to 26 inches, highly mottled yellowish-brown (10YR 5/4), dark grayish-brown (10YR 4/2), and gray (10YR 6/1), heavy, sticky silty clay; moderate, fine to medium, subangular blocky structure; firm; clay films common on ped surfaces but become more patchy with depth.
- B23—26 to 40 inches, mottled grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) light silty clay; weak, fine, subangular blocky structure; a few, distinct mottles of strong brown (7.5YR 5/8).
- B3—40 to 48 inches, dark-gray (10YR 4/1), heavy silty clay loam mottled with yellowish brown (10YR 5/8); massive; slightly sticky; numerous, small, soft concretions; considerable fine sand.
- C—48 to 58 inches +, gray (10YR 5/1) silty clay loam with coarse splotches of yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6); massive; firm; slightly sticky.

The color of the surface soil ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2). In areas that have the darker surface soil, the A2 horizon is less distinct and the contact of the A2 and B2 horizons is less abrupt.

Where the soil has been cultivated and slightly eroded, the A2 horizon has been mixed with the surface soil. When dry, the surface soil in eroded spots is grayer than that described, because some mixing has occurred. Distinctness of the A2 horizon varies. It is most clearly expressed on level areas and at the heads of drainageways, and less so on the slopes between drainageways.

Edina silt loam, terrace phase, 1 to 3 percent slopes (Et) (Capability unit IIIw-3).—The profile of this soil is similar to the one described. The soil is on terraces or level benches along the major streams, but it is above overflowed areas. It occurs in somewhat more sloping, less extensive areas than Edina silt loam, 1 to 2 percent slopes. In addition, it has been dissected more by stream channels.

This soil is believed to have developed in the same loessal material as Edina silt loam, 1 to 2 percent slopes. The loess was deposited on old stream terraces. Some alluvial-colluvial material that washed from adjacent uplands may also have influenced the formation of this soil.

The surface layer of the terrace phase is 2 to 3 inches thicker than that of the upland phase. The gray A2 hori-

zon, however, is normally thinner and is 3 to 6 inches thick, compared with 4 to 8 inches for that of the upland phase. The upper B2 horizon of the terrace phase is a more uniform very dark gray and has fewer mottles of brown and gray than that of Edina silt loam, 1 to 2 percent slopes.

Gara Series

The soils of the Gara series have a moderately dark colored surface soil and are moderately well drained. They occur primarily on gentle to strong slopes where timber has encroached upon prairie. The Gara soils occupy only about 5 percent of the county but occur in all townships. They developed in glacial till of Kansan age. Prairie grass was the dominant vegetation in the early stages of their development, and trees, in the later stages. More than half the original surface soil has been lost through erosion from more than 70 percent of the Gara acreage. Erosion has been most severe in rolling cultivated areas. Little or no erosion has occurred where the soils have been protected by a good cover of grass or trees.

The Gara soils are associated with the Shelby soils. They differ primarily in the color of the surface soil and the degree of leaching and development of the subsoil. The Gara soils occur between the Grundy and Seymour soils, which are on the ridges, and the Wabash soils, which are in the valleys of streams and drainageways.

The capacity of the Gara soils to supply plant nutrients is moderate. These soils are normally acid to a depth of approximately 4 to 5 feet, but they are neutral in some local areas at a depth beyond 2½ feet. Lime and fertilizer are needed for good yields and should be applied in amounts indicated by soil tests. Air and water relationships are favorable in the upper 20 to 24 inches of the profile but are less favorable in the plastic, mottled subsoil below this depth. Runoff and erosion are major hazards in the growing of crops. Cultivation is suggested only for slopes of 3 to 8 percent, and the fields need to be protected from erosion. In terraced fields the cropping system can consist of row crops for 2 successive years followed by small grain or meadow crops for 2 years. If contouring or terracing is not used to control erosion, row crops should not be grown.

Gara loam, 9 to 18 percent slopes (Gb) (Capability unit VIe-6).—This is the most extensive Gara soil in the county. A profile observed in a moist pasture in the SW¼SE¼ sec. 2, T. 61 N., R. 29 W. is described as follows:

- A1—0 to 7 inches, dark grayish-brown (10YR 4/2), very friable loam with numerous, small glacial pebbles; weak, fine, granular structure; soil particles have gray (10YR 5/1, dry) featherings that are dark grayish brown when moist
- A2—7 to 11 inches, grayish-brown (10YR 5/2) loam; weak, fine, granular structure, very friable; when crushed, soil mass is yellowish brown; small glacial pebbles are common
- B1—11 to 20 inches yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 4/4), gritty clay loam; compact and plastic but breaks to moderate, fine to medium, subangular blocky aggregates; dark grayish-brown (10YR 4/2) clay films occur in patchy pattern on aggregates, which have coatings of gray silt and fine sand when dry.
- B21—20 to 36 inches, yellowish-brown (10YR 5/6) clay loam highly spotted and mottled with gray (10YR 5/1)

and light yellowish brown (10YR 6/4); moderate, medium, subangular blocky structure; numerous glacial pebbles and a few, small, soft concretions of strong brown (7.5YR 5/6); thin clay films on most ped faces.

B22—36 to 54 inches, yellowish-brown (10YR 5/6), gritty, heavy clay loam with coarse and fine splotches of gray, brownish yellow, and strong brown, weak, coarse, subangular blocky structure to massive (structureless); plastic.

B3—54 to 70 inches +, highly spotted and mottled gray, brownish-yellow, and brown, friable clay loam; massive; a few lime concretions and many glacial pebbles

The color of the surface layer ranges from dark grayish brown (10YR 4/2), with some very dark grayish brown (10YR 3/2), to grayish brown (10YR 5/2) that approaches pale brown (10YR 6/3). The soil is darker on gentle slopes near the Shelby soils, and it is grayer on the heavily timbered, steep slopes. In some places, erosion has exposed the A2 horizon, and as a result, the present surface layer is grayish brown.

On some narrow ridges and gentle slopes adjacent to the Grundy and Seymour soils, the surface layer of the Gara soil is siltier and approaches the texture of silt loam. In these places the A2 and B1 horizons contain more fine material, and they have the texture of gritty silty clay and are more highly mottled than elsewhere.

This soil, on some low slope positions, is coarser textured, has a more friable subsoil, and contains more sand and pebbles. The variations in the Gara soil in these places may have been caused by the action of water. In a few minor areas, the glacial till contains a large amount of residuum from local shale and limestone. The soil profile formed from this material has redder colors, a higher content of clay, and mottling of higher contrast.

Gara loam, 3 to 8 percent slopes (Ga) (Capability unit IIIe-6).—This soil has a profile quite similar to that of Gara loam, 9 to 18 percent slopes. It differs generally in having been cultivated, and, as a result, there is less residue from grasses and leaves on the surface. Tillage has mixed the top 5 to 7 inches of the soil into a uniformly colored Ap horizon. This soil also differs from the steeper Gara soil in that the A and upper B horizons contain more silty and silty clay material, presumably because of the influence of a thin surface covering of loess. The B2 and lower horizons are essentially the same as those of Gara loam, 9 to 18 percent slopes. Gara loam, 3 to 8 percent slopes, generally is somewhat more eroded than Gara loam, 9 to 18 percent slopes, probably because of more intensive cultivation in the past.

Gosport Series

Soils of the Gosport series have a thin surface layer and are underlain by slowly permeable, sandy and clayey, acid shale material of Pennsylvanian age. They are primarily in the southeastern and northwestern parts of the county along the Grand River. They are of minor extent and occupy strongly sloping to steep topography where the Snead, Mandeville, and Gara soils also occur.

The Gosport soils have developed under forest, and the surface mantle is modified in places by mixtures of loess and glacial drift. Lenses of sandstone occur in some places but are not present in all soils.

The Gosport soils are erodible because of the strong slopes, a thin surface layer, and the slow permeability of the shaly subsurface horizons. Their capacity to supply plant nutrients is low. Lime and fertilizer are needed to grow grass. Because of the low moisture-holding capacity, the Gosport soils are apt to be droughty during the growing season. Most of the areas are in timber of poor quality.

Gosport silt loam, 8 to 20 percent slopes (Gp) (Capability unit VIIe-3).—This is the only Gosport soil in the county. Small areas of this soil are included with areas mapped as Mandeville silt loam, 6 to 10 percent slopes. A profile of the Gosport soil observed in a moderately steep, moist wooded area in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 36, T. 58 N., R. 26 W., is described as follows:

- A1—0 to 8 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, granular structure; very friable; numerous root fibers and partly decayed twigs and leaves.
- A3-B1—8 to 13 inches, yellowish-brown (10YR 5/4), friable, heavy silt loam, some variegated coloring of dark brown (10YR 4/3) from horizon above and of yellowish brown (10YR 5/8) from broken shale fragments; weak, medium, subangular blocky structure with patches of dark-brown coatings.
- C1—13 to 30 inches, partly weathered silty and sandy acid shale of mixed yellowish-brown (10YR 5/8) and brownish-yellow (10YR 6/8) colors
- C2—30 inches +, yellowish-brown (10YR 5/8) shale bed with thin, alternating bands of sandy and silty acid shale.

This soil has areas with a darker (10YR 3/2) surface soil than normal. Some areas have little or no surface soil, and a mixture of shale fragments and silty soil occurs at the surface. A few areas show considerable evidence of glacial material in the surface layer.

Gosport silt loam, 8 to 20 percent slopes, occurs in association with the Mandeville and Snead soils. In a few places, the surface layer of the Gosport is nearly as dark as that of the Snead soils, and the subsurface layer is similar to that of the Snead. The Gosport lacks a clearly expressed B horizon, but the Mandeville has a B horizon. Some minor inclusions of Mandeville soil occur in mapped areas of this Gosport soil.

Grundy Series

Soils of the Grundy series have a dark-colored silty surface layer and a mottled silty clay subsoil. They have formed in moderately thick loess and occur on gentle slopes throughout the county. They generally have a slope of 4 percent or less and are primarily on the inter-stream divides in the higher parts of the county.

These soils are imperfectly to poorly drained. Surface drainage is normally medium, but ponding occurs in some minor areas. The subsoil consists of mottled, plastic silty clay. Because of slow permeability and the long, gentle slopes, erosion is the major hazard. Excess water, caused by restricted drainage, is also a significant hazard. Little of the dark-colored surface soil has eroded from the gently sloping ridgetops. Some of the long, gentle slopes, however, have eroded considerably and are highly susceptible to additional erosion. The Grundy soils are normally highly productive, but lime and fertilizer are needed for sustained high yields. Because these soils are inclined to be slightly wet, nitrogen fertilizer is especially helpful in getting crops off to early spring growth.



Figure 3.—Combining of soybeans on Grundy silt loam, 1 to 4 percent slopes. Soybeans are well adapted to this gently sloping soil, despite the slowly permeable silty clay subsoil. Wetness often delays early planting of soybeans and corn. Soybeans are more suitable for late planting than corn.

The Grundy soils are adapted to all common crops and grasses grown in the area (fig. 3). Most of the acreage is cultivated. The fine-textured subsoil somewhat restricts optimum movement of air and water for some plants. Intensive cropping systems are adapted to the soils, and moderate to high yields of most crops can be obtained through the use of practices that control erosion and improve drainage. Contour cultivation and terracing are particularly well adapted.

The Grundy soils are associated with the Edina and Seymour soils, but they have a darker colored surface layer, less gray coloring in the lower part of the surface layer, and a less abrupt change from the surface layer to the subsoil. The Grundy soils occur throughout the county, whereas the Edina and Seymour soils are primarily on the broad upland ridge in the northeastern part.

Grundy silt loam, 1 to 4 percent slopes (Gr) (Capability unit IIe-6).—This is the most extensive Grundy soil in the county. A profile of this soil observed in a moist meadow in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, T. 59 N., R. 29 W., 4 miles north of the junction of State Highway 6 and U.S. Highway 69, is described as follows:

- A1—0 to 11 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure, friable.
- A3—11 to 15 inches, very dark gray (10YR 3/1), friable silt loam; moderate, fine, granular structure; when dry, soil shows gray silt or sand grains on aggregates, but the gray color disappears when the soil is moist.
- B1—15 to 23 inches, very dark gray (10YR 3/1), friable silty clay loam; a few, faint, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; soil aggregates show gray (10YR 5/1) silty coatings when dry but these are obscure when soil is moist.
- B21—23 to 40 inches, very dark grayish-brown (10YR 3/2) silty clay; a few, faint mottles of dark yellowish brown (10YR 4/4) and dark gray (10YR 4/1); moderate, fine and medium, subangular blocky structure; firm or plastic; nearly continuous, very dark grayish-brown (10YR 3/2) clay films on ped faces.
- B22—40 to 52 inches, dark grayish-brown (2.5Y 4/2), plastic, light silty clay with common, fine, strong-brown (7.5YR

5/6) and grayish-brown (2.5YR 5/2) mottles; moderate, medium, subangular blocky structure; patchy, very dark grayish-brown (10YR 3/2) clay films.

B3—52 to 60 inches +, grayish-brown (2.5Y 5/2), plastic silty clay loam; a few, faint, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak, coarse, blocky structure to massive (structureless); vertical cleavage most prominent; a few, soft, strong-brown concretions and a few, fine, dark-brown concretions; sand content increases with depth and larger sand grains are noticeable in lower part of this horizon.

The thickness of the A1 horizon ranges from 8 to 14 inches. In cultivated fields that have been slightly eroded, there is an Ap horizon, about 8 inches thick, instead of the A1 horizon of noncultivated areas. On some more rolling, eroded slopes, the surface layer is light silty clay loam, probably because of the mixing of the finer material by tillage implements. The surface soil may be somewhat more gray (10YR 3/2 to 4/2) in the nearly level areas. In these areas the soil also has more gray coatings in the A3 horizon, which give this horizon the appearance of a weakly developed A2 horizon. Gray mottles predominate in the B2 horizon of soil on the gentler slopes and in the heads of drainageways. In these places the A3 and B1 horizons are thinner than normal. As the slope increases, brown mottles predominate and the A3 and B1 horizons are thicker.

In places sand grains and a few glacial pebbles occur in the B horizon at a depth below 26 to 28 inches, particularly on the steep slopes and where the Grundy soil joins the Lagonda, Shelby, or Gara soils. The Grundy soil is normally acid throughout the profile.

Grundy silt loam, terrace phase, 1 to 4 percent slopes (Gt) (Capability unit IIe-6).—This soil is similar to Grundy silt loam, 1 to 4 percent slopes. The surface layer has the same variations in thickness and color, but generally there are slightly less dark coloring and more gray coatings in the A3 and B1 horizons. This terrace phase is on nearly level to gently sloping terraces, 15 to 20 feet above the adjacent bottom lands. Most of it is in the old valley of Muddy Creek. Productivity, land use, major hazards, and needed treatments are similar to those of Grundy silt loam, 1 to 4 percent slopes.

Keytesville Series

The soils of the Keytesville series cover about 2 percent of the county. They normally occur in small, gently and moderately sloping areas in the hilly and forested sections. They are on low benches or on high terraces. The soils have a grayish-brown surface soil, a pale-brown subsurface soil, and a dense, plastic, claypan subsoil. Runoff is slow to medium, and internal drainage is slow to very slow. The Keytesville soils have developed from weathered shale and glacial till and a thin mantle of loess.

The soils are very low in organic matter. They are in hilly parts of the county but are on slopes that are easy to cultivate. Erosion has been moderate to severe, and nearly all the surface soil has been removed from the more sharply sloping areas.

The Keytesville soils are primarily associated with the Mandeville and Snead soils. Compared with the Mandeville soils, they have a thicker, grayer silty subsurface layer and a more abrupt boundary to a heavier, more

dense, and poorly drained subsoil. The Keytesville soils are grayer throughout than the Snead soils, and they have an A2 horizon and an abrupt boundary between the A2 and the claypan subsoil.

The Keytesville are among the least productive soils in the county. They are acid throughout and have limited ability to provide plant nutrients and water. They are best suited to small grains, hay, and pasture. Because of the compact subsoil, deep-rooted crops do not grow well.

Keytesville silt loam, 3 to 7 percent slopes (Kv) (Capability unit IVe-5).—This is the only Keytesville soil in the county. It is of minor extent. A profile of this soil observed in a moist bluegrass pasture, with a slope of 2 to 7 percent, about 3 miles south of Gallatin in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 59 N., R. 27 W., is described as follows:

A1—0 to 6 inches, grayish-brown (10YR 5/2) to light brownish-gray (10YR 6/2), friable silt loam; numerous, small, dark concretions on and in the soil; cloddy to compact when dry.

A2—6 to 12 inches, pale-brown (10YR 6/3) silt loam; weak, thin, platy structure that breaks easily into weak, fine granules; numerous, small, dark concretions and dark-gray and yellowish-brown mottles.

B21—12 to 24 inches, dark grayish-brown (10YR 4/2), extremely firm silty clay, weak, coarse, subangular blocky structure to massive (structureless); distinct, light-gray (10YR 7/1) silt coatings on aggregate faces, soil mass is mottled with dark yellowish brown (10 YR 5/4); discontinuous, dark yellowish-brown (10YR 4/4) clay films on some ped faces.

