SOIL SURVEY OF

DeKalb County, Missouri

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Missouri Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1969-73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the DeKalb County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and tree and shrub group of each. It also shows the page where each soil is described.

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

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of capability units and woodland groups.

Foresters and others can refer to the sections "Wood Crops" and "Trees and Shrubs," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect parks, picnic areas, and other recreation areas in the section "Recreation."

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

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

Newcomers in DeKalb County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: Typical pasture on the Lamoni-Zook-Shelby association.

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SOIL SURVEY OF DEKALB COUNTY, MISSOURI

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

DEKALB COUNTY is in the northwestern part of Missouri (fig. 1). It has a total area of 270,390 acres, or 423 square miles. Maysville, the county seat, is in the central part of the county. In 1970, the total population of the county was 7,305. Of this, 1,045 lived in Maysville; 2,252 in other towns; and 4,008 in rural areas. Many people living in rural areas work in large towns or cities not in the county.

U.S. Highway 36 crosses the southern part of DeKalb County, and Interstate 35 crosses the southeast corner. Most freight is delivered by truck. Two railroads serve the county, but neither have regularly scheduled runs.

Farming is the main enterprise in DeKalb County. In 1969 about 83 percent of the area was in crops and pasture. The principal field crops are corn, soybeans, legumes, and grasses. Beef cattle is the largest livestock enterprise, but there are also hogs, dairy cattle, and sheep. The number of farms in the county is increasing somewhat because people are buying small acreages and commuting to Kansas City and St. Joseph to work.

DeKalb County is within an area known as the Rolling Prairie of northwest Missouri. At one time bluegrass seed production was of major importance in parts of the county. Forested areas are mostly confined to narrow strips along the larger streams.

Soils on uplands formed mostly in loess and glacial till, and soils on bottom land formed in alluvial sediment washed from the upland soils.

Most of the upland soils are subject to erosion if cultivated. Flooding and the lack of surface drainage are the main hazards on the bottom land.

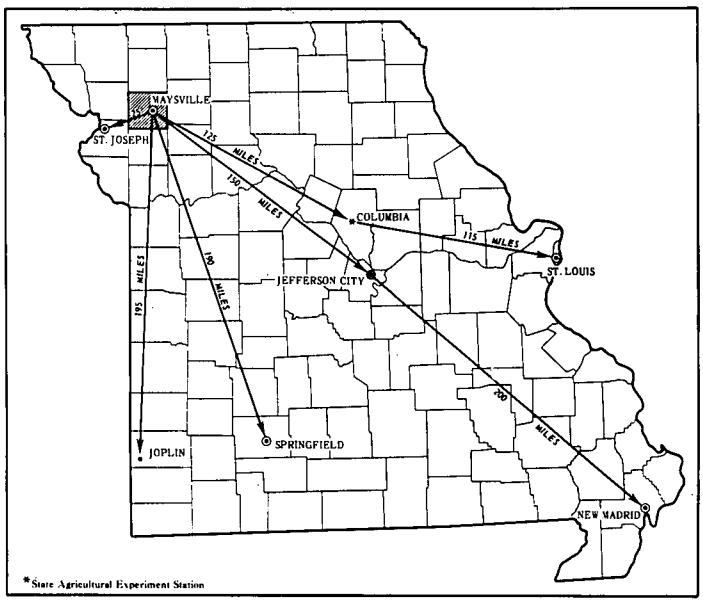

Figure 1.—Location of DeKalb County in Missouri.

How This Survey Was Made

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

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

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

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

For example, Shelby loam, 9 to 14 percent slopes, is one of several phases within the Shelby series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, the soil complex, is shown on the soil map of DeKalb County.

A soil complex consists of areas of two or more soils so intermingled or so small that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Gosport complex, 14 to 30 percent slopes, is an example of a complex in DeKalb County.

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

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

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

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

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

Descriptions, names, and delineations of soils in this soil survey do not fully agree with soil maps in adjacent counties published at a different date. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, and the extent of soils within the survey. In places it is more feasible to combine small acreages of similar soils that respond to use and management in much the same way than it is to separate these soils and give them names.

The four soil associations in DeKalb County are described on the following pages.

1. Lamoni-Zook-Shelby association

Deep, nearly level to moderately steep, moderately well drained to poorly drained soils formed in glacial till and alluvial sediments

The landscape in this soil association (fig. 2) is characterized by narrow, nearly level bottom land; narrow, moderately sloping ridgetops; and strongly sloping to moderately steep side slopes.

This soil association occupies about 53 percent of the county. About 52 percent of the association is Lamoni soils, 23 percent Zook soils, 21 percent Shelby soils, and 4 percent minor soils.