B22—24 to 40 inches, highly spotted and mottled gray (10YR 5/1) and dark yellowish-brown (10YR 4/4), plastic silty clay; massive; sand grains and shale fragments noticeable.

C—40 to 60 inches +, yellowish-brown (10YR 5/4), heavy silty clay loam, highly spotted and mottled with brownish yellow (10YR 6/8) and gray (10YR 5/1); massive; high percentage of fine sand present; friability, brownish-yellow color, and content of sand and shale increase with depth.

This soil is variable because of differences in slope, position, and parent material. In some places, there is evidence of water sorting of soil material and of buried profiles. The color of the surface layer ranges from dark grayish brown to grayish brown. The thickness of the A2 horizon is variable. In eroded areas where this horizon has been mixed with the Ap, practically none of the A2 remains, but, in uneroded areas, the A2 is 10 to 12 inches thick. The texture of the B2 horizon ranges from hard silty clay loam to plastic clay. In some areas a B1 horizon, 2 to 5 inches thick, occurs between a weak A2 horizon and the B2.

Lacona Series

The Lacona series consists of dark grayish-brown soils that have developed in residual materials from limestone and shale of Pennsylvanian age. Surface drainage is good, because these soils normally occur on strongly sloping to steep topography. Internal drainage is medium. The soils occupy about 4 percent of the county. They are primarily in the southern part, along the Caldwell County line, and in the eastern part. They occur in association with Mandeville and Snead soils, which developed from similar material. The Lacona soils have formed where the limestone and shale materials have weathered to a

considerable depth. The parent material is primarily silty shale, but thin beds of sandstone and of limestone occur in places.

The Lacona soils are browner than the Mandeville soils and are better drained. They differ from the associated Snead soils in having a thicker solum and less clay in horizons below the surface layer.

The Lacona soils are well adapted to many kinds of crops and are of moderate to high productivity if well managed. As indicated by the depth to which the brown color extends, they are the best drained dark-colored soils of the uplands in the county. They are especially well adapted to alfalfa and to legume-grass mixtures. The less sloping areas are suited to corn, but susceptibility to erosion is a major hazard. The steep areas are nearly all in grass and are well suited to this use.

Lacona silt loam, 2 to 8 percent slopes (Lc) (Capability unit IIIe-6).—This is the most extensive Lacona soil in the county. A profile of this soil observed in a moist pasture of bluegrass, $3\frac{1}{2}$ miles southwest of Lock Springs in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T. 58 N., R. 26 W., is described as follows:

- A1—0 to 10 inches, very dark grayish-brown (10YR 3/2), friable silt loam; moderate, medium, granular structure; many roots
- B1—10 to 16 inches, dark-brown (10YR 4/3), slightly plastic, light silty clay loam; moderate, coarse, granular and fine subangular blocky structure; when crushed, soil mass is yellowish brown (10YR 5/6), numerous roots to 24 inches, dark-brown (10YR 4/3), slightly plastic, light silty clay; moderate, medium, subangular blocky structure; brown color caused by fairly continuous clay films on soil aggregates; when crushed, soil mass is yellowish brown (10YR 5/6); roots are numerous; a few, soft, dark yellowish-brown concretions
- B2—24 to 40 inches, yellowish-brown (10YR 5/4), plastic silty clay with numerous, faint, gray (10YR 5/1) mottles that increase with depth; moderate, fine and medium, subangular blocky structure, dark-brown clay films occur in a patchy pattern; numerous, small, soft, brown concretions
- C—40 to 60 inches, yellowish-brown (10YR 5/8), plastic silty clay loam, highly mottled with dark grayish brown (10YR 4/2) and gray (10YR 5/1); a few high-contrast mottles of reddish yellow and strong brown; shale fragments are common and increase with depth; massive; some vertical cracking

The color of the surface layer ranges from very dark brown to brown. Darker colors are common where prairie grass was the major vegetation, and the lighter colors occur in timbered areas. In some areas limestone bedrock occurs within 4 feet of the surface, and in these areas the surface layer and subsoil have more reddish and brownish hues than those described in the profile.

The sandstone content of the subsoil and parent material varies. In places shale fragments are more common than those in the profile described. A few patches of dark-colored soils similar to the Snead occur within areas of the Lacona soil. In some areas, generally those on the broad ridges, silty loess material has influenced the surface horizon. In these places the surface layer and upper subsoil have hues of yellowish brown. In eroded areas, the surface layer is thinner, slightly browner in color, and of silty clay loam texture.

Lacona silt loam, 9 to 15 percent slopes (Lb) (Capability unit IVe-6).—This soil is very similar to Lacona silt loam, 2 to 8 percent slopes. It differs primarily in having slightly thinner A and B horizons and, in places, partly

weathered parent material at a depth of 30 to 40 inches from the surface. In addition, shale fragments are more common in the subsoil, and limestone fragments are more common at a depth of 4 to 5 feet.

This soil is primarily in grass and is seldom cropped.

Lagonda Series

The Lagonda soils have a dark-colored silty surface layer and a plastic silty clay subsoil. They occur on gentle to moderate slopes and have moderate surface drainage and slow internal drainage. They have developed from loess of moderate thickness over glacial till. The surface layer and upper B horizon have developed primarily from loess, and the lower B horizon, primarily from weathered glacial till. The Lagonda soils have developed under prairie grass and are among the most extensive soils in the county.

The Lagonda soils occur in association with the Grundy and Shelby soils. Compared with the Grundy soils, they have a more plastic lower subsoil that contains glacial drift. Compared with the Shelby soils, they have a thicker, siltier surface layer and a darker colored, more strongly mottled upper subsoil.

Erosion has normally been fairly severe on the Lagonda soils because of extensive cultivation on the long slopes and the slow permeability of the soils. These soils also have a secondary hazard of excess wetness. Seepy spots are common in the dramageways and at contact points between the loess and the till on some side slopes. The Lagonda soils are high in natural fertility and are easily tilled. They are well adapted to corn, small grains, hay, and pasture.

Lagonda silt loam, 2 to 8 percent slopes (Lg) (Capability unit IIIe-5).—This is the only Lagonda soil in the county. A profile of this soil observed in a moist cornfield, with a slope of 2 to 7 percent in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 29, T. 59 N., R. 26 W., is described as follows:

- Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2), friable silt loam, moderate, fine, granular structure
- A1—6 to 10 inches, very dark gray (10YR 3/1), friable silt loam, moderate, medium, granular structure
- A3—10 to 14 inches, very dark grayish-brown (10YR 3/2) to dark-gray (10YR 4/1), friable, heavy silt loam, moderate, medium, granular structure; when dry, granule faces show thin silty coating of gray
- B21—14 to 24 inches, very dark gray (10YR 3/1), plastic silty clay mottled with yellowish brown (10YR 5/6); moderate, medium, subangular blocky structure, when crushed, soil is dark brown (10YR 4/3) because of the color of interior of peds; peds have fairly continuous, dark-gray clay films, soil contains sand grains and evidence of glacial till
- B22—24 to 36 inches, very dark gray (10YR 3/1), plastic silty clay highly mottled with yellowish brown (10YR 5/4); massive (structureless) breaking to weak, coarse, subangular blocky structure; vertical cleavage clearer than horizontal; numerous, soft, black and brown concretions, numerous coarse sand grains and much glacial grit
- B3—36 to 50 inches +, mottled gray (10YR 5/1), yellowish-brown (10YR 5/8), and very dark gray (10YR 3/1), plastic, gritty silty clay; massive; contains fragments of broken glacial rocks that increase in number with depth; yellowish-brown color increases noticeably below a depth of 40 inches

The thickness of the loess mantle on the high divides and gently sloping areas is 20 to 30 inches, and on the

rolling slopes, less than 12 inches. Where the loess is thinnest, the surface layer is coarse loam to heavy loam.

Where erosion has removed most of the surface layer, the present surface layer is silty clay loam. In some of the wet areas at the heads of drainageways or where the contact between loess and till coincides with the boundary between the A and B horizons, the profile has a high concentration of gray color and of dark concretions. In dry soil, this zone is an indistinct gray layer. On the rolling slopes, the concentration of brown mottles and the glacial material are nearer the surface.

Mandeville Series

The Mandeville series is made up of light-colored soils that have developed from a thin layer of loess over acid silty shale. The native vegetation was trees. These soils are of minor extent but occur throughout the county in moderately to strongly rolling areas where the soils have formed from residual shale and limestone material. Surface drainage is medium, and internal drainage is medium.

The Mandeville soils are on rounded, narrow ridgetops and rolling slopes in association with the Gosport soils. They differ from Gosport soils primarily in having a solum that is moderately thick over shale, instead of shallow over shale. Also, the Mandeville soils have an A-B horizon sequence over shale, and Gosport soils, normally an A-C sequence. Mandeville soils are only moderately deep to partly weathered shale, but the Lacona soils are deep over shale.

The Mandeville soils are medium to low in inherent fertility because the mineral nutrients in the soil-forming materials were low in supply. They are subject to severe erosion if cropped or if pastured and poorly managed. If proper conservation measures are used and adequate lime and fertilizer are applied, satisfactory yields of cultivated crops and grasses can be obtained. Yields, however, are generally not so high as those obtained from the darker colored and deeper soils formed from shale material.

Mandeville silt loam, 2 to 5 percent slopes (Ma) (Capability unit IIIe-6).—This is the most extensive Mandeville soil in the county. A profile of it observed in a moist wooded field in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 31, T. 58 N., R. 26 W., is described as follows:

- A1—0 to 8 inches, dark grayish-brown (10YR 4/2), friable silt loam; moderate, fine, granular structure
- A2—8 to 12 inches, yellowish-brown (10YR 5/4), friable silt loam; moderate, medium, granular structure; when dry, soil is light yellowish brown (10YR 6/4); soil particles have gray silty coatings.
- B21—12 to 24 inches, dark yellowish-brown (10YR 4/4), light, firm silty clay; a few gray mottles; moderate, fine, subangular blocky structure; gray silty coatings on aggregates in upper part of layer and dark-brown (10YR 4/3) clay films in lower part; numerous, small, black concretions
- B22—24 to 40 inches, dark yellowish-brown (10YR 4/4), plastic silty clay, strongly mottled with gray (10YR 5/1); a few strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; patchy clay films; some shale fragments.
- C—40 to 60 inches +, mottled dark yellowish-brown (10YR 4/4), yellowish-red (5YR 5/6), and strong-brown (7.5YR 5/6), slightly plastic silty clay loam; massive; shale fragments and partly decomposed shale are common

The soil is somewhat variable in some properties. The thickness of the soil material over the parent shale is quite variable within short distances. The depth to partly decomposed shale ranges from 24 to 50 inches, but commonly the shale is 30 to 40 inches below the surface. The solum is commonly thicker on the gentle slopes and thinner on the rolling slopes. The influence of loess in the surface layer is common, particularly on the higher ridges, and there is evidence of glacial till in the surface layer and upper subsoil. The texture of the B2 horizon ranges from silty clay loam to clay, but normally it is plastic silty clay. A thin A3 or B1 horizon occurs in some sites. Limestone outcrops are common. Small inclusions of Sneed soils also occur in areas of the Mandeville soil.

Mandeville silt loam, 6 to 10 percent slopes (Mb) (Capability unit IVe-6).—This soil is similar to Mandeville silt loam, 2 to 5 percent slopes. The slopes are more rolling, however, and spots of eroded surface soil are more common. In addition, grass and trees are more common.

The profile of this soil differs from that described for Mandeville silt loam, 2 to 5 percent slopes, in the following ways: (a) A 1- to 2-inch layer of very dark brown (10YR 2/2) silt loam, high in content of partly decayed leaves and twigs, occurs in some noneroded areas; (b) in eroded areas this organic layer is absent and the A1 horizon is 4 to 8 inches thick and is brown (10YR 5/3); (c) the A2 horizon is thinner and, in many places, is mixed with the A1, because of the trampling by livestock; (d) the B21 and B22 horizons are variable in thickness, and the C horizon occurs at a depth of 30 to 40 inches; and (e) many fragments of limestone occur in the B horizon.

The productivity of this soil is similar to that of Mandeville silt loam, 2 to 5 percent slopes, except that eroded areas are generally less productive.

Nodaway Series

The Nodaway series consists of deep, dark-colored, well-drained soils on broad bottom lands along the Grand River and smaller streams. These soils are made up of recent alluvium, and they receive fresh sediments where they are subject to occasional overflow. They are the third most extensive soil series and cover nearly 10 percent of the county. Nodaway soils occur in nearly level to undulating areas and normally are not subject to sheet erosion. In some places, however, scouring and stream-bank erosion are hazards.

The texture of the surface layer ranges from heavy silt loam to very fine sandy loam, but silt loam is predominant. The color ranges from very dark grayish brown to brown. Some areas that are subject to annual overflow have thin strata of fine-textured material throughout the profile. In general, the soils are darker in the small valleys than on the bottom lands of the Grand River. They are lighter in areas that have received recent deposits.

In the main valley of the Grand River, some of the Nodaway soils occur as alluvial fans on which small side streams have deposited fresh material. In many places, old, dark-colored buried soils are at a depth of 30 to 60 inches. The buried surface soil, in places, is silty clay loam or silty clay.

Nearly all of the Nodaway soils are cultivated. Corn and soybeans are the major crops. The soils have adequate

moisture-holding capacity for all crops commonly grown. In dry springs, corn is normally planted, but, if rain delays the planting of corn, soybeans are grown. The hazard of flooding has been reduced materially in the lower reaches of the Grand River by the straightening of the stream channel. In other areas the construction of levees has reduced this hazard. The soils are medium to high in fertility and are suitable for many kinds of crops. They are responsive to fertilizer, especially nitrogen.

Nodaway silt loam (No) (Capability unit I-1).—This is the only Nodaway soil in the county. A profile observed in a moist cornfield in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 58 N., R. 26 W., is described as follows:

- Ap—0 to 10 inches, dark grayish-brown (10YR 4/2), friable silt loam; weak, fine, granular structure.
- C1—10 to 24 inches, dark grayish-brown (10YR 4/2), friable silt loam; very faint mottles of gray (10YR 5/1); some lenses of pale-brown (10YR 6/3), coarse silt loam and fine sand.
- C2—24 to 36 inches, brown (10YR 5/3) and dark grayish-brown (10YR 4/2) very fine sandy loam; a few, faint mottles of gray (10YR 6/1) and yellow (10YR 7/6); a few, small, soft, dark concretions.
- C3—36 to 50 inches +, splotched and mottled brown (10YR 5/3), yellowish-brown (10YR 5/8), and gray (10YR 6/1) very fine sandy loam.

This soil normally has uniform characteristics. The thickness of the profile and the prominence of the fine sand lenses vary, however. In places the lenses are absent, and in only a few places are they more than one-eighth inch thick.

Sampsel Series

The Sampsel series consists of dark-colored, imperfectly to poorly drained soils developed from weathered limestone and clay shale of Pennsylvanian age. These soils have a silty surface soil and a plastic silty clay to clay subsoil. They are normally high in organic matter, and dark colors persist throughout the profile. The lower subsoil is mottled with brown and gray.

The Sampsel soils cover about 2 percent of the county. They occur primarily on moderate to strong slopes within the area of soils formed in residual material. In profile characteristics they resemble the Seymour and Snead soils. They have a darker, slightly thicker surface layer and a darker subsoil than the Seymour soils. The Sampsel soils developed from residual material; the Seymour soils from loess. The Sampsel soils have a siltier surface soil than the Snead soils, as well as a thicker mantle of soil material over the parent shale.

The Sampsel soils are fairly high in natural fertility. The heavy texture of the subsoil somewhat restricts deep rooting of plants, but the soils are well adapted to corn, grass, and clover. The slowly permeable subsoil and rolling slopes cause a high rate of runoff. Susceptibility to erosion is the major hazard. The soils are inclined to be slightly wet, and they dry slowly. There are seeps on some side slopes.

These soils produce excellent grass and are used primarily for pasture. Nitrogen fertilizer is needed for early spring growth of plants.

Sampsel silt loam, 5 to 15 percent slopes (Sc) (Capability unit IVe-6).—This is the only Sampsel soil in the county. A profile of this soil observed in a moist, moder-

ately sloping pasture of bluegrass in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 17, T. 60 N., R. 28 W., is described as follows:

- A1—0 to 10 inches, very dark brown (10YR 2/2), friable silt loam; moderate, medium, granular structure; numerous root fibers.
- A3—10 to 14 inches, very dark brown (10YR 2/2), slightly plastic, heavy silt loam to light silty clay loam; moderate, fine, subangular blocky structure; on drying, aggregates show faint gray coating of silt on faces; soil mass flecked with orange and brown, soft concretions.
- B21—14 to 29 inches, very dark gray (10YR 3/1), plastic silty clay loam; weak, fine and medium, angular blocky structure; numerous, dark yellowish-brown (10YR 4/4), patchy coatings on aggregates.
- B22—29 to 40 inches, highly mottled gray (10YR 5/1), olive-gray (5Y 5/2), and yellowish-brown (10YR 5/8), plastic silty clay; weak, coarse, blocky structure to massive; some well-defined vertical cleavage; distinct, dark yellowish-brown (10YR 4/4) clay films.
- C—40 to 56 inches +, highly splotched and mottled yellowish-brown (10YR 5/8), gray (10YR 5/1), and olive-gray (5Y 5/2), plastic silty clay and weathered clay shale; massive.