Lamoni soils are moderately sloping and are somewhat poorly drained. They are on the narrow tops and the sides of ridges. The surface layer is black and very dark grayish brown clay loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark grayish brown clay, and the lower part is gray clay loam underlain with gray and yellowish brown clay loam.

Zook soils are nearly level and are poorly drained. They are on narrow bottom land. The surface layer is black silty clay loam about 36 inches thick. It is underlain with very dark gray and dark gray silty clay loam.

Shelby soils are strongly sloping to moderately steep and are moderately well drained. They are on the sides of ridges. The surface layer is very dark brown loam about 7 inches thick. The subsoil is clay loam about 40 inches thick. It is brown in the upper part and yellowish brown in the lower part. It is underlain by calcareous glacial till.

Minor soils in this association are Clarinda, Grundy, Lagonda, and Sharpsburg soils. They are in gently sloping and moderately sloping areas on the tops and upper sides of ridges.

The available water capacity is moderate to high. Organ-

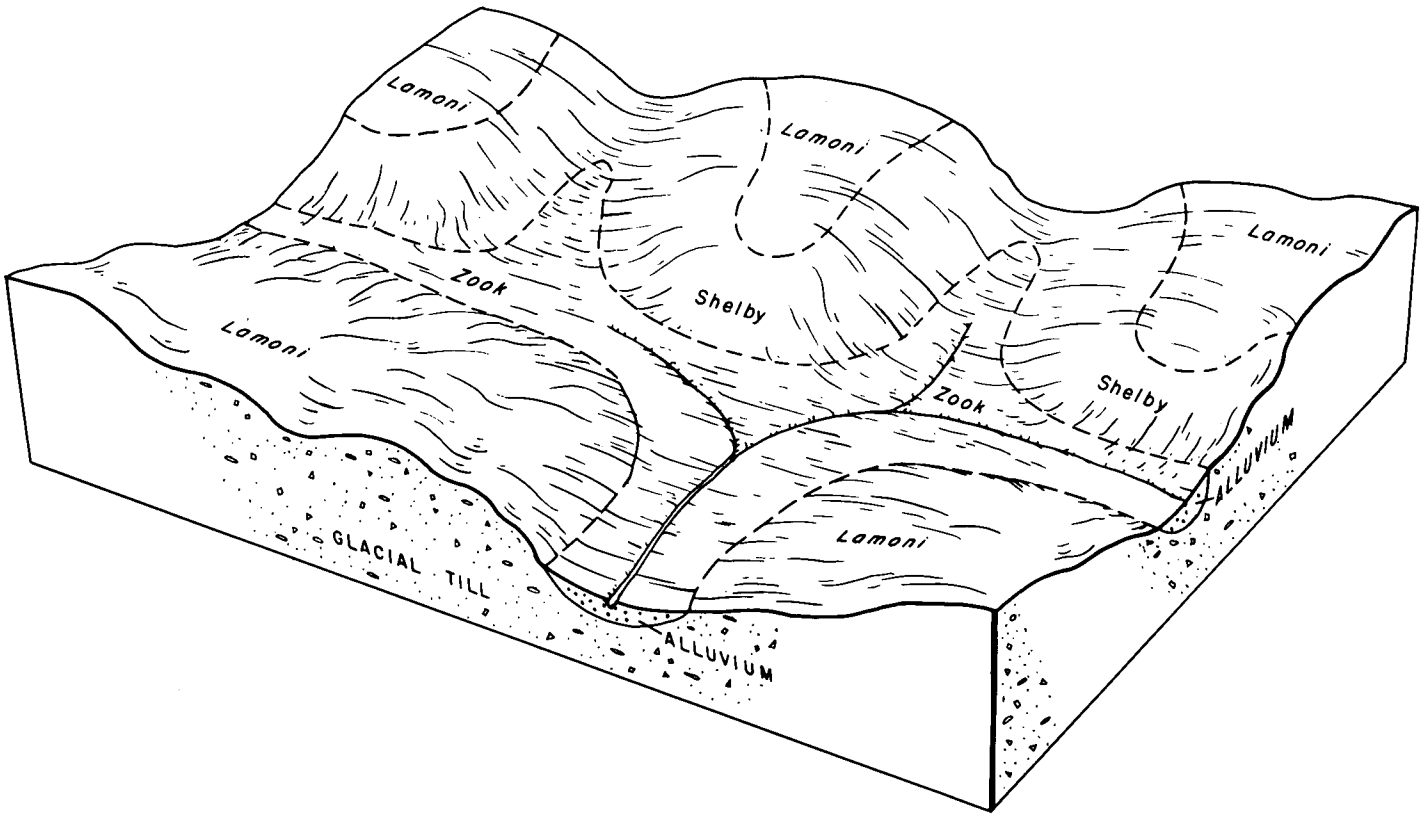

Figure 2.—Pattern of soils and parent material in association 1.

ic-matter content is low to high, and natural fertility is medium to high. The main concern of management is controlling water erosion.