The soil is on upland ridges, on side slopes, and in low basins. In the basins, the surface soil has been influenced by overwash from adjacent slopes. In some gently sloping areas at the heads of drainageways, there is a considerable amount of gray coatings on the aggregates in the upper B horizon. Brown mottles are more pronounced in the subsoil on rolling slopes than on other slopes. On some slopes, loess and glacial till are in the upper part of the profile. Where the original surface soil has been lost through erosion, the texture of the present surface soil is silty clay loam. In addition, the A1 horizon is thinner and the Ap horizon in cultivated fields is underlain abruptly by the B2 horizon. In some places there are small, localized outcrops of limestone.

Sandy Terraces

Sandy terraces are of very minor extent in Daviess County. They normally occur on the flood plains of the Grand River as scattered mounds or ridges of sandy material, elevated about 6 to 10 feet from the surrounding bottom lands. They are remnants of old river deposits that probably formed during glacial times, and they are subject to overflow. The surface layer consists of dark-brown material that is underlain by dark yellowish-brown stratified sand and clay loam. The subsurface layer has variable characteristics. The topography is uneven, and drainage is normally good to excessive. The moisture-holding capacity ranges from moderate to low.

This land type is used for corn and soybeans. Fertility ranges from moderate to low.

Sandy terraces (Sb) (Capability unit IIIs-4).—A profile of this land type observed in a moist cultivated field in the central part of the NE $\frac{1}{4}$ sec. 25, T. 60 N., R. 28 W., is described as follows:

- Ap—0 to 10 inches, dark-brown (10YR 4/3), friable sandy loam; weak, fine, granular structure.
- A3—10 to 15 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure with faint, brown coatings; very friable and porous.
- B1—15 to 30 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, subangular blocky structure; faint, patchy coatings on aggregates; when crushed, soil mass is yellowish brown (10YR 5/4).

B2—30 to 48 inches, yellowish-brown (10YR 5/6), heavy loam with few, faint, brown (10YR 5/3) and dark-brown (10YR 4/3) mottles; some thin seams of clay loam; weak, coarse, subangular blocky structure, friable; content of sand increases with depth.

B3—48 to 60 inches, yellowish-brown (10YR 5/8) loamy sand; single grain; compact but friable; considerable coarse sand and fine gravel.

The profile just described represents the midway point in the range of characteristics of this land type. Variations in the profile occur within short distances. The more nearly normal profile in Daviess County is sandier and is shallower to stratified sandy material. The surface soil ranges from very fine sandy loam to loamy sand. The subsurface layer varies in thickness and ranges from coarse sand to sandy clay loam.

Seymour Series

The Seymour series consists of moderately dark colored soils that developed in moderately thick Peorian loess under prairie vegetation. These soils occur on gentle slopes and on narrow, rounded ridgetops, primarily in the northeastern part of the county. They cover 4 percent of the county.

The Seymour soils are fairly uniform in profile characteristics. They have a very dark grayish-brown to dark grayish-brown surface layer, about 10 inches thick; a mottled dark-gray silty clay upper subsoil; and a mottled yellowish-brown, massive silty clay lower subsoil. Surface drainage is slow to medium, and internal drainage is slow.

The Seymour soils are associated with the Edina, Lagonda, and Grundy soils. The Seymour lack the thick, distinct, gray A2 horizon of the Edina and have a somewhat darker surface soil. The Seymour and Lagonda soils have fairly similar profile characteristics. However, the Seymour soils have developed entirely in loessal material, whereas the Lagonda soils show the influence of glacial till in the subsoil. Seymour soils occupy the same position on the landscape as the Grundy soils. Seymour soils, compared with the Grundy soils, have a grayer surface layer and a grayer, slightly more dense and plastic subsoil.

The Seymour soils are well adapted to intensive cultivation of corn, soybeans, grasses, and legumes. Most of the acreage is cropped. The soils are medium in natural fertility, and liberal use of lime and fertilizer is essential for high yields. The major hazard is erosion, and the secondary hazard is excess wetness.

Seymour silt loam, 1 to 4 percent slopes (Se) (Capability unit IIIe-5).—This is the only Seymour soil in the county. A profile of this soil observed in a moist cornfield in the SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 61 N., R. 26 W., is described as follows:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, crumb structure; very friable.

A1—7 to 10 inches, dark-gray (10YR 4/1), friable silt loam; moderate, fine, granular structure.

A3—10 to 16 inches, very dark grayish-brown (10YR 3/2), friable, heavy silt loam; moderate, fine and medium, granular structure; when slightly dry, aggregates show thin silty coatings of gray that give a dark grayish-brown cast to an exposed cut.

B21—16 to 26 inches, dark-gray (10YR 4/1), plastic silty clay mottled with very dark gray (10YR 3/1) and yellow-

ish brown (10YR 5/8); moderate, medium, subangular blocky structure; nearly continuous, very dark gray (10YR 3/1) clay films on aggregates.

B22—26 to 50 inches, highly mottled yellowish-brown (10YR 5/4), grayish-brown (10YR 5/2), and olive-brown (2.5Y 4/4), compact, plastic silty clay to clay; weak, subangular blocky structure; patchy clay films; numerous, black and brown, soft concretions.

B3—50 to 60 inches, highly splotched and mottled yellowish-brown (10YR 5/6), dark grayish-brown (10YR 4/2), light brownish-gray, (2.5Y 6/2), and light olive-brown (2.5Y 5/4), heavy silty clay loam; massive with some vertical cleavage; numerous, large, black iron or manganese stains; some sand grains.

D—60 to 70 inches +, light brownish-gray (2.5Y 6/2), gritty silty clay highly splotched and mottled with yellowish brown (10YR 5/8) and gray (5/0); massive; very sticky and plastic when moist; numerous glacial pebbles.

The soil is reasonably uniform from place to place. On gentler slopes, the surface layer is slightly grayer than elsewhere and gray coatings in the A3 horizon are more pronounced. Eroded areas lack an A3 horizon and have heavy silt loam to light silty clay loam texture because the upper subsoil has been mixed with the surface soil. On gentle slopes, the deep subsoil is dominantly gray, but on the rolling slopes, it is dominantly brownish. The B3 horizon of the profile described has presumably formed from loess. In some areas this horizon is absent and the B2 horizon lies directly over weathered glacial till.

Shelby Series

The Shelby soils are the most extensive soils and cover 23 percent of the county. They are dark colored and have a loam surface soil and a clay to clay loam subsoil. They developed in glacial till of Kansan age. Slopes are generally moderate, but the range is from gentle to strong. Shelby soils occur throughout the county in rolling and steeply rolling areas adjacent to the major streams. Run-off is medium to rapid, and internal drainage is medium to slow. The soils are subject to severe erosion. More than half the acreage of Shelby soils has lost half or more of the original surface layer.

The Shelby soils are associated with the Lagonda and Gara soils. They have a darker colored surface soil and a darker brown upper subsoil than the Gara soils. They differ from Lagonda soils in having a loam surface soil, a browner subsoil, and glacial till parent material.

Most areas of the Shelby soils are cultivated and used for corn, but the strongly sloping parts are generally in grass. Yields of crops and grass vary according to the severity of erosion and the amounts of lime and fertilizer applied. The uneroded Shelby soils are productive. Nearly all the common crops can be grown if fertilizers are applied and erosion is controlled. Many slopes are short and irregular, and erosion control practices are difficult to apply. Gully erosion is common, and a few areas are so gullied that it is not practical to cultivate them. In these areas, the yields of grass are low.

Shelby loam, 4 to 8 percent slopes (Sh) (Capability unit IIIe-6).—This is the most extensive soil in the county (fig. 4). A profile of this soil observed in a moist meadow



Figure 4.—View of Shelby loam, 4 to 8 percent slopes, showing a pit dug to examine the soil. In this part of the field, the surface layer is very dark grayish-brown loam, 9 inches thick. Under this is lighter colored, friable, silty clay loam that grades to plastic, gritty silty clay. In the upper part of this field, much of the original loamy surface layer has been lost through erosion and the underlying, finer textured material has been mixed in tillage with the remaining surface layer. The present surface soil is generally thinner and lighter colored than that shown in pit.

in NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 16, T. 58 N., R. 27 W., is described as follows:

- A1p—0 to 6 inches, very grayish brown (10YR 3/2), friable loam, fine, granular structure; a few glacial pebbles, $\frac{1}{8}$ inch in diameter or larger, on the surface and throughout the profile
- A12—6 to 10 inches, very dark brown (10YR 2/2), friable loam to silty clay loam containing very dark grayish-brown (10YR 3/2) material from layer above; fine and medium, granular structure.
- B1—10 to 16 inches, variegated very dark grayish-brown (10YR 3/2) and very dark brown (10YR 2/2), friable silty clay loam; moderate, coarse, granular structure
- B21—16 to 24 inches, very dark grayish-brown (10YR 3/2), plastic, gritty silty clay faintly mottled with yellowish brown (10YR 5/6); moderate, fine, subangular blocky structure, ped interiors are dark yellowish brown (10YR 4/4), and coatings on peds are dark grayish brown (10 YR 4/2).
- B22—24 to 40 inches, yellowish-brown (10YR 5/8), plastic clay loam, equally splotched and mottled with dark brown (10YR 4/3) and dark gray (10YR 4/1); moderate, fine and medium, subangular blocky structure; patchy clay films, numerous, large, gray splotches, 1 to 2 inches in diameter; numerous concretions
- B3—40 to 50 inches, highly splotched and mottled dark grayish-brown (10YR 4/2), yellowish-brown (10YR 5/8), and dark yellowish-brown (10YR 4/4), sticky, plastic, gritty silty clay, weak coarse, subangular blocky structure to massive, numerous glacial pebbles and some lime concretions in lower part.
- C—50 to 60 inches +, same color and texture as in above horizon; massive, numerous, large lime concretions and small, dark, soft iron concretions; numerous, large (6 to 8 inches in diameter), irregular masses of gray (10YR 5/1), gritty clay

The surface soil ranges from very dark brown to dark grayish brown but is predominantly very dark grayish brown (10YR 3/2). It is normally grayer where the Shelby soil is near the Gara soils. It is darker where the subsoil is high in lime.

The surface soil ranges from coarse silt loam to silty clay loam. The siltier texture occurs on the gentle slopes where a thin mantle of loess has influenced the formation of the surface soil. The silty clay loam surface soil normally occurs where much of the original loamy surface material has been lost through erosion and the underlying, finer textured material has been incorporated with the remaining soil through tillage or through excessive trampling by livestock. In eroded areas the A1 horizon is thinner than normal and, in places, the B1 is absent. In severely eroded areas, the surface soil is clay loam and is dominated by dark-brown and yellowish-brown colors from former subsoil that is now exposed at the surface.

Some of the lower slopes have received accumulations of soil from the upper slopes and, consequently, have a darker and thicker surface horizon. It is common for the upper third of some slopes to have soil with a modal profile; the middle third to have soil with a profile altered through the erosion of the surface layer and by the mixing of the material from the subsurface layer; and the lower third to have soil with an abnormally thick surface layer and B1 horizon.

The subsoil varies in texture and color. Generally, on the less sloping ridgetops where loess may have contributed to the soil-forming material, the subsoil is grayer and more mottled and contains less of the coarse glacial material than elsewhere. On such ridgetops Shelby loam, 4 to 8 percent slopes, is adjacent to the Lagonda soils and has similar profile characteristics.

In some areas of minor extent, the soil-forming material contains much sandy and gravelly material. These areas presumably are pockets of coarse, porous glacial till or are places in which glacial outwash was deposited during an earlier cycle of erosion. Such areas generally occur in a spotted pattern and are considered as variations of this Shelby soil. In other small areas, the glacial drift included an abnormally large amount of residuum from local limestone and shale. In these areas the subsoil is particularly plastic and dense, and in many places it has hues of reddish yellow and strong brown.

Lime concretions and free carbonates occur at variable depths ranging from approximately 3 feet to more than 6 feet. The concretions more commonly occur at a depth of 3 feet in the strongly sloping areas or in areas where the surface horizon has been removed through erosion.

Shelby loam, 9 to 15 percent slopes (S_m) (Capability unit IVE-6).—This soil is very similar to Shelby loam, 4 to 8 percent slopes. It has essentially the same range in profile characteristics. The slopes are normally more rolling, however, and the cover of silty loess on the surface has had less influence in formation of the soil. There is also less gray coloring in the upper and lower parts of the subsoil. In addition, the surface horizon in uneroded areas is thinner than in Shelby loam, 4 to 8 percent slopes. In most places Shelby loam, 9 to 15 percent slopes, has a slightly thicker, more uniformly dark-brown B1 horizon. The soil is not likely to have the faint, gray mottlings that may occur in the upper subsoil of Shelby loam, 4 to 8 percent slopes.

Many areas of Shelby loam, 9 to 15 percent slopes, have been cultivated, and some are still in cultivation. More of this soil is used for grass than of Shelby loam, 4 to 8 percent slopes. Grassed waterways help to control runoff in cultivated areas (fig. 5).

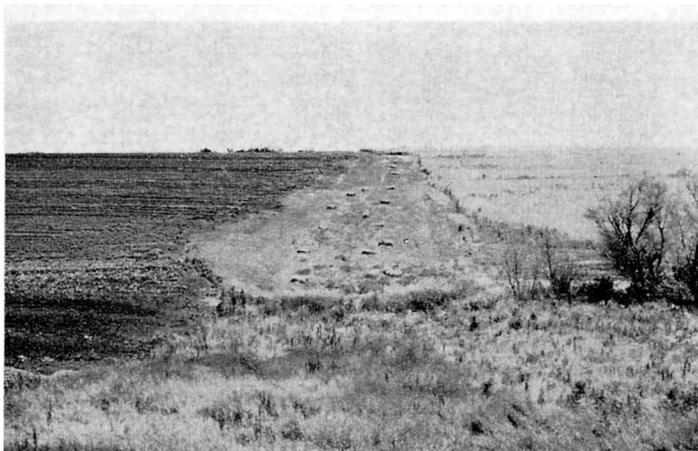


Figure 5.—Grassed waterway on Shelby loam, 9 to 15 percent slopes, is shown in the center of the picture. The fields have a slope of 11 percent. Standard terraces empty into the waterway, which has been seeded to brome grass and reed canary grass. This waterway has handled a 2.9-inch rain without scouring.

Snead Series

The Snead series is made up of very dark colored soils that are developing in the residuum from limestone and calcareous clay shale. These soils cover approximately 5 percent of the county and occur primarily in the steep area of residual soils along the Grand River. The surface layer of very dark grayish-brown to black silty clay is underlain at a depth of 8 to 12 inches by yellowish-brown or olive, partly decomposed clay shale of Pennsylvanian age. The dark color in the Snead soils is caused by the accumulation of organic matter. The soil parent material has a high content of lime that encourages the growth of grass and, consequently, the accumulation of organic matter.

The Snead soils are primarily strongly sloping to steep. Surface drainage is medium to very rapid, and internal drainage is slow. The areas are covered mainly by scattered timber and grass. These soils are susceptible to erosion, and some of the original surface soil has been lost from areas that were not protected by permanent vegetation. In most areas, however, the soils have not eroded severely. The thickness of the surface soil is variable, because the soils are young and are still in the process of forming from the parent material.

The Snead soils occur in association with the Gosport soils. Unlike the Gosport, they are dark colored and were derived from calcareous shale, rather than from the acid shale. The Snead soils are very high in natural fertility, but they normally are not suited to cultivation because they are steep and are shallow to parent material. They are excellent for grass, but their grazing capacity is only moderate because the soils are droughty in dry summers. Some of the less steeply sloping areas are used for small grains and meadow, but grass is the major crop.

Snead silty clay, 6 to 15 percent slopes (Sn) (Capability unit IVE-6).—A profile of this soil observed in a moist pasture of bluegrass in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 58 N., R. 26 W., approximately 4 $\frac{1}{2}$ miles west of Lock Springs, is described as follows:

A1—0 to 10 inches, black (10YR 2/1), slightly plastic silty clay; moderate, coarse, granular structure; numerous roots: high organic-matter content.

C1—10 to 20 inches, grayish-brown (2.5Y 5/2), plastic, partly weathered silty clay shale mottled with yellowish brown (10YR 5/4), small limestone fragments; weak, medium, subangular blocky structure with stratification planes present.

C2—20 inches +, olive (5Y 5/6) and grayish-brown (2.5Y 5/2), relatively unweathered, calcareous shale

This youthful soil has a thin solum, and its development is influenced markedly by the kind of parent material and the effects of erosion. The surface layer is normally 8 to 12 inches thick, but the range is from 6 to 16 inches in thickness. On some gentle, uneroded slopes, the surface layer is as much as 16 inches thick and in its lower part shows evidence of fine, subangular blocky structure. The extent of weathering of the parent shale varies. In some areas the parent material immediately below the surface layer does not appear to have been altered by weathering. In other areas the weathering has advanced to the stage that the soil mass appears as a massive silty clay with only slight evidence of the shale bedding planes.