Most areas of this association are used for hay and permanent pasture. Small grain, hay, and pasture grow well. The main enterprise is raising beef cattle. Corn and soybeans are grown on the tops and upper sides of some ridges.

2. *Lagonda-Grundy association*

Deep, gently sloping and moderately sloping, somewhat poorly drained soils formed in loess and in loess that is shallow over glacial till

The landscape in this soil association (fig. 3) is characterized by wide, gently sloping ridges, moderately sloping side slopes, and narrow drainageways.

This soil association occupies about 29 percent of the county. About 46 percent of the association is Lagonda soils, 30 percent Grundy soils, and 24 percent minor soils.

Lagonda soils are gently sloping to moderately sloping and are somewhat poorly drained. They are on the narrow tops and the sides of ridges. The surface layer is black silt loam about 9 inches thick. The subsoil is about 46 inches thick. It is mainly dark grayish brown silty clay underlain with gray silty clay.

Grundy soils are gently sloping and are somewhat poorly drained. They are on the wide tops of ridges. The surface layer is about 11 inches thick. It is black silt loam in the upper part and black silty clay loam in the lower part. The subsoil is about 36 inches thick. It is dark grayish brown silty clay loam and silty clay in the upper part and grayish brown silty clay and silty clay loam in the lower part. It is underlain by grayish brown silty clay loam.

Minor soils in this association are Clarinda, Lamoni, Sharpsburg, and Zook soils. The Sharpsburg soils are on the narrow tops of ridges. The Clarinda and Lamoni soils are downslope from Lagonda soils. The Zook soils are on the narrow drainageways.

The available water capacity is moderate to high. Organic-matter content and natural fertility are high. The main concern of management is controlling water erosion.

Most areas of this association are used for cultivated crops. Corn, soybeans, hay, and pasture plants grow well. The main enterprises are growing cash crops and raising beef cattle.

3. *Zook-Kennebec association*

Deep, nearly level, poorly drained and moderately well drained soils formed in alluvial sediments

The landscape in this soil association (fig. 4) is characterized by the larger bottom lands.

This soil association occupies about 9 percent of the county. About 45 percent of the association is Zook soils, 32 percent Kennebec soils, and 23 percent minor soils.

Zook soils formed in fine textured alluvial material and are poorly drained. They are in the lower areas of flood plains, commonly some distance from the main channel.