Snead stony silty clay, 8 to 20 percent slopes (Ss) (Capability unit VII-6).—A profile of this soil observed in a moist area of scattered timber and bluegrass in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 17, T. 59 N., R. 27 W., is described as follows:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) to black (10YR 2/1), slightly plastic silty clay: strong, granular structure; numerous, dense limestone slabs and fragments; grass roots and leaf litter plentiful

C1—8 to 36 inches, light olive-brown (2.5Y 5/6), partly weathered clay shale with splotches of yellowish brown (10YR 5/6), numerous, large and small limestone fragments; weak, subangular blocky structure in the soil material surrounding limestone slabs

C2—36 to 60 inches, olive (5Y 5/4) clay shale with splotches of olive yellow (5Y 6/8), numerous limestone slabs and fragments.

D—60 inches +, a layer, 12 feet thick, consisting of dense, massive limestone underlain by alternate bands of shale and limestone.

The thickness of the surface layer is the primary variation. In some places there is little or no surface soil over the limestone slabs, but in other places there are pockets of soil, 15 to 18 inches thick, over the slabs. The amount of limestone slabs and fragments varies. In some areas limestone makes up only 10 percent of the soil mass, but in others the thin surface soil is underlain immediately by massive limestone. The variations just described occur in a spotted and patchy pattern within mapped areas of this soil.

Wabash Series

The Wabash series is made up of very dark gray to black, medium- and fine-textured soils on the flood plains of the Grand River and tributary streams. These soils occur in association with the Nodaway soils but are darker and have a finer textured subsurface layer. They are generally poorly drained and are nearly level to undulating.

The Wabash soils make up about 13 percent of the county. Three soil types are recognized—silt loam, silty clay loam, and clay. The silt loam type commonly occurs in the narrow valleys and on the flood plains of the Grand River. The surface layer of this type is the result of a fairly recent deposit of soil material. The areas in which this type occurs have slightly better drainage and are less inclined to be wet in spring than areas of the silty clay loam and clay types.

The clay type has a surface soil of black clay and normally occurs in broad, level to depressed areas on the bottom lands of the Grand River. The silty clay loam type is intermediate in texture between the silt loam and clay types.

Excess water is the major hazard on the Wabash soils. It results from stream overflow, flash flooding, ponding, or the slow drying out of the fine-textured surface soil.

Wabash silt loam and Wabash silty clay loam are among the most productive soils in the county, but the use of much of these soils is slightly limited by overflow. Corn, wheat, and soybeans are the main crops grown. Areas used principally for pasture are narrow bottom lands that are not suited to cropping and tracts in which wetness delays normal farming operations in spring and fall.

Areas of Wabash clay are not well suited to agriculture. Swamp grass was the original vegetation, and in wet years or following periods of overflow, weeds and marsh grass take over quickly. Soybeans are the major crop, but yields are variable. The soil cracks badly during dry seasons, and crops are damaged by drought. Tile drainage is not feasible. Open ditches are effective, but these are short lived because of the damage through overflow.

Wabash silt loam (Wb) (Capability unit IIw-1).—This soil is the most extensive of the Wabash series and makes up 65 percent of the acreage of the Wabash soils in the county. A profile observed in a moist cornfield in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 58 N., R. 26 W., is described as follows:

- Ap—0 to 8 inches, very dark brown (10YR 2/2), friable silt loam; moderate, medium, granular structure.
- AB—8 to 14 inches, black (10YR 2/1) silty clay loam; moderate, coarse, granular structure; faint, gray (10YR 6/1) silty coatings on dry aggregates; a few, strong-brown and black, soft concretions.
- B3—14 to 30 inches, very dark grayish-brown (10YR 3/2), plastic silty clay with mottles of dark gray (10YR 4/1); weak, fine, subangular blocky structure; a few, strong-brown (7.5YR 5/8), soft concretions of iron.
- C—30 to 50 inches +, dark-gray (10YR 4/1), plastic clay mottled with yellowish brown (10YR 5/8), massive

The thickness of the silty surface layer varies. Where there are thick, recent accumulations of soil material, the silty layer is 30 to 36 inches thick over older, finer textured material. The recent overwash tends to be dark brown (10YR 4/3) to dark gray (10YR 4/1), depending on its source. In some areas the AB horizon is not present. In places the silt loam surface layer is underlain by silty clay loam or silty clay subsurface material. Mottling occurs in all profiles, but it begins at a depth ranging from 10 to 30 inches and varies in intensity. In some places gray mottles cover only 5 to 10 percent of the exposed surface of the peds, but in others they cover as much as 30 to 40 percent. In some narrow valleys, the surface soil contains a considerable amount of sand, and, in places, the texture is loam.

Wabash silty clay loam (Ws) (Capability unit IIw-1).—This soil makes up about 15 percent of the acreage of Wabash soils in the county. The profile is similar to that just described for Wabash silt loam. It differs chiefly in that the surface layer is silty clay loam and is 12 to 20 inches thick. The structure of the lower part of the surface layer and the upper part of the subsoil is somewhat stronger than that of Wabash silt loam. The structure ranges from moderate, fine, subangular blocky in the lower part of the surface layer below the plow layer to

moderate, angular blocky in the subsoil. In places silt has been deposited on the surface in a layer that is generally only 2 or 3 inches thick.

Wabash clay (Wc) (Capability unit IIIw-14).—Wabash clay makes up about 20 percent of the acreage of Wabash soils in the county. It differs from Wabash silt loam in that the entire profile consists of very dark gray (10YR 3/1) to black (10YR 2/1), plastic clay. Yellowish-brown and gray mottles occur at a depth of about 14 to 18 inches, as in the silt loam type, and dark colors are predominant throughout the profile. The structure is weak to moderate, fine to medium, blocky throughout the upper 36 to 40 inches of the profile and is better developed than that of Wabash silt loam.

Wabash clay occurs in large, fairly uniform, level to depressed areas in the broad bottom lands of the Grand River. Surface drainage and internal drainage are very slow. This soil remains wet longer after rains than does either Wabash silt loam or Wabash silty clay loam. During extended dry periods, Wabash clay cracks extensively at the surface. These cracks are 1 to 2 inches wide and extend to a depth of 20 to 30 inches.

Use and Management of the Soils

This section has four parts. The first part explains the system of grouping soils according to their capability and lists the capability classes, subclasses, and units in Daviess County. The second part lists the soils in each capability unit and suggests management for each unit. In this part, there is also a table that gives examples of cropping systems and supporting practices for the soils in the various capability units. The third part gives estimated yields of principal crops grown on the soils of the county. The last part consists of a discussion of the engineering properties of the soils and the suitability of the soils as material in various kinds of construction.

Capability Groups of Soils

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

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

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral; for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness

can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard 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-1 or IIIe-6.

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

The eight classes in the capability system, and the subclasses and units in the county, are described in the list that follows. The soils were assigned to capability units under a statewide system. Not all of the capability units in the State are represented in Daviess County; consequently, the numbering of the units is not consecutive.

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

(No subclasses.)

Capability unit I-1.—Well-drained, nearly level and undulating soil of the bottom lands.

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

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

Capability unit IIe-6.—Deep, imperfectly to poorly drained, undulating to gently sloping soils of the uplands and terraces.

Subclass IIw. Soils that have moderate limitations because of wetness.

Capability unit IIw-1.—Poorly drained, level to nearly level soils of the bottom lands.

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

Subclass IIIe. Sloping soils that are subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-6.—Deep, moderately well drained to imperfectly drained, sloping soils with a silty clay loam or silty clay subsoil.

Capability unit IIIe-5.—Imperfectly to poorly drained, sloping soils with a plastic silty clay to clay subsoil that is very slowly permeable.

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

Capability unit IIIw-14.—Very poorly drained,

nearly level soil of the bottom lands that has a clay surface soil and subsoil.

Capability unit IIIw-3.—Poorly drained, gently sloping soil that has a dark grayish-brown to gray silty surface soil and a silty clay subsoil.

Subclass IIIs. Soils that are limited by a low capacity for holding available water.

Capability unit IIIs-4.—Gently sloping and undulating areas of sandy soils that are droughty.

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

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

Capability unit IVe-6.—Moderately well drained to poorly drained, strongly sloping soils that have a silty clay loam and clay loam subsoil.

Capability unit IVe-5.—Poorly drained, gently to moderately sloping, light-colored soil that has a silty clay subsoil.

Class V. Soils not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to permanent vegetation. (No class V soils in Daviess 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.

Capability unit VIe-6.—Moderately well drained, strongly sloping soil.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation 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.

Capability unit VIIe-3.—Strongly sloping to steep soil that is shallow over shale.

Subclass VIIs. Soils very severely limited by moisture capacity or stones.

Capability unit VIIs-6.—Strongly sloping and steep soil with a stony surface; shallow over limestone and shale.

Class VIII. Soils and landforms that have limitations making them unsuited to commercial plant production and restricting their use to recreation, wildlife, water supply, or esthetic purposes. (No class VIII soils in Daviess County.)

Management by Capability Units

In the following pages each capability unit is described briefly, the soils in each are listed, and some suggestions are given for the use and management of the soils of each unit. In table 3 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 suggested cropping systems were provided by the supervisors of the Daviess County Soil and Water Conservation District as being suitable for maintaining crop yields and conserving soils.

TABLE 3.—*Maximum intensity of land use and supporting practices for soils of the*

[Average management consists of: Applying about half the amounts of lime and fertilizer indicated by soil tests, returning crop residues Highly specialized management consists of: Improving drainage where needed (D); returning crop residues to the soil (R), applying mulch tillage to protect the soil (M), practicing wind stripcropping to prevent wind erosion (S), planting adapted crop varieties and fire and from excessive grazing (W), harvesting mature trees and removing poor trees (Z). The capital letters shown in parentheses

Capability unit	Cropping systems and practices for nearly level areas—	
	Average management	Highly specialized management
Unit I-1—Well-drained, nearly level and undulating soil of the bottom lands. (No) Nodaway silt loam	3 years of row crops followed by 1 year of a small grain seeded with a cover crop that is to be turned under for green manure	Continuous row crops if supported by highly specialized management practices R, F, T, and D.
Unit IIe-6—Deep, imperfectly to poorly drained, undulating to gently sloping soils of the uplands and terraces (Bk) Blockton silt loam, 1 to 4 percent slopes (Gr) Grundy silt loam, 1 to 4 percent slopes (Gt) Grundy silt loam, terrace phase, 1 to 4 percent slopes	3 years of row crops followed by 1 year of a small grain seeded with a cover crop that is to be turned under for green manure.	Continuous row crops, if supported by highly specialized management practices R, F, T, and D.
Unit IIw-1—Poorly drained, level to nearly level soils of the bottom lands (Wb) Wabash silt loam (Ws) Wabash silty clay loam	3 years of row crops followed by 1 year of a small grain seeded with a cover crop that is to be turned under for green manure	Continuous row crops if supported by highly specialized management practices R, F, T, and D.
Unit IIIe-6.—Deep, moderately well drained to imperfectly drained, sloping soils with a silty clay loam or silty clay subsoil. (Ga) Gara loam, 3 to 8 percent slopes. (La) Lacona silt loam, 2 to 8 percent slopes (Ma) Mandeville silt loam, 2 to 5 percent slopes (Sh) Shelby loam, 4 to 8 percent slopes		
Unit IIIe-5—Imperfectly to poorly drained, sloping soils with a plastic silty clay to clay subsoil that is very slowly permeable (Lg) Lagonda silt loam, 2 to 8 percent slopes (Se) Seymour silt loam, 1 to 4 percent slopes		
Unit IIIw-14—Very poorly drained, nearly level soil of the bottom lands that has a clay surface soil and subsoil (Wa) Wabash clay	Continuous row crops, except for a legume or a grass crop once every 4 or 5 years	Continuous row crops if supported by highly specialized management practices R, F, T, and D.
Unit IIIw-3.—Poorly drained, gently sloping soils that have a gray silty surface soil and a silty clay subsoil. (Bu) Burrell silt loam, 1 to 3 percent slopes. (Ed) Edina silt loam, 1 to 2 percent slopes (Et) Edina silt loam, terrace phase, 1 to 3 percent slopes	3 years of row crops, 1 year of a small grain, and 1 year of meadow.	4 years of row crops and 1 year of a small grain seeded to a cover crop that is to be turned under for green manure, if supported by highly specialized management practices D, R, F, and T
Unit IIIs-4.—Gently sloping and undulating areas of sandy soils that are droughty. (Sb) Sandy terraces		In the few nearly level areas, 2 years of row crops with a cover crop seeded each year, 1 year of a row crop without a cover crop, and 1 year of a small grain seeded with a cover crop to be turned under for green manure. This cropping system requires highly specialized management practices R, F, and M or S
Unit IVe-6—Moderately well drained to poorly drained, strongly sloping soils that have silty clay loam and silty clay subsoil (Lb) Lacona silt loam, 9 to 15 percent slopes (Mb) Mandeville silt loam, 6 to 10 percent slopes (Sa) Sampsel silt loam, 5 to 15 percent slopes (Sm) Shelby loam, 9 to 15 percent slopes (Sn) Sneed silty clay, 6 to 15 percent slopes.		

different capability units under average management and highly specialized management

to the soil by leaving the straw, stalks, and stubble in the field, by feeding livestock in the field, or by spreading barnyard manure lime and fertilizer in amounts indicated by soil tests (F), practicing minimum tillage to preserve soil structure (T), practicing stubble-seeding mixtures (V); managing grazing, controlling weeds, and practicing timely field operations (C), protecting woodland from are to be used to identify the practices in this table]

Cropping systems and practices or land use for sloping areas under highly specialized management--			Remarks
Without contouring or terracing	Contouring	Terracing	
1 or 2 years of a small grain followed by 1 or 2 years of meadow	1 year of a row crop, 1 or 2 years of a small grain, and 1 year of meadow.	3 years of row crops followed by 1 year of a small grain seeded with a cover crop that is to be turned under for green manure	Some areas may need to be protected against runoff from hills, simple surface drainage may be needed in low, isolated spots. Nitrogen fertilizer is especially important for early growth of plants in wet seasons; simple surface drainage may be needed in level or ponded areas
1 year of a small grain and 3 years or more of a hay mixture.	1 year of a row crop, 1 year of a small grain, and 3 years or more of a hay mixture.	2 years of row crops, 1 year of a small grain, and 2 years or more of a hay mixture.	Simple surface drainage may be needed in ponded areas, nitrogen fertilizer is important for early growth of plants. In many areas there are spots where erosion has removed part of the surface soil and tillage has exposed the subsoil.
1 or 2 years of a small grain followed by 2 or 3 years of meadow.	1 year of a row crop, 1 year of a small grain, and 2 years of meadow.	2 years of row crops, 1 year of a small grain, and 1 year of meadow.	Seepage areas are common on slopes and at heads of drainage-ways; nitrogen fertilizer is important for early growth of plants
1 or 2 years of a small grain followed by 2 or 3 years of meadow.	1 year of a row crop, 1 year of a small grain, and 2 years of meadow	2 years of row crops, 1 year of a small grain, and 1 year of meadow.	Crop failures are common because wetness delays farming operations in spring and fall, control of weeds is a problem. Nitrogen fertilizer is important for early growth of plants, the soil should not be tilled when wet
1 or 2 years of a small grain followed by 2 or 3 years of meadow.	1 year of a row crop, 1 year of a small grain, and 2 or more years of meadow.	1 year of a row crop followed by 1 year of a small grain seeded to a cover crop that is to be turned under for green manure	These sandy areas occur in bottom lands and are subject to occasional overflow, in some years, wind erosion damages bare areas.
Continuous hay and meadow crops.	1 year of a small grain followed by 3 years or more of meadow.	1 year of a row crop, 1 year of a small grain, and 3 years or more of meadow.	Irregular slopes make the construction of terraces difficult; because of erosion, the subsoil is exposed in many spots

TABLE 3.—*Maximum intensity of land use and supporting practices for soils of the*

Capability unit	Cropping systems and practices for nearly level areas—	
	Average management	Highly specialized management
Unit IVc-5.—Poorly drained, gently to moderately sloping, light-colored soil that has a silty clay subsoil. (Kv) Keytesville silt loam, 3 to 7 percent slopes.	(Not suited to cropping) -----	(Not suited to cropping) -----
Unit VIc-6 —Moderately well drained, strongly sloping soil. (Gb) Gara loam, 9 to 18 percent slopes.	(Not suited to cropping) -----	(Not suited to cropping) -----
Unit VIIe-3.—Strongly sloping and steep soil that is shallow over shale. (Gp) Gosport silt loam, 8 to 20 percent slopes.	(Not suited to cropping) -----	(Not suited to cropping) -----
Unit VIIs-6.—Strongly sloping and steep soil with a stony surface; shallow over limestone and shale. (Ss) Snead stony silty clay, 8 to 20 percent slopes.	(Not suited to cropping) -----	(Not suited to cropping) -----

CAPABILITY UNIT I-1

Only one soil—Nodaway silt loam (No)—is in capability unit I-1. This is a deep, friable, well-drained soil that occurs in nearly level and undulating bottom lands. It has little susceptibility to erosion. Water moves easily through the profile. The moisture-holding capacity is adequate for the growing of many kinds of adapted crops. The surface layer is slightly acid, and the subsoil is neutral to calcareous. Overflow is not a serious threat during the growing season, but it may occur occasionally in abnormally wet seasons.

In general, this soil is used for crops, and it is highly productive. It can be used continuously for row crops, under highly specialized management that includes the return of crop residues to the soil, the application of fertilizer as needed, and the use of minimum tillage. Under less specialized management, 1 year in 4 of the cropping system should be used for a small grain seeded with a winter cover crop that is turned under for green manure.

Erosion control practices usually are not needed on this soil. Some simple precautions may be needed, however, to prevent streambank erosion and to provide drainage in a few low spots along fence lines and in headlands.

Many kinds of pasture grasses and trees can be grown on this soil, but they are generally grown only in narrow, elongated areas in which it is impractical to use most types of farm machinery.

CAPABILITY UNIT IIe-6

The soils of unit IIe-6 are deep, dark and moderately dark, imperfectly to poorly drained, and nearly level to gently sloping. They occur in the uplands or on terraces.

The surface layer is silty, and the subsoil consists of silty clay. Water moves slowly into the soil, and during wet seasons excess water is a major hazard to crops. Erosion is the major hazard because of the long, gentle slopes and the slowly permeable subsoil. The soils in unit IIe-6 are—

Blockton silt loam, 1 to 4 percent slopes (Bk).

Grundy silt loam, 1 to 4 percent slopes (Gr).

Grundy silt loam, terrace phase, 1 to 4 percent slopes (Gi).

These soils are well suited to corn, soybeans, small grains, pasture (fig. 6), and hay. Under highly special-

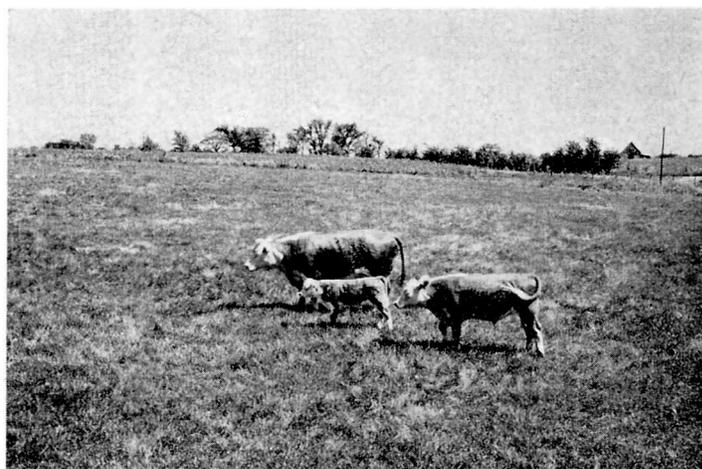


Figure 6.—Excellent bluegrass pasture on Grundy silt loam, 1 to 4 percent slopes. Some other areas of this soil are cultivated intensively.

different capability units under average management and highly specialized management—Continued

Cropping systems and practices or land use for sloping areas under highly specialized management—			Remarks
Without contouring or terracing	Contouring	Terracing	
1 year of a small grain followed by 3 or more years of meadow.	1 or 2 years of a small grain followed by 1 or 2 years of meadow.	1 year of a row crop, 1 year of a small grain, and 1 year of meadow.	Most areas are small and have irregular slopes.
Pasture or woodland-----	Pasture or woodland; new pasture seedings and mowing operations should be on the contour; tillage for woodland plantings should be also on the contour.	Pasture or woodland; diversion terraces may be needed, but field terraces are not generally applicable.	Pastures should be renovated when necessary, through highly specialized management practices F, V, and C; highly specialized management practices W and Z are needed in wooded areas.
Pasture or woodland-----	Pasture or woodland; new pasture seedings and mowing operations should be on the contour; tillage for woodland plantings should also be on the contour.	(Terraces not applicable)-----	Pastures should be renovated when necessary, through highly specialized management practices F, V, and C; highly specialized management practices W and Z are needed in wooded areas.
Woodland or pasture-----	Woodland or pasture-----	(Terraces not applicable)-----	Pasture renovation is difficult because of the rocky soil, and tillage is not usually feasible; highly specialized management practices W and C are needed in wooded areas.

ized management, they are productive, but, in general, they are especially subject to erosion if row crops are grown. Nevertheless, under highly specialized management, row crops can be grown continuously on nearly level areas that are not likely to erode. At present the soils are used mainly for crops; row crops are grown intensively.

On long, gentle slopes that have been terraced, row crops should be grown only 3 consecutive years and should be followed by 1 year of a small grain that is seeded to a cover crop to be turned under as green manure. Most of the slopes on these soils are long and gentle and are well adapted to terraces. In unterraced fields, the proportion of small grains or meadow crops in the rotation should be increased.

Moderate to large applications of nitrogen, phosphate, and potash fertilizer are needed for early spring growth and sustained high yields of most crops.

Trees that occur naturally on these soils are elm, box-elder, and honeylocust.

CAPABILITY UNIT IIw-1

This unit consists of poorly drained, level to nearly level soils of the bottom lands. Internal drainage is generally medium to slow. In some areas, water stands temporarily on the surface and intermittent flooding occurs. Simple surface drainage may be required to get uniform stands and high yields of crops. The soils in unit IIw-1 are—

- Wabash silt loam (Wb).
- Wabash silty clay loam (Ws).

These soils are fertile and are adapted to many kinds of crops. They are suited to continuous row crops if highly specialized management is applied. This includes the

proper use of crop residues, fertilization according to the results of soil tests, and minimum tillage. If management of slightly less intensity is applied, at least 1 year in 4 of the rotation should consist of a small grain seeded with a cover crop that is to be turned under for green manure. Diversion ditches may be needed to control excess runoff from the adjoining uplands.

These soils are excellent for pasture. Grass yields well in dry seasons and withstands occasional flooding. Many of the areas are elongated and narrow and are better suited to pasture than to cultivated crops.

Trees are not usually planted on these soils, but sycamore, walnut, basswood, cottonwood, and other deciduous trees grow naturally along streams and other drainageways.

CAPABILITY UNIT IIIe-6

This unit is made up of deep, moderately well drained to imperfectly drained, sloping soils with a silty clay loam or silty clay subsoil. The soils commonly occur on slopes of 2 to 8 percent. The surface layer is silty or loamy to a depth of 8 to 12 inches. Runoff is fairly rapid because of the degree of slope and the somewhat restricted movement of water in the subsoil. Erosion is a major hazard. The soils in unit IIIe-6 are—

- Gara loam, 3 to 8 percent slopes (Ga).
- Lacona silt loam, 2 to 8 percent slopes (La).
- Mandeville silt loam, 2 to 5 percent slopes (Ma).
- Shelby loam, 4 to 8 percent slopes (Sh).

Many kinds of crops and grasses can be grown on these soils. With highly specialized management, including proper soil treatment and control of erosion, moderate to high yields can be expected.

Many of the slopes are irregular and are broken by a number of drainageways and short spur ridges. Erosion has occurred over much of the acreage, and there are many spots in which subsoil has been brought to the surface in tillage. In the cultivated areas, erosion control practices are necessary to prevent excessive loss of soil. Under highly specialized management that includes the use of properly installed terraces (fig. 7) and terrace outlets, the



Figure 7.—Terraces constructed in this field of Shelby loam, 4 to 8 percent slopes, prevent excessive runoff and erosion on the long, gently rolling slopes.

following 5-year rotation is suggested: 2 years of row crops, 1 year of a small grain, and 2 years of a hay mixture. Fairly large, uneroded areas that have slopes of less than 5 percent may be adapted to slightly more intensive rotations. If practices to control erosion are not applied, row crops should be excluded from the rotation.

These soils respond well to fertilization; moderate to large applications of a complete fertilizer will increase yields of crops.

A protective cover of grass should be maintained in waterways (fig. 8) and tillage implements should be lifted



Figure 8.—A grassed waterway serves as an outlet for terraces on fields of Shelby loam, 4 to 8 percent slopes (capability unit IIIe-6) and Grundy silt loam, 1 to 4 percent slopes (capability unit IIe-6). This waterway is 1,900 feet long. One cutting of hay from this waterway provided feed for 30 head of cattle for 40 days.

across the waterways. Working or pasturing the soils when they are wet will cause excessive compaction.

Trees that grow well on the soils of unit IIIe-6 are oak, hickory, honeylocust, elm, and other hardwoods.

CAPABILITY UNIT IIIe-5

This unit consists of imperfectly drained to poorly drained, sloping soils that have a dark-gray to dark grayish-brown silty surface layer and a plastic silty clay to clay subsoil. Runoff is medium. Most areas are gently sloping to undulating, but some are nearly level. Erosion is a major hazard because of the slow permeability of the subsoil; the long, gentle slopes; and the soft, erodible surface soil. In wet seasons, excess moisture is also a hazard, and it delays farming operations and limits the suitability of crops. During extremely long droughts, the lack of soil moisture is a hazard. The soils in unit IIIe-5 are—

Lagonda silt loam, 2 to 8 percent slopes (lg).
Seymour silt loam, 1 to 4 percent slopes (Se).

These soils are well adapted to corn, soybeans, and small grains and to hay and pasture crops, including ladino clover and fescue. Alfalfa and bromegrass grow well under careful management but are not so well adapted as some clovers and grasses. The soils are moderately fertile and produce high yields if properly managed.

From the standpoint of the size of the fields and the ease of cultivation, the soils of unit IIIe-5 are among the most favorable in the county. Nevertheless, the hazards of erosion, excess water, and, in some seasons, droughtiness restrict the use of these soils.

Because many of the slopes are long and gentle, terraces are needed to control erosion if row crops are to be grown.

If terraces have been built and highly specialized management practices are followed, the soils can be used for row crops about half the time. For example, the following rotation can be applied: 2 years of row crops, 1 year of a small grain, and 1 year of meadow. If mechanical practices do not control erosion effectively, row crops should be left out of the rotation.

Trees are generally not planted on these soils. Stands of trees are of minor extent and are confined essentially to field boundaries, irregular areas, and heads of small drainageways.

CAPABILITY UNIT IIIw-14

This capability unit contains only one soil—Wabash clay (Wa). This is a very poorly drained, nearly level, dark-colored soil with a clay surface soil and subsoil. It is known locally as gumbo. It occupies large, uniform areas in the bottom lands, primarily where the river valley is more than a mile wide.

The original vegetation was swamp grass. Most of the acreage is now used for corn or soybeans. The soil is high in fertility, but yields are irregular. Under highly specialized management, row crops can be grown every year. In favorable years, excellent yields are obtained. Excess water is likely to delay farming operations, and during many years, much of the land is idle because it is wet. Surface drainage is normally needed, but it is often difficult to establish and maintain outlets. In dry seasons the soil shrinks and cracks. Control of weeds is difficult.

CAPABILITY UNIT IIIw-3

In unit IIIw-3 are poorly drained, gently sloping soils that have a dark grayish-brown to gray silty surface soil

and a silty clay subsoil. The soils occur on upland divides and stream terraces and cover less than 3 percent of the county.

Excess water is the major hazard. It accumulates because of the nearly level to gently sloping topography and the slowly permeable subsoil. Because of the long, gentle slopes, erosion is a secondary hazard. The soils in unit IIIw-3 are—

- Burrell silt loam, 1 to 3 percent slopes (Bu)
- Edma silt loam, 1 to 2 percent slopes (Ed).
- Edina silt loam, terrace phase, 1 to 3 percent slopes (Ei).

These soils are well suited to corn, soybeans, small grain, hay, and pasture. They are of moderate to high productivity, but they require highly specialized management to maintain yields of crops. Most of the acreage is cultivated.

In nearly level areas, not subject to erosion, the following rotation is suggested: 4 years of row crops followed by 1 year of small grain seeded to a green-manure crop. In gently sloping areas, erosion control practices and other highly specialized management are needed. Under such management, a suggested rotation is 2 years of row crops, 1 year of a small grain, and 1 year of hay or pasture.

Because the soils are somewhat wet and cold in spring, nitrogen fertilizer is especially needed for early growth of crops. Phosphate and potash fertilizers are also helpful.

CAPABILITY UNIT IIIs-4

This unit is made up of a miscellaneous land type—Sandy terraces (Sb). Sandy terraces consist of gently sloping and undulating areas of sandy soils that are droughty. The areas occur as mounds or ridges of sandy loam and sand on the flood plains of the Grand River. The surface soil of dark-brown sandy loam is underlain by sand that has a few, thin streaks and bands of fine-textured material. The sandy soil is fertile, but its moisture-holding capacity is low, and droughtiness is a major hazard. The areas are subject to overflow during high floods.

Sandy terraces are used primarily for corn and soybeans. Fall and winter cover crops should be seeded in each row crop. When turned under, the cover crop increases the moisture-holding capacity of the soil and helps to prevent wind erosion. Under highly specialized management, the following rotation is suggested for nearly level areas of Sandy terraces: 2 years of row crops with a cover crop seeded each year, 1 year of a row crop, and 1 year of small grain and a green-manure crop.

CAPABILITY UNIT IVe-6

This unit consists of moderately well drained to poorly drained, strongly sloping soils that have a silty surface soil and a silty clay loam and silty clay subsoil. The surface soil is thin, and in many places, the clayey subsoil is exposed. In some of the soils, shale material occurs at a depth of 24 to 30 inches. Susceptibility to erosion is the major hazard. The soils in unit IVe-6 are—

- Lacona silt loam, 9 to 15 percent slopes (Lb)
- Mandeville silt loam, 6 to 10 percent slopes (Mb)
- Sampsel silt loam, 5 to 15 percent slopes (Sa)
- Shelby loam, 9 to 15 percent slopes (Sm).
- Snead silty clay, 6 to 15 percent slopes (Sn).

Most areas on slopes of 10 percent or less have been cultivated, but they have become eroded as the result of inadequate management. Because the slopes are irregular, erosion control practices are difficult to apply.



Figure 9.—In foreground, cattle grazing improved pasture consisting of a mixture of alfalfa and bromegrass on Shelby loam, 9 to 15 percent slopes. In background, unimproved pasture and scattered trees growing on Gara loam, 9 to 18 percent slopes.

The soils are well suited to grass and are used principally for pasture (fig. 9). They generally produce high yields if properly managed. Moderate applications of fertilizer are needed to obtain well-balanced stands of grass.

Under highly specialized management, limited cultivation is possible on some of the less rolling areas that can be terraced. In such fields 1 year of a row crop followed by a small grain seeded to a hay mixture that is left for 3 years or more will help to maintain the soils and to provide favorable yields. Unterraced areas should be used only for pasture or hay.

Trees grow well on the soils of this unit. Oak, hickory, elm, and honeylocust are best suited.

CAPABILITY UNIT IVe-5

The only soil in unit IVe-5 is Keytesville silt loam, 3 to 7 percent slopes (Kv). This is a poorly drained, gently to moderately sloping, light-colored silty soil. It occurs on bench slopes and on high terraces in the hilly and forested parts of the county. Seepy spots are common. The parent material of this soil is weathered shale that has been modified in places by weathered glacial till. A thin mantle of loess is on the surface. The subsoil consists of dense, mottled, plastic silty clay.

This soil is one of the least productive in the county. Most of it is cultivated, but it is better suited to grass and hay than to grain. Where only a little erosion has occurred, fields can be terraced, and other highly specialized management can be applied, the most intensive rotation that is suggested consists of 1 year of a row crop, 1 year of a small grain, and 1 year of meadow.

The soil is only moderately productive of grass and hay, and complete fertilization is needed for satisfactory yields.

Oak, hickory, elm, and honeylocust are adapted to this soil and grow well on it.

CAPABILITY UNIT VIe-6

Only one soil—Gara loam, 9 to 18 percent slopes (Gb)—is in unit VIe-6. This is a moderately well drained, strongly sloping soil. Slopes are irregular, and drainage-

ways are common between the strong side slopes. Many areas are eroded, and, if unprotected, the soil is highly susceptible to further erosion.

This soil has developed under a mixture of prairie grass and timber. Surface runoff is rapid where the vegetation is sparse. Grass is well adapted to the soil, and good yields are obtained under proper management. Although the soil is primarily in grass, large areas of timber occur. Most of the timber is in irregularly shaped tracts that are scattered along drainageways. The major trees are oak, hickory, and elm.

Some of the areas have been cultivated, but most of these have been severely damaged by erosion and have been allowed to revert to grass or trees. All tillage done in the seeding and renovating of pastures and the management of timber should be on the contour.

CAPABILITY UNIT VIIe-3

The only soil in unit VIIe-3 is Gosport silt loam, 8 to 20 percent slopes (Gp). This is a strongly sloping to steep, light-colored silty soil, in which partly weathered, yellowish-brown shale of Pennsylvanian age occurs at a depth of 12 to 20 inches. Many areas not protected by vegetation have been severely eroded.

This soil occurs in a mixed pattern with other soils that have developed from shale or limestone material or glacial till. It is low in natural fertility, in organic matter, and in moisture-holding capacity.

The soil is not suited to cultivation. Pastures are of poor quality, and, unless well managed, produce low yields. Most of the acreage is covered by trees, mainly oak and hickory. Yields of timber are low.