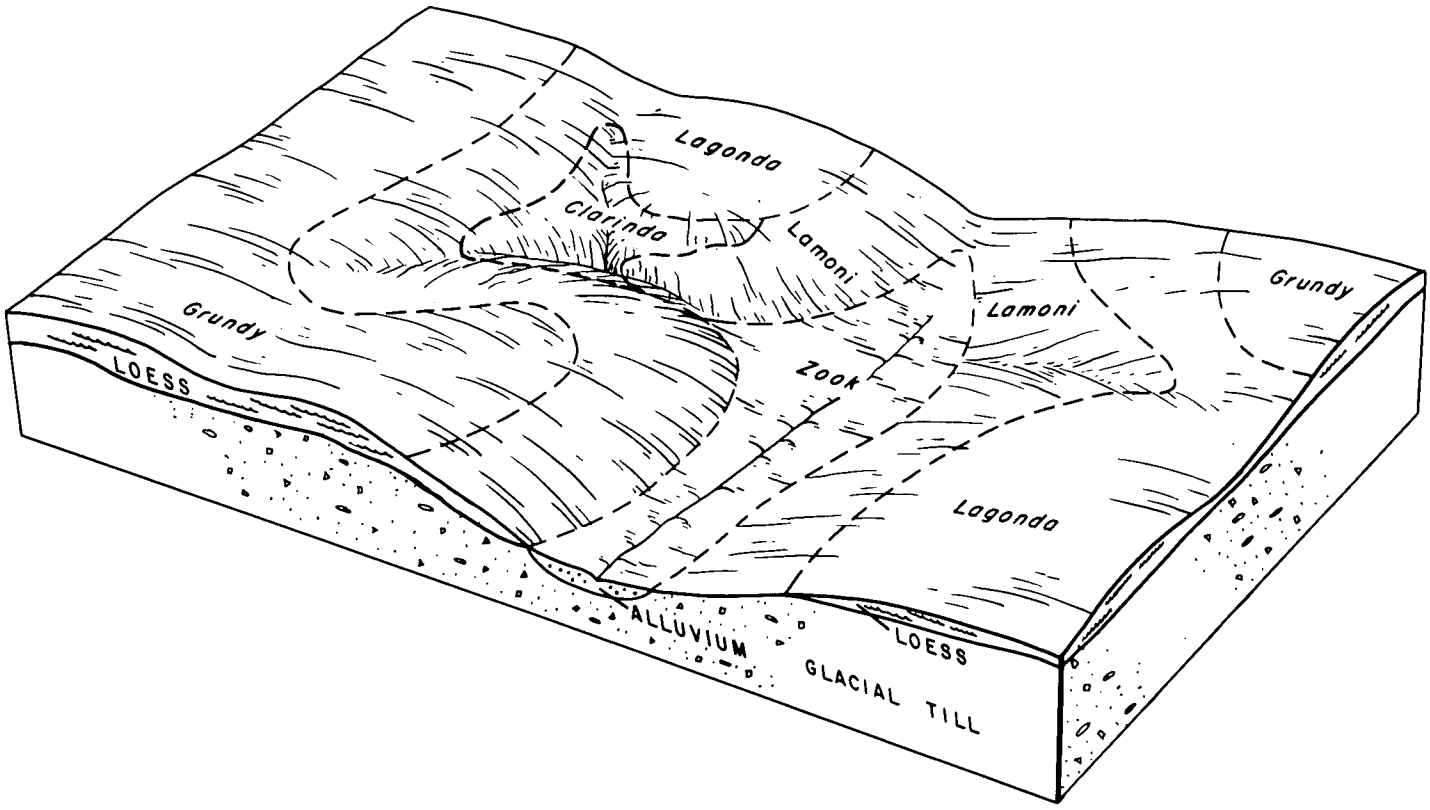

Figure 3.—Pattern of soils and parent material in association 2.

The surface layer is black silty clay loam about 36 inches thick. The underlying material is dark gray silty clay loam.

Kennebec soils formed in silty alluvial material and are moderately well drained. They are near and adjacent to the main channel. The surface layer is black silt loam about 40 inches thick. It is underlain by very dark brown, dark brown, and very dark grayish brown silt loam.

Minor soils in this association are Vesser and Wiota soils. These nearly level soils are on low second bottoms at a slightly higher elevation than the major soils. Wiota soils are well drained, and Vesser soils are somewhat poorly drained.

The available water capacity is moderate to very high. Organic-matter content and natural fertility are high. The main concern of management is poor surface drainage and occasional flooding.

Most areas of this association are used for cultivated crops. Corn and soybeans grow well. Wet areas are used for permanent pasture and timber. The main enterprise is growing cash crops.

4. *Armstrong-Gara-Ladoga association*

Deep, gently sloping to moderately steep, somewhat poorly drained and moderately well drained soils formed in loess and glacial till

The landscape in this soil association (fig. 5) is characterized by sparsely timbered areas on the narrow tops of ridges and moderately steep hillsides adjacent to the larger streams. Small areas of shallow rocky soils are on steep slopes.

This soil association occupies about 9 percent of the county. About 32 percent of the association is Armstrong soils, 29 percent Gara soils, 16 percent Ladoga soils, and 23 percent minor soils.

Armstrong soils are moderately sloping and are somewhat poorly drained. They are on the narrow tops and the sides of ridges. The surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 67 inches thick. It is yellowish brown and dark yellowish brown clay loam and clay in the upper part and yellowish brown, olive gray, and grayish brown clay loam in the lower part.

Gara soils are strongly sloping to moderately steep and are moderately well drained. They are on the steeper slopes adjacent to Armstrong soils. The surface layer is loam about 10 inches thick. It is black in the upper part and dark grayish brown in the lower part. The subsoil is clay loam about 34 inches thick. It is brown in the upper part and yellowish brown in the lower part. The underlying material is yellowish brown and olive gray clay loam.