CAPABILITY UNIT VIIs-6

The only soil in unit VIIs-6 is Sneed stony silty clay, 8 to 20 percent slopes (Ss). The surface layer is 3 to 12 inches of dark-colored silty clay. Limestone rocks and fragments are in and on the soil. Massive ledge rock and shale are at a depth ranging from 3 to 12 inches. In some cracks and ledges, soil material extends to a depth of more than 12 inches.

Trees and shrubs grow in the thin mantle of soil, but they are generally of poor quality or are deformed. Grass grows exceptionally well, but pastures yield poorly because of the low moisture-holding capacity of the soil and the inaccessibility of the pastures to normal grazing. Most of the areas are in grass and trees and are best suited to this use. The main trees are of the oak-hickory type.

Estimated Yields

Estimated average acre yields of the principal crops grown on the soils of Daviess County are listed in table 4. In columns A are yields to be expected under average management, and in columns B are yields to be expected under the highly specialized management that is now being used by some farmers in the county.

The yields are estimated averages for a 5- to 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 interviews with farmers, members of the staff of the Missouri Agricultural Experiment Station, cooperators of the Daviess County Soil and Water Conservation District, and representatives of the Soil Conservation Service. In making the estimates, the

prevailing climate, the characteristics of the soils, and the influence of different kinds of management on the soils were considered. The estimated yields were based on uneroded or only slightly eroded areas of the soils. Yields may be much lower on eroded areas of the soils, especially if the subsoil is heavy textured or is otherwise unfavorable.

To obtain the yields shown in columns A of table 4, farmers use the following average management practices:

(1) At least half the lime and fertilizer needed, as determined by soil tests, is applied.

(2) Crop residues are returned to the soil by leaving stalks, straw, and stubble in the field; by feeding livestock in the field; or by returning all barnyard manure to the soil.

To obtain the yields shown in columns B, farmers use the following highly specialized management practices, accompanied by erosion control practices as needed:

- (1) Drainage is improved where needed.
- (2) All crop residues are left in the field and mixed with the soil.
- (3) Fertilizer and lime are applied in amounts indicated by soil tests.
- (4) The minimum amount of tillage is done to preserve soil structure.
- (5) Stubble-mulch tillage is practiced to protect the soil.
- (6) Wind stripcropping is done to prevent erosion.
- (7) Adapted varieties, species, and seeding mixtures are used.
- (8) Cultural practices that include management of grazing, weed control, and timely planting and harvesting are followed.

Engineering Properties of the Soils

Specific properties of the soils are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the most important of these soil properties are permeability, drainage, texture, plasticity, depth to hard rock, and depth 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. This information and the detailed soil map in the back of the report will help engineers in—

1. Making soil and land use studies that will aid them in selecting and developing industrial, business, residential, and recreational sites.
2. Making preliminary estimates of the engineering properties of the soils that will help in the planning of agricultural drainage systems, farm ponds, terraces, waterways, irrigation systems, and the layout of farm buildings.
3. Making preliminary evaluations of soil and ground conditions in selecting highway locations.
4. Locating probable sources of gravel, sand, and limestone and fill, topdressing, and other construction materials.

5. Correlating performance of engineering structures with soil conditions and, thus, developing information for designing and maintaining the structures.
6. Supplementing information from other published maps, reports, and aerial photographs for obtaining data that will be useful to engineers.
7. Developing preliminary estimates for other types of construction in the county.

the in-place condition of the soil at the proposed construction site.

Most of the engineering information about Daviess County soils is given in table 5. This table contains estimates of various soil properties that affect engineering, and it rates the suitability of soils for stated kinds of engineering construction. These estimates are not based on tests of engineering soil samples, since no samples for this purpose were taken during the survey.

The ratings of soils in table 5 as to "Susceptibility to frost action" depend on the texture of the soils and the depth to the water table during the freezing period. Silts and fine sands with a higher water table have a "high" susceptibility to frost action.

Nevertheless, 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

TABLE 4.—Estimated average acre yields of principal crops under two levels of management

[Yields in columns A are those expected under average management, those in columns B, under highly specialized management. The two levels of management are described in the text. Absence of a yield figure indicates the crop is not commonly grown on the specified soil]

Map symbol	Soil	Capability unit	Corn		Wheat		Oats		Soybeans		Clover		Lespedeza		Pasture	
			A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bk	Blockton silt loam, 1 to 4 percent slopes.	IIe-6----	Bu 50	Bu 80	Bu 20	Bu. 30	Bu. 35	Bu 60	Bu 22	Bu 32	Tons 2 0	Tons 3. 0	Tons 1. 5	Tons 1. 5	Lb beef per acre 175	Lb beef per acre 275
Bu	Burrell silt loam, 1 to 3 percent slopes.	IIIw-3----	30	50	15	25	20	35	13	20	. 3	1 5	1 0	1 5	120	200
Ed	Edina silt loam, 1 to 2 percent slopes.	IIIw-3----	35	60	15	28	25	40	16	26	. 5	2. 0	1. 0	1 5	150	250
Et	Edina silt loam, terrace phase, 1 to 3 percent slopes.	IIIw-3----	35	60	15	28	25	40	16	26	. 5	2 0	1. 0	1 5	150	250
Ga	Gara loam, 3 to 8 percent slopes.	IIIe-6----	30	50	15	28	25	40	15	25	1 0	2 0	1 0	1. 5	130	200
Gb	Gara loam, 9 to 18 percent slopes.	VIe-6----	25	45	12	25	20	35	-----	-----	1. 0	2 0	1. 0	1 5	130	200
Gp	Gospport silt loam, 8 to 20 percent slopes.	VIIe-3----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	. 8	1. 0	70	150
Gr	Grundy silt loam, 1 to 4 percent slopes.	IIe-6----	50	80	20	30	40	55	20	30	2 0	3 0	1. 5	1. 5	175	275
Gt	Grundy silt loam, terrace phase, 1 to 4 percent slopes.	IIe-6----	50	80	20	30	40	55	20	30	2. 0	3 0	1. 5	1. 5	175	275
Kv	Keytesville silt loam, 3 to 7 percent slopes.	IVe-5----	20	40	10	20	20	35	10	20	. 3	1. 5	. 8	1. 2	80	175
La	Lacona silt loam, 2 to 8 percent slopes.	IIIe-6----	40	60	20	25	35	50	18	28	1. 0	3. 0	1. 3	1 5	175	275
Lb	Lacona silt loam, 9 to 15 percent slopes.	IVe-6----	40	55	20	25	30	45	15	25	1. 0	3 0	1. 3	1 5	175	275
Lg	Lagonda silt loam, 2 to 8 percent slopes.	IIIe-5----	38	65	18	27	30	45	18	28	1 8	2 5	1 0	1 5	175	275
Ma	Mandeville silt loam, 2 to 5 percent slopes.	IIIe-6----	30	40	10	20	20	40	15	25	. 5	2 0	. 8	1. 3	100	200
Mb	Mandeville silt loam, 6 to 10 percent slopes.	IVe-6----	25	40	10	20	20	35	-----	-----	. 5	2. 0	. 8	1 3	100	200
No	Nodaway silt loam	I-1-----	50	80	25	30	40	55	25	30	2. 5	3. 0	1. 5	1. 5	200	275
Sa	Sampsel silt loam, 5 to 15 percent slopes	IVe-6----	40	60	15	25	30	50	18	28	2. 0	3. 0	1. 5	1. 5	175	275
Sb	Sandy terraces	IIIs-4----	30	50	15	25	25	35	20	25	1. 5	3. 0	1. 0	1. 5	100	200
Se	Seymour silt loam, 1 to 4 percent slopes.	IIIe-5----	40	65	20	30	35	55	20	29	2. 0	3. 0	1. 5	1. 5	175	275
Sh	Shelby loam, 4 to 8 percent slopes.	IIIe-6----	40	70	20	27	35	50	16	25	2. 0	3. 0	1. 5	1. 5	175	275
Sm	Shelby loam, 9 to 15 percent slopes.	IVe-6----	30	60	15	25	30	45	15	20	2. 0	3 0	1. 5	1 5	175	275
Sn	Snead silty clay, 6 to 15 percent slopes	IVe-6----	30	40	20	25	35	40	18	28	1. 8	2. 0	1. 5	1 5	175	250
Ss	Snead stony silty clay, 8 to 20 percent slopes.	VIIIs-6----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	100	200
Wa	Wabash clay	IIIw-14---	35	45	20	25	30	40	20	26	1. 0	2. 0	1 0	1. 5	100	200
Wb	Wabash silt loam	IIw-1----	55	80	25	30	40	55	30	35	2. 0	3. 0	1. 5	1. 5	200	275
Ws	Wabash silty clay loam	IIw-1----	50	70	20	25	30	40	20	26	1. 0	2 0	1 0	1. 5	100	200

The ratings of soils for "Suitability as fill material" depend on the proportion of particles of different size in the soil mass. When compacted under the proper content of moisture, well-graded soils with relatively equal mixtures of sand, silt, clay, and gravel have a "high" suitability as fill material. Many soils that have a silty surface soil and a silty clay subsoil make better fill material

when the surface soil and subsoil are mixed than when these components are used separately. In many places the surface soil and subsoil could be mixed during the earth-moving process and would provide the most satisfactory fill material. In table 5 suitability ratings are given for the surface soil, the subsoil, and a mixture of the surface soil and subsoil. In some soils fill material

TABLE 5.—*Estimates of various soil properties affecting*

Soils and map symbols	Descriptions of the soils	Thickness of soil material	Kind of underlying parent material	Depth to seasonally high water table ¹	Internal drainage ²	Susceptibility to frost action
Blockton----- (Bk)	12 inches of silt loam over 5 inches of silty clay loam that is underlain by 30 inches or more of plastic silty clay.	<i>Inches</i> 50+	Medium- and fine-textured alluvium	<i>Inches</i> 18	Slow-----	Moderate---
Burrell----- (Bu)	14 inches of silt loam over 30 inches or more of plastic silty clay.	50+	Medium- and fine-textured alluvium.	14	Slow-----	Moderate---
Edma----- (Ed, Et)	15 inches of silt loam over 25 inches of plastic silty clay that is underlain by 20 inches of silty clay loam.	50+	Medium- and fine-textured loess and till.	15	Very slow---	High-----
Gara----- (Ga, Gb)	11 inches of loam over 50 inches or more of clay loam.	50+	Clay loam till with pockets of sand and clay.	36	Medium to slow.	Moderate---
Gosport----- (Gp)	13 inches of silt loam over 40 inches or more of weathered silty and sandy shale.	13	Partly weathered silty and sandy shale and limestone.	(³)	Slow-----	Moderate---
Grundy----- (Gr, Gt)	15 inches of silt loam over 8 inches of silty clay loam that is underlain by 40 inches of silty clay.	50+	Medium- and fine-textured loess and till.	20	Slow-----	Moderate---
Keytesville----- (Kv)	12 inches of silt loam over 40 inches or more of silty clay	50+	Mixed fine-textured alluvium.	12	Very slow-----	High-----
Lacona----- (La Lb)	10 inches of silt loam over 6 inches of silty clay loam that is underlain by 40 inches or more of silty clay.	40-50+	Partly weathered limestone and shale.	(³)	Medium-----	Low-----
Lagonda----- (Lg)	14 inches of silt loam over 35 inches or more of silty clay.	50+	Fine-textured till-----	14	Slow-----	High-----
Mandeville----- (Ma, Mb)	12 inches of silt loam over 40 inches or more of silty clay.	30-40+	Partly weathered shale and limestone	(³)	Medium-----	Low-----
Nodaway----- (No)	24 inches of silt loam over 36 inches or more of very fine sandy loam.	50+	Medium-textured alluvium.	(³)	Medium to rapid.	Low-----
Sampsel----- (Sa)	14 inches of silt loam over 14 inches of silty clay loam that is underlain by 30 inches or more of silty clay.	50+	Weathered clay shale and limestone.	15	Slow-----	Moderate---

See footnotes at end of table.

from the substratum or weathered rock in deep cuts may have different ratings than the surface soil or subsoil.

The ratings for soils as to erodibility in cuts and fills depend on the soil density, or the amount of pore space after the shaped surface has been exposed to the weather. Silty and sandy soils with much pore space are highly susceptible to erosion.

In Daviess County, agricultural drainage is not a serious problem, because most of the cultivated soils are sloping. Some depressions and nearly level areas occur, however, in bottom lands and on upland divides. These areas can be improved through the use of surface ditches and outlets that are fairly easy to design and construct.

engineering and the estimated suitability of the soils for engineering construction

Suitability of surface soil as topdressing for cuts and fills	Suitability of soil as source of sand and gravel	Suitability as fill material			Erodibility in cuts and fills when exposed to weather	Farm ponds or lakes	
		Surface soil	Subsoil	Mixture of surface soil and subsoil		Suitable kind	Hazards
High.....	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	Generally no hazards, but in nearly level areas, watersheds may not be large enough
Moderate...	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	Generally no hazards, but in nearly level areas, watersheds may not be large enough
High.....	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	Generally no hazards, but in nearly level areas, watersheds may not be large enough
High.....	Generally not suitable, but near Lock Springs some large pockets of gravel are in the fill.	Moderate...	High.....	High.....	Moderate...	Impounded..	A few pockets of sand
Moderate...	Suitable where there are thick, massive beds of limestone that can be crushed	Low.....	Moderate...	Moderate...	Moderate...	None.....	Shallow over shale and limestone
High.....	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	Generally no hazards, but in nearly level areas, watersheds may not be large enough.
Moderate...	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	Generally no hazards, but in nearly level areas, watersheds may not be large enough
High.....	Not suitable.....	Moderate...	Low.....	High.....	Moderate to low	Impounded..	Permeable soil and outcrops of rock.
High.....	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	None.
Moderate...	Not suitable.....	Moderate...	Low.....	High.....	Moderate to low.	Impounded..	Limestone and shale close to the surface.
High.....	Not suitable ⁴	Moderate...	Moderate...	Moderate...	Moderate...	Impounded..	Permeable soil, but in nearly level areas, watersheds may not be large enough.
High.....	Not suitable.....	Moderate...	Low.....	High.....	Low.....	Impounded..	None

See footnotes at end of table.

TABLE 5.—*Estimates of various soil properties affecting*

Soils and map symbols	Descriptions of the soils	Thickness of soil material	Kind of underlying parent material	Depth to seasonally high water table ¹	Internal drainage ²	Susceptibility to frost action
Sandy terraces..... (Sb)	10 inches of sandy loam over 30 inches of loam that is underlain by 12 inches or more of loamy sand.	40-50	Sandy alluvium.....	(³)	Rapid to excessive	Very low...
Seymour..... (Se)	16 inches of silt loam over 40 inches of plastic silty clay that is underlain by 12 inches or more of silty clay loam.	50+	Medium- and fine-textured loess and till.	16	Slow.....	High.....
Shelby..... (Sh, Sm)	10 inches of loam over 6 inches of silty clay loam, over 24 inches of clay loam that is underlain by 20 inches or more of silty clay.	50+	Clay loam till with pockets of sand and clay	36	Medium to slow.	Moderate...
Snead..... (Sn, Ss)	10 inches of silty clay over 20 inches or more of partly weathered clay shale and limestone.	10-20	Weathered limestone and clay shale.	(³)	Slow.....	Moderate...
Wabash clay..... (Wa).	50 inches or more of clay.....	50+	Fine-textured alluvium...	20	Very slow....	High.....
Wabash silt loam and silty clay loam (Wb, Ws)	14 inches of silt loam or silty clay loam over 30 or more inches of silty clay to clay.	50+	Fine-textured alluvium...	20	Medium to slow.	Moderate...

¹ Depth at which free water or seep zones occur during wet seasons.

² Terms used to describe internal drainage are defined in the "Soil Survey Manual" (See footnote 1, p. 5.)

The engineering properties of some soils are fairly similar. Roughly, there are four groups of soils in the county, each of which is made up of soils with similar engineering properties. A discussion of each group follows.

In general, the Blockton, Burrell, Edina, Grundy, Keytesville, Lagonda, Sampsel, Seymour, Snead, and Wabash soils have slow to very slow internal drainage. These soils also have a silty surface soil and a silty clay to clay subsoil that have a fairly high shrink-swell potential. During wet seasons, soils of this group may have a seasonally high water table that occurs where the silty surface layer contacts the clayey subsoil. They are susceptible to moderate frost action. Soils of this group that occur on uplands are generally well suited to pond construction and are sources of good fill material if the soil layers are properly mixed and compacted.

The Gosport soils and some areas of the Snead soils normally occur on irregular slopes, are somewhat shallow, and have many outcrops of rock. They are not generally well suited to pond construction and are only moderately suitable as fill material. The many massive outcrops of limestone, however, are sources of material that can be crushed into agricultural limestone or used for a base course or subbase for road construction.

The Gara, Lacona, Mandeville, Shelby, and Nodaway soils are the better drained soils in the county. They are deep and have a silty or loamy surface layer. Their subsoil is fairly high in clay, but the texture, structure,

and topography of the soils cause them to be moderately well drained to well drained. These soils have a moderate to low susceptibility to frost damage and show little or no evidence of a seasonally high water table in the upper 40 inches of the profile.

The miscellaneous land type, Sandy terraces, is a mixture of sandy soils. It is not extensive and occurs on undulating terraces in river valleys. The soils are rapidly to excessively drained and do not have a high water table. They are a good source of fill material if mixed with finer textured material. Their value for this purpose is limited because the sandy material covers only a small acreage. The material in Sandy terraces is not suitable for pond construction.

Genesis, Classification, and Morphology of the Soils

This section has three parts. The factors of soil formation in Daviess County are discussed in the first part; the soil series are classified by great soil groups in the second part; and the morphology of the soils is described in the third part.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on parent material. The characteristics of the soil at

engineering and the estimated suitability of the soils for engineering construction—Continued

Suitability of surface soil as topdressing for cuts and fills	Suitability of soil as source of sand and gravel	Suitability as fill material			Erodibility in cuts and fills when exposed to weather	Farm ponds or lakes	
		Surface soil	Subsoil	Mixture of surface soil and subsoil		Suitable kind	Hazards
Moderate	Moderate	Low	Low	Low	Moderate to high.	None	Permeable soil.
High	Not suitable	Moderate	Low	High	Low	Impounded	Generally no hazards, but in nearly level areas, watersheds may not be large enough.
High	Generally not suitable, but near Lock Springs some large pockets of gravel are in the till	Moderate	High	High	Moderate to low.	Impounded	A few pockets of sand.
High	Suitable where there are thick, massive beds of limestone that can be crushed	Moderate	Low	Moderate	Low	Impounded	Shale and limestone outcrops.
Moderate	Not suitable	Low	Low	Low	Low	Impounded	In nearly level areas, watersheds may not be large enough; subject to occasional flooding.
High	Not suitable	Moderate	Moderate	Moderate	Moderate to low	Impounded	In nearly level areas, watersheds may not be large enough, subject to occasional flooding.

³ Five feet or more.

⁴ Much of this soil occurs as sand and gravel bars in the channel of the Grand River.

any given point depend upon (1) the climate, (2) the plant and animal life, (3) the physical and mineralogical composition of the parent material, (4) the relief or lay of the land, and (5) time. The effect of climate on soil and plants is modified by the characteristics of the soil and by relief. Relief, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Living organisms

Plants and animals are active in the soil-forming process. The extent of this activity depends on the life processes peculiar to each kind of living organism. The kinds of plants and animals that live on and in the soil are determined by the climate, parent material, relief, and age of the soil and by other organisms.

Climate

Daviess County has a climate that is marked by extremes in temperature. The average annual precipitation is about 37 inches. Two-thirds of this falls in the period from April through September. The average annual snowfall is about 21 inches. Average daily maximum temperature is 36° F., in January, and 90°, in July. Average minimum temperature is 17°, in January, and 66°, in July. Many winter nights have temperatures below zero, and a few summer days have temperatures as high as 100°.

Some of the soils in the county have developed under deciduous forest, in which oak, elm, maple, hickory, and walnut were the main species. Forests occurred primarily on the steeply rolling areas in the southeastern and central parts of the county, along the south bank of the Grand River. Most of the soils, however, developed under tall prairie grasses. Transitional soils, which developed in areas covered first by tall prairie grasses and later by trees, generally occur on rolling to steeply rolling slopes. These transitional soils have some of the characteristics of both the Gray-Brown Podzolic soils and the Brunizems.

The moderately humid climate affects the process of soil development by aiding the leaching of lime from most of the soils to a depth of 4 feet or more. An accumulation of clay in the subsoil characterizes the profile of all soils of the uplands, except the shallow Lithosols. The soils in Daviess County are not so highly weathered as the older soils in regions of greater rainfall. The climate of the county was favorable for the prairie vegetation that prevailed on most of the uplands.

Forest vegetation has roots that go moderately deep and take up plant nutrients from the soil. Most of the trees and shrubs shed their leaves each year, and the amount of plant nutrients in the leaves varies considerably. As a rule, deciduous trees return larger amounts of bases and phosphorus to the soil in their leaves than do coniferous trees. In this way the upper part of the soil obtains plant nutrients from the lower part, which partly replace those that are leached out by percolating water.

Organic material is added to soils under forest by the decay of leaves, twigs, roots, and entire plants. Most of the organic matter accumulates on the surface where it is acted upon by micro-organisms, earthworms, and other forms of life and is subjected to direct chemical reactions. Plant nutrients released by the decomposition of organic matter are available for new growth of plants.

Prairie grasses have a dense, fibrous root system. The roots are finer and more numerous than those of trees and shrubs. The fine roots decay faster and add more organic matter to the soil than the roots of trees. Consequently, the Brunizems, which have formed under grasses, have darker, thicker surface layers than the soils that have formed under forest. Organic matter and dark color normally extend deeper in soils that have developed under prairie grasses than in those that have developed under trees.

Decaying organic matter releases organic acids that hasten the leaching and translocation of inorganic material. The rate at which organic material decomposes is influenced by temperature and by the amount of moisture present.

Parent material

Parent material probably has been the most significant soil-forming factor in Daviess County. It consists of (1) material that weathered in place from rock, (2) material transported by glacial action, (3) material transported by wind (loess), and (4) material transported by water or gravity (alluvium or colluvium).

The basic geological structure of Daviess County consists of limestone and shale of the Pennsylvanian age. Limestone beds from the Kansas City group of the Missourian series predominate. Limestone and coal-measure shale of the Marmaton group of the Des Moines series outcrop in a few places. Some shale and sandstone outcrops of the Pleasanton group of the Missourian series and Cherokee shale of the Des Moines group also occur. After the beds of limestone, shale, and sandstone were laid down, the land surface was exposed to weathering and erosion for millions of years. Hills and valleys were formed, and one valley marks the present course of the Grand River.

Weathering of the rocks produced soil material. The silty shale and sandstone produced soil material of medium texture, because the shale contained a lot of silt, and the sandstone contained appreciable amounts of fine material. The calcareous clay shale and limestone produced fine-textured (clayey) soils. Soils that formed in residual materials are those of the Mandeville, Sampsel, Gosport, and Snead series. These soils occur on about 20 percent of the area of Daviess County.

During the Kansan stage of Pleistocene time, Daviess County was completely covered by a glacier. This huge sheet of ice deposited large amounts of glacial till. The till is thickest in the northeastern and southwestern parts of the county and thins out toward the valley of the Grand River. Borings for wells indicate that the thickness in places is more than 120 feet. In most parts of the county, the till ranges from 10 to 30 feet in thickness. The till consists mainly of limestone, shale, and sandstone material mixed with some sand and gravel. It was originally calcareous, but it has now been leached to variable

depths. Calcareous material occurs at a depth of 40 to 60 inches in some soils that have developed in deep deposits of glacial till. In some places the till consists of sand and gravel particles of uniform size, which appear to have been sorted by water. These localized areas of reworked till occur as pockets of glacial outwash, and the soils that have formed in this material vary in texture. Soils that have formed from the glacial material are members of the Gara and Shelby series. Approximately 30 percent of the county consists of soils that have developed primarily from glacial till.

The Iowan and Wisconsin glacial ages occurred after the Kansan. These glaciers did not reach Daviess County. During the melting of the last ice sheet in the Wisconsin glacial age, large amounts of water flowed down the Missouri River and its tributaries to the area north and west of Daviess County. Much finely ground rock and soil material was deposited on the flood plains of the upper part of the Missouri River and in large, shallow lakebeds in the uplands. When cold weather checked the melting of the ice sheet, the flood plains and lakebeds became dry mudflats. Windstorms blew the fine particles from these flats and deposited the dust on the uplands. The largest particles were deposited near the mudflats, and the finer particles, farther away. The area that is now Daviess County received deposits of the finer material. These silty windblown deposits are called loess and are the material in which the Edina, Grundy, and Lagonda soils have formed. The terrace phases of the Edina and Grundy soils received thin deposits of the loess.

Most of the loess in much of Daviess County was deposited during the Peorian interglacial period. The loess is thickest on the broad, gently sloping divides and thins out on the steep topography near the major streams. It has a maximum thickness of from 50 to 70 inches on the broad divides, and it thins to 20 to 40 inches over much of the county. Most of the loess has been lost from slopes of more than 6 percent. About 20 percent of the county consists of soils that have developed primarily in loess.

Some of the soils in Daviess County consist of alluvium and colluvium. The soft silty soil material of the uplands is very erodible and has washed from large areas, especially in the north-central and west-central parts of the county. Gully erosion is common on the rolling glacial till soils that have been cultivated. In many places the eroded material has accumulated in alluvial fans at the bases of upland slopes and along narrow valleys. Wabash silt loam is forming in most narrow stream valleys in a mixture of alluvial and colluvial material that has been moved from the uplands, mainly by gravity.

The surface layer of soils consisting of alluvium varies more in texture and in color than that of soils formed from loess or till. Deposits made by fast-flowing water are normally coarse, and those by slow-moving water are fine. The coarse material is deposited near stream channels or in narrow valleys where water flows with greater velocity. Fine material is deposited in the broader, more level areas or on stream terraces some distance from present stream channels.

In Daviess County the fine-textured alluvial sediment normally occurs where the valley of the Grand River is wide, and the coarse-textured sediment, in the narrow, meandering channel of the river and the smaller streams. The valley of the Grand River is 2 to 3 miles wide near

the eastern and western boundaries of the county but narrows to less than a mile in the central part.

Soils of Daviess County that consist of alluvium or colluvium are those of the Nodaway and Wabash series. These soils cover nearly 23 percent of the county.

Relief

Relief is important in soil formation because it influences drainage, runoff, infiltration, and other related factors, including accelerated erosion. Slopes range from nearly level to steep. On some steep slopes that yield large amounts of runoff, erosion is rapid and keeps an almost even pace with rock weathering and soil formation. Some soils on steep slopes have shallow profiles, and in some places all the soil has been removed and rock or shale is exposed at the surface. Soils that form under these conditions do not stay in place long enough to develop horizons.

Drainage is also a factor that causes differences in soils. The Edina soils, for example, occur on the broad, nearly level, prairie areas where internal drainage is slow. Consequently, they have a highly leached subsurface horizon and a dense subsoil. The Mandeville and Lacona soils, however, are rolling to hilly and have moderately good internal drainage and are only moderately weathered.

The slopes bordering the Grand River on the south are characteristically steeper than those on the north. This is believed to have been caused by glacial action from the north. The ice sheet smoothed the south-facing slopes but scoured the north-facing slopes of the main valley. In this way, glacial action influenced the soil pattern. On the steep, north-facing slopes that border the valley on the south side of the river are areas of shallow, stony soils that developed from residual material. Any glacial material that abutted these slopes was quickly removed by erosion. As a result, the Mandeville, Snead, Lacona, and Sampsel soils formed in the underlying material. Soils on the north side of the river more commonly formed from thicker glacial deposits. In this area relief was smoother, erosion was less severe, and the thicker soil profiles developed.

Time

Time is necessary for soils to form from parent material. The old soils in Daviess County have formed in residual material, in glacial till, or in loess. They have been in place a long time, and well-defined horizons have developed in them. The young soils are forming near streams where fresh deposits of silt are added from time to time. Young soils have not been in place long enough for distinct horizons to have developed. Some soils are young because they occupy steep slopes; the soil material washes away before distinct horizons have had time to develop.

Classification of the Soils

Soils can be classified in several ways to bring out their relationship to one another. The classification units commonly used in the field are the series, type, and phase. The soil type is the basic classification unit. It consists of soils that are similar in kind, thickness, and arrangement of soil layers.

A soil type may consist of several phases. Characteristics that suggest dividing a soil type into phases are variations in slope, in degree of erosion, in topographic position, and in substratum material. The soil phase, or the soil type if it has not been subdivided, is the unit shown on the soil map.

Soil types are grouped into soil series. The soil series consists of one or more soil types that differ in texture of the surface soil but are alike in other ways. Each series is named for the place near where it was first mapped. For example, Sampsel silt loam was first mapped near and named after the village of Sampsel, which is in Livingston County and only a few miles from the eastern boundary of Daviess County.

In this report most of the soils have series, type, and phase names. Consider for example, Shelby loam, 4 to 8 percent slopes. Shelby is the series name; loam is the type name; and 4 to 8 percent slopes is the phase designation. A few soils have only series and type names because they have no variations in slope or in other properties. Nodaway silt loam is an example.

Soil series are classified into great soil groups. Soils of a great soil group have major features of their profile in common. They have similar horizons arranged in the same way, but they may differ in such characteristics as thickness of profile and in degree of development of the different horizons.

Most soil series have characteristics that are within the range of a great soil group, and they are classified accordingly. A few soil series, however, have some of the characteristics of two great soil groups. Such a soil series is placed in the great soil group it most nearly resembles but is classified as intergrading to the other great soil group. For example, soil series in the Gray-Brown Podzolic group that have a thick, dark-colored surface horizon because of the influence of prairie grasses are classified as Gray-Brown Podzolic soils intergrading toward Brunizems.

The soils of Daviess County are classified in the following great soil groups: (1) Gray-Brown Podzolic soils, (2) Brunizems, (3) Planosols, (4) Humic Gley soils, (5) Rendzinas, (6) Lithosols, and (7) Alluvial soils. The miscellaneous land type—Sandy terraces—is not classified in a great soil group.

The classification of the soils in the county is based largely on characteristics observed in the field, and it may be revised as knowledge about soil series and their relations increases. The soil series in Daviess County are classified as follows:

Great soil group:	<i>Soil series</i>
Gray-Brown Podzolic soils-----	Burrell Gara ¹ Mandeville
Brunizems -----	Blockton Grundy Lacona Lagonda Sampsel Seymour Shelby
Planosols -----	Edina Keytesville
Humic Gley soils-----	Wabash
Rendzinas -----	Snead
Lithosols -----	Gospport
Alluvial soils-----	Nodaway

¹ The Gara soils intergrade toward Brunizems

Morphology of the Soils by Great Soil Groups

In this section the morphology of the soil series in Daviess County is discussed by great soil groups. Profiles that represent each soil series are described in the section "Descriptions of the Soils."

Gray-Brown Podzolic soils

The Gray-Brown Podzolic soils, in their virgin state, have a rather thin, organic covering (A0) and an organic-mineral layer (A1) that overlie a grayish-brown, leached A2 horizon. The A2 horizon is over an illuvial brown B horizon. In Daviess County the material underlying the B horizon consists of loessal or alluvial silt or material that weathered from limestone or shale.

Gray-Brown Podzolic soils have formed under deciduous trees in a temperate, humid, continental climate. The differences among the typical Gray-Brown Podzolic soils in the county are in color, in the content of clay, in thickness of horizons, and in other characteristics that are chiefly related to the parent materials and topography. The Mandeville, Burrell, and Gara soils are classified as Gray-Brown Podzolic soils.

The Mandeville soils have formed in a thin loess cap that overlies residual limestone and shale. Where Mandeville soils occur, the loess covering is less than 20 inches thick; it approaches maximum thickness on gentle slopes and thins out on the steep slopes. The thickness of the loess and the grade of the slope have an important bearing on the degree of leaching and profile development. The Mandeville soils are moderately weathered. This is evident from the uniform color in the upper 20 to 30 inches of the profile, from the lack of abrupt boundaries between horizons, and from the lack of strongly developed horizons. The permeability of the upper solum and the strongly sloping topography have retarded the development of distinct horizons. Mandeville soils are moderately rich in minerals but are low in organic matter. Over much of the area of these soils, erosion has reduced the amount of organic matter in the surface soil.

The Burrell soils have formed on water-deposited terraces that are covered with loess. In degree of development they are about equal to the Mandeville soils, but they are grayer throughout, are more leached of minerals, and are more mottled in the B horizon. Because they are on low, gently sloping terraces, these soils are more moist and have more distinct horizons than the Mandeville soils.

The Gara soils have developed under a cover of prairie grasses that later gave way to an invasion of trees. They show the influence of both grass and trees. The color of the surface soil, the presence of an A2 horizon, and the color of the B horizon indicate that the influence of trees somewhat obscures that of prairie grasses. For this reason, in Daviess County the Gara soils are classified as Gray-Brown Podzolic soils intergrading toward Brunizems.

Brunizems

The Brunizems, formerly called Prairie soils, have formed in a temperate, humid, continental climate under a cover of tall grasses. Typically, these soils have a dark-colored A1 horizon. There is a gradual transition from the A to the B horizon, and the B2 horizon has a brown or yellowish-brown matrix that is commonly mottled with gray. Clay has accumulated in the B horizon. The

Blockton, Grundy, Lacona, Lagonda, Sampsel, Seymour, and Shelby soils are classified as Brunizems.

The Blockton soils have developed under grass, from medium-textured alluvium on terraces. They have somewhat more distinct horizons and a finer textured upper subsoil than the Grundy soils.

The Grundy soils have developed from moderately thick loess, under grass cover. They are somewhat darker throughout than the Seymour soils, have less distinct horizons, and are less dense in the B horizon.

The Lacona soils have formed in a thin cap of loess that overlies material derived from silty shale. They are browner throughout the upper solum, have a siltier surface layer, and contain less sand than the Shelby soils, which have developed in glacial till. The Lacona are the best drained soils of the Brunizem group in Daviess County.

The Lagonda soils have developed from plastic, clayey glacial till overlain by a thin mantle of loess. They are similar to the Grundy soils, but differ primarily in having a more dense, plastic upper B horizon with a higher proportion of gray mottles and in having more sand and gravel in the lower part of the B horizon.

The Sampsel soils have developed from clay shale under grass. They closely resemble the Grundy soils but are slightly finer textured throughout and have a denser subsoil.

The Seymour soils have developed from loess under a grass cover. They are somewhat grayer in the surface layer, are more mottled with gray in the subsoil, are less well drained, and have a denser subsoil than the other Brunizems in Daviess County.

The Shelby soils are moderately dark colored loamy soils that have developed from glacial till under a cover of prairie grasses. The upper part of the subsoil is browner than the lower part. The Shelby soils are better drained than the Grundy soils and have a browner upper subsoil and a less dark lower subsoil.

Planosols

The Planosols have eluviated surface and subsurface horizons underlain abruptly by a B horizon that is more strongly illuviated or compacted than that of other great soil groups. The firm to very firm, very fine textured B2 horizon, commonly called a claypan, restricts the movement of water and the penetration of many roots. The Planosols in Daviess County are the soils of the Edina and Keytesville series.

The Edina soils have developed in loessal material on the broad upland divides and on gently sloping stream terraces. They have a dark grayish-brown surface soil, 8 to 10 inches thick, and a gray silty A2 horizon that grades abruptly to a layer of dark-gray, mottled silty clay.

The Keytesville soils are on high stream terraces and have developed from old alluvium, including loessal, residual, and glacial materials, and from a thin covering of loess. They have a distinct, gray A2 horizon that abruptly grades to a dark grayish-brown silty clay B2 horizon. The Keytesville soils are grayer throughout than the Edina soils, and the surface soil is normally thinner.

Humic Gley soils

Humic Gley soils are poorly drained and have a thick surface soil and a gleyed subsoil. They have developed

from alluvium derived from a variety of materials, and they occupy the bottom lands along streams and drainage-ways. In Daviess County the Wabash soils are classified in the Humic Gley group.

Wabash silt loam occurs in narrow valleys adjacent to the major streams and is slightly better drained than Wabash clay or Wabash silty clay loam. The latter two soils occur in the broad parts of the valley of the Grand River.

Rendzinas

Rendzinas have a very dark brown to black surface layer underlain by dark-gray to olive-brown, calcareous material. Partly weathered limestone and shale occur within 2 feet of the surface. In Daviess County the Snead soils are in the Rendzina group.

The Snead soils are only partly weathered and lack a B horizon. Their dark color is attributed to the accumulation of organic matter in the presence of lime. The variability in color and in quantity of stones results from differences in the parent rocks. The variation in thickness of their surface soil and the degree of weathering of the parent rock are related to differences in slope and in erosion.

Lithosols

The Lithosol group consists of soils that have no clearly expressed morphology. Lithosols are made up of a partly weathered mass of soil fragments and occupy mainly hilly and steep areas. Included in this group are soils that are very shallow over bedrock and that have weakly developed profiles. Geologic erosion almost keeps pace with the weathering of rocks. In Daviess County the Gosport soils are classified as Lithosols.

The Gosport soils have a thin, dark-brown silty surface layer with variegated colors of yellowish brown and with shale fragments of various sizes. Relatively unweathered parent shale and bedrock generally occur at a depth of 8 to 12 inches.

Alluvial soils

The Alluvial great soil group consists of soils made up of recently deposited alluvial materials. These soils have little or no profile development and receive fresh deposits of sediments during occasional floods. The profile characteristics of the soils are determined largely by the kinds of sediments deposited. In Daviess County the Nodaway soils belong to the Alluvial group.

The Nodaway soils consist of dark grayish-brown, medium-textured sediments. Drainage is generally good because underdrainage in the coarse- or medium-textured material is favorable. The Nodaway soils occur on the bottom lands in association with the Wabash soils. They differ from the Wabash soils mainly in being better drained, in being browner throughout, and in having less fine-textured sediments in the soil layers.

General Nature of the Area

The organization and population, physiography, climate, and other features of Daviess County are discussed in this section.

Organization and Population

Daviess County was established in 1836, and Gallatin, the county seat, in 1837. In 1841, a group of Mormons, under the leadership of Joseph Smith, settled near the present village of Jameson, but they eventually left the area.

In 1900, the county had a population of 21,325, according to the U.S. census. Through the years, however, the population has declined, and, in 1960, it was only 9,502. In the same year, Gallatin had a population of 1,658. The rural population is evenly distributed and has a density of approximately 20 people per square mile. Small towns in the county are Altamont, Coffey (Salem), Jameson, Jamesport, Lock Springs, Pattonsburg, and Winston.

Physiography

Daviess County is in the Northwestern Prairie section of the State. It is in the heart of what is commonly referred to as the meat-producing area of northwestern Missouri.² It is nearly square and is about 24 miles long and 24 miles wide.

Physiographically, the county consists of a broad plain covered by loess and glacial drift. The plain has been altered and modified by erosion and stream action. The Grand River of northern Missouri flows in a southeasterly direction from the northwestern to the southeastern corner. The river channel has been recut and straightened in the lower approximate one-fourth of its course in the county. Remnants of the broad plain are the gently rolling prairie ridges, which are the major stream divides in the northeastern and southwestern parts of the county. North of the Grand River, tributary streams flow generally southward. These streams are Sampson, Big, Cypress, Hickory, Muddy, Pilot Grove, Brushy, and Clear Creeks.

South of the Grand River, tributary streams flow mainly northward. These streams are Grindstone, South Big, Dog, and Marrowbone Creeks and Lick Fork.

The valley of the Grand River is 2 to 3 miles wide, except at some points in the central section where the plain is only one-fourth to one-half mile wide. There is a considerable hazard of overflow in the narrow part of the valley. Terraces or second bottoms along the drainage-ways are fairly small and inextensive. An area of high benches, or low upland basins, approximately one township in size, occurs in the north-central part of the county, near Jameson. This basin is adjacent to the point where the valley of Grand River narrows, and it is believed to be a remnant of a preglacial drainage basin that later was modified by glacial outwash and loessal material. The Grundy soils occur in this area.

Elevations within the county range from a little over 1,000 feet, at the high point on the divide in the southwestern part of the county, to just under 800 feet, in the valley of the Grand River.

Climate

The climate of Daviess County is temperate and continental. Monthly and annual temperatures and precipita-

² HAMMAR, CONRAD, ROTH, WALTER J., AND JOHNSON, O. R. TYPES OF FARMING IN MISSOURI. Mo. Agri. Expt. Sta. Res. Bul. 284, 28 pp., illus. 1938.

tion, compiled from records of the U.S. Weather Bureau Station at Hamilton (formerly Kidder) in Caldwell County, are given in table 6. These figures are considered representative for Daviess County.

TABLE 6.—*Temperature and precipitation at Hamilton Station, Caldwell County, Missouri*
[Elevation, 980 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1906)	Wettest year (1898)	Average snowfall
January	26 0	69	-27	1 22	1 46	4 73	5 1
February	28 4	80	-28	1 54	2 36	1 50	5 3
March	40 8	89	-8	2 19	1 85	5 10	3 8
April	52 2	93	6	3 28	2 44	3 89	1 0
May	62 6	102	22	4 65	1 37	11 17	(³)
June	71 8	104	37	4 97	2 09	10 58	0
July	76 6	112	46	3 88	2 25	4 91	0
August	75 4	111	40	3 96	2 74	5 26	0
September	67 3	105	26	5 20	2 28	7 30	0
October	55 8	98	8	3 07	42	5 04	3
November	41 8	84	-3	2 15	2 74	1 78	1 7
December	29 2	72	-21	1 27	1 23	2 64	4 3
Year	52 3	112	-28	37 38	23 23	63 90	21 5

¹ Average temperature based on a 62-year record, through 1955; highest temperature, on a 60-year record, and lowest temperature, on a 59-year record, through 1952.

² Average precipitation based on a 66-year record, through 1955; wettest and driest years, on a 63-year record, in the period 1878-1955; snowfall, on a 58-year record, through 1952.

³ Trace.

Winters are short and moderate, with short periods of zero weather. Summers are often hot, but temperatures higher than 90° F. are rare. The average temperature in winter is 27.9°; in spring, 51.9°; in summer, 74.6°; and in fall, 52.3°.

The average date of the last killing freeze in spring is April 20, and of the first in fall, October 17. Rainfall is well distributed throughout the year and is usually enough for crops. About 86 percent of the rainfall occurs in spring, summer, and fall. The least amount of rainfall occurs in winter and makes up only 14 percent of the yearly total.

Crops are sometimes injured from dry weather, especially on eroded and shallow soils with low water-holding capacity. They are occasionally injured by wet weather, especially on the more poorly drained soils of the bottom lands and on soils in the fairly level basin north of Jamesport.

Flood Control

Floods are a great hazard in Daviess County. They occur almost every year in the valleys of the Grand River, Big Creek, and other large streams. They may occur any time of the year, but most likely in spring. Floods in the smaller valleys are of short duration, but in the valley of the Grand River they may continue for many days. Buildings, fences, and facilities for storing crops, therefore, are not built on the bottom lands.

Sections of the channel of the Grand River and of other large streams have been straightened. This accelerates streamflow and tends to reduce the height and duration of floods. The new channel of the Grand River has a larger capacity than the old channel. The low gradient of the stream cannot be increased, and, therefore, the channel tends to widen but not to deepen. A large flood-control reservoir on the Grand River has been proposed. It would include much of the valley between Gallatin and Pattonsburg. Controlling floods by use of levees does not seem feasible, because flood levels are high and drainage problems would follow.

Vegetation

Early settlers have estimated that approximately two-thirds of Daviess County had a cover of prairie vegetation, and that the rest was covered by timber. According to the U.S. Census of Agriculture, 37,000 acres was woodland in 1959, and this included pastured woodland. Through natural means, the amount of timber would increase rapidly if trees were not cut or their growth interfered with through grazing and fire.

Practically all of the gently rolling upland was originally covered by large bluestem and other prairie grasses. Large areas of clayey soils on the flood plains of the Grand River were covered with swamp grass and were known as prairie bottom.

The original forest consisted of many kinds of trees. Oak grew on the ridges, and elm, hackberry, ash, maple, and walnut grew on the slopes and in the valleys. The border between the forest and the prairie was characterized by sumac, hazel, haw, and other shrubs.

At present, the major species of trees in the county are pin, white, and black oaks, red and white elms, soft and hard maples, and cottonwood, willow, white ash, boxelder, and honeylocust. The minor species are red and bur oaks, shagbark, bitternut, and shellbark hickories and walnut, sycamore, and basswood.

The most heavily timbered areas are on the rolling hills adjacent to the bottom lands of the Grand River in the southeastern and the northwestern parts of the county. There is some evidence that dense stands of timber formerly were in these places. Many of the present stands are fire-scarred and are of poor quality.

Harvested timber is used primarily on the farm for firewood, posts, and poles. Sawlogs are produced occasionally for the construction of barns and outbuildings. Four sawmills, a box factory, and a stave and heading mill are operated in the county. These concerns provide a ready market for wood crops grown locally. Proper management of existing woodland is needed, however, to insure a continuing source of wood products. Steep, gullied areas should be planted to trees for protection against erosion.

Most small woodlots are used for both timber and pasture. The most favorable forest sites are on the Gara, Gosport, and Shelby soils.

Land Use

According to a survey of conservation the U.S. Department of Agriculture completed in 1959, approximately 64 percent of Daviess County is cultivated, 21 percent is in

pasture, 12 percent is in timber, and 3 percent is in other uses. The raising of livestock is the predominant type of agriculture. The 1959 Census of Agriculture reported 38,429 cattle, produced mainly for beef, and 68,757 hogs in the county. The common crops are corn, wheat, oats, soybeans, clover, lespedeza, and pasture plants. In 1959, there were 48,292 acres in corn and 40,456 acres in soybeans. In that year, wheat was harvested on 23,183 acres, and oats on 5,473 acres.

Soil and water conservation practices used in the county include liming and fertilizing, contouring and terracing, use of suitable cropping systems, proper use of crop residues, improvement of drainage, conservation of wildlife, and proper management of pasture and timber.

Water Supply

Water for domestic use on farms is obtained from wells and cisterns. Most of the wells are less than 100 feet deep. There are very few springs, and these produce only small amounts of water. Perennial streams are usually turbid most of the year. Many farms have one or more ponds that supply water for livestock.

Wildlife and Recreation

Daviess County has many irregularly shaped fields and field borders and areas of timber and brush along drainageways that provide favorable habitats for game animals and birds. Rabbit, squirrel, and quail are common. Deer are not numerous but are increasing in number in the rougher areas of the county. Many farm ponds have been stocked with bass and bluegill. Catfish, perch, buffalo fish, and carp are common kinds of fish in the Grand River. Small lakes have been developed in several communities.

Wildlife habitats in the county are being improved through the increase in the number of farm ponds, field-border plantings, food plots, and plantings of multiflora rose, and by protecting woodland from fire.

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

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boundary, horizon. 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. Synonyms: Clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

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

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

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile

Erosion, soil. The wearing away of the land surface by wind, running water, and other geological agents.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. Nearly level land, consisting of stream sediment, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which the soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

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

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity, or soon after maturity, for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The relative position of the several soil 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 B horizon but more like the A than the B; sometimes absent.
- B1 Transitional to B horizon but more like B than A; sometimes absent.

- B2 A usually darker colored horizon, which often represents the zone of maximum illuviation where podzolized.
 B3 Transitional to C horizon.
 C Slightly weathered parent material; absent in some soils.
 D Underlying substratum.

The A horizons make up a zone of eluviation, or leached zone. The B horizons make up a zone of illuviation, in which clay and other materials have accumulated. The A and B horizons, taken together, are called the solum, or true soil.

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 materials from soils or other material by percolating water.

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

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows. Abundance—*few, common, and many*; size—*fine, medium, and coarse*; and contrast—*faint, distinct, and prominent.* The size measurements are these: *Fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil, and carbon, hydrogen, and oxygen obtained largely from the air and water, are plant nutrients.

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

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Productivity (of soil). The present capability of a soil for producing a specified plant or sequence of plants under a specified system of management. It is measured in terms of output, or harvest, in relation to input of production for the specific kind of soil under a specified system of management.

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

Relief. The elevations or inequalities of a land surface, considered collectively.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

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

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

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

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

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

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

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum (pl. sola). The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering 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 in thickness.

Terrace (agricultural). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called *second bottoms*, as contrasted to *flood plains*, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Transitional soil. A soil somewhat resembling two different kinds of soils and genetically related to them.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Upland (geology). 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.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

[See table 1, p. 6, for the approximate acreage and proportionate extent of the soils; table 2, p. 7, for a summary of the characteristics and properties of the soils, table 3, p. 20, for examples of cropping systems and supporting practices; table 4, p. 27, for estimated yields of crops; and table 5, p. 28, for information that is significant to engineering]

<i>Map symbol</i>	<i>Soil</i>	<i>Capability unit</i>		
		<i>Page</i>	<i>Symbol</i>	<i>Page</i>
Bk	Blockton silt loam, 1 to 4 percent slopes.....	6	IIe-6	22
Bu	Burrell silt loam, 1 to 3 percent slopes.....	6	IIIw-3	24
Ed	Edina silt loam, 1 to 2 percent slopes.....	8	IIIw-3	24
Et	Edina silt loam, terrace phase, 1 to 3 percent slopes.....	8	IIIw-3	24
Ga	Gara loam, 3 to 8 percent slopes.....	9	IIIe-6	23
Gb	Gara loam, 9 to 18 percent slopes.....	9	VIe-6	25
Gp	Gosport silt loam, 8 to 20 percent slopes.....	10	VIIe-3	26
Gr	Grundy silt loam, 1 to 4 percent slopes.....	10	IIe-6	22
Gt	Grundy silt loam, terrace phase, 1 to 4 percent slopes.....	11	IIe-6	22
Kv	Keytesville silt loam, 3 to 7 percent slopes.....	11	IVe-5	25
La	Lacona silt loam, 2 to 8 percent slopes.....	12	IIIe-6	23
Lb	Lacona silt loam, 9 to 15 percent slopes.....	12	IVe-6	25
Lg	Lagonda silt loam, 2 to 8 percent slopes.....	12	IIIe-5	24
Ma	Mandeville silt loam, 2 to 5 percent slopes.....	13	IIIe-6	23
Mb	Mandeville silt loam, 6 to 10 percent slopes.....	13	IVe-6	25
No	Nodaway silt loam.....	14	I-1	22
Sa	Sampsel silt loam, 5 to 15 percent slopes.....	14	IVe-6	25
Sb	Sandy terraces.....	14	IIIs-4	25
Se	Seymour silt loam, 1 to 4 percent slopes.....	15	IIIe-5	24
Sh	Shelby loam, 4 to 8 percent slopes.....	15	IIIe-6	23
Sm	Shelby loam, 9 to 15 percent slopes.....	16	IVe-6	25
Sn	Snead silty clay, 6 to 15 percent slopes.....	17	IVe-6	25
Ss	Snead stony silty clay, 8 to 20 percent slopes.....	17	VIIIs-6	26
Wa	Wabash clay.....	18	IIIw-14	24
Wb	Wabash silt loam.....	18	IIw-1	23
Ws	Wabash silty clay loam.....	18	IIw-1	23



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