Ladoga soils are gently sloping to moderately sloping and are moderately well drained. They are on the narrow tops of ridges. The surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is brown and yellowish brown silty clay loam about 40

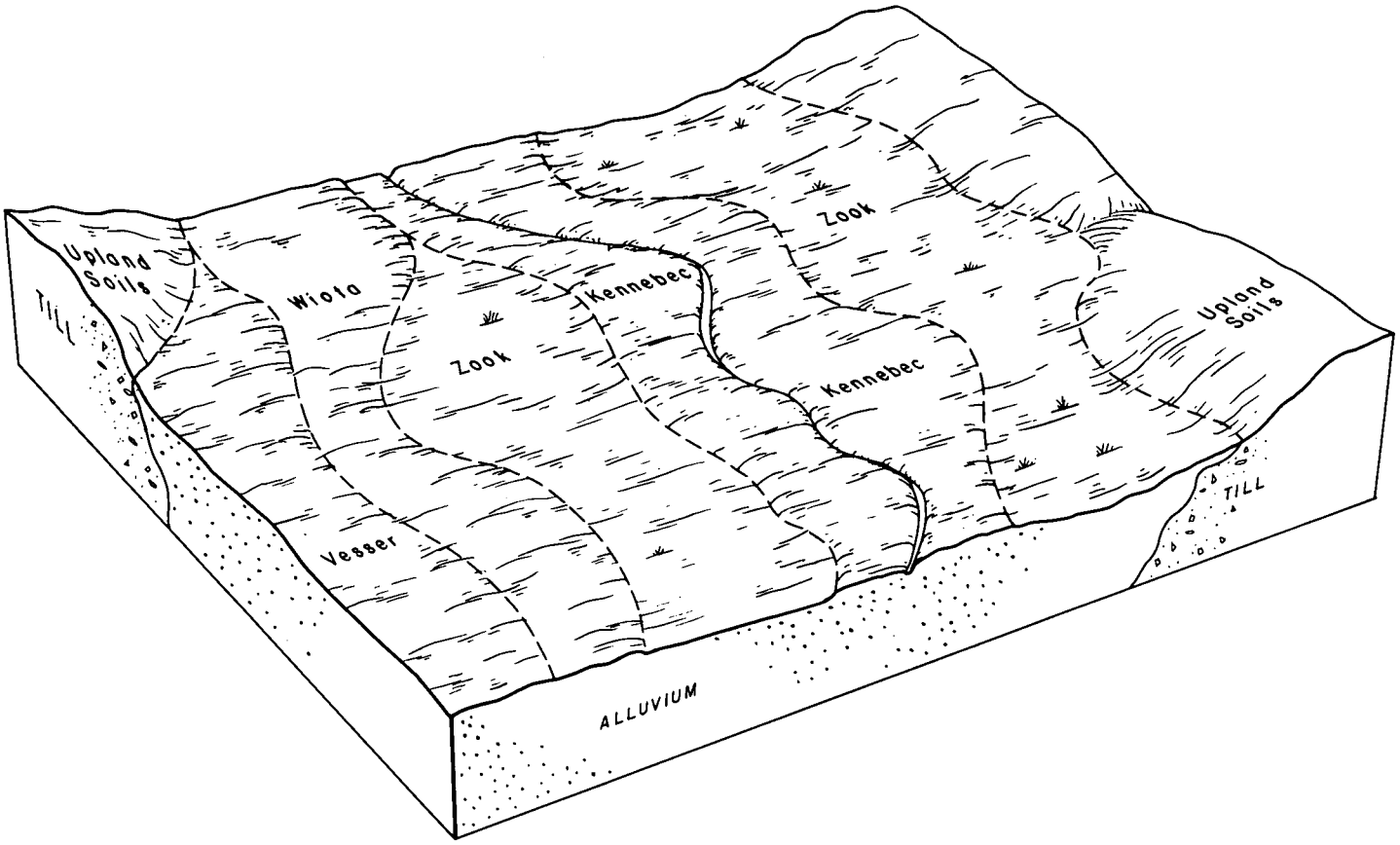

Figure 4.—**Pattern of soils and parent material in association 3.**

inches thick. It is underlain by grayish brown silty clay loam.

Minor soils in this association are Gosport, Sampsel, Shelby, and Lamoni soils. The Gosport soils are in steep rocky areas, and the Sampsel soils are in adjacent moderately sloping areas. Lamoni and Shelby soils are in fringe areas adjacent to the Lamoni-Zook-Shelby association.

The available water capacity is moderate to high. Organic-matter content is low to moderate, and natural fertility is low to medium. The main concern of management is controlling water erosion.

Most areas of this association are used for hay and permanent pasture plants, both of which grow moderately well. The main enterprise is raising beef cattle. Corn and soybeans are grown on the tops and upper sides of some ridges.

Descriptions of the Soils

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

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

Preceding the name of each mapping unit is a symbol which identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*7*).[1]

[1] Italicized numbers in parentheses refer to Literature Cited, p. 44.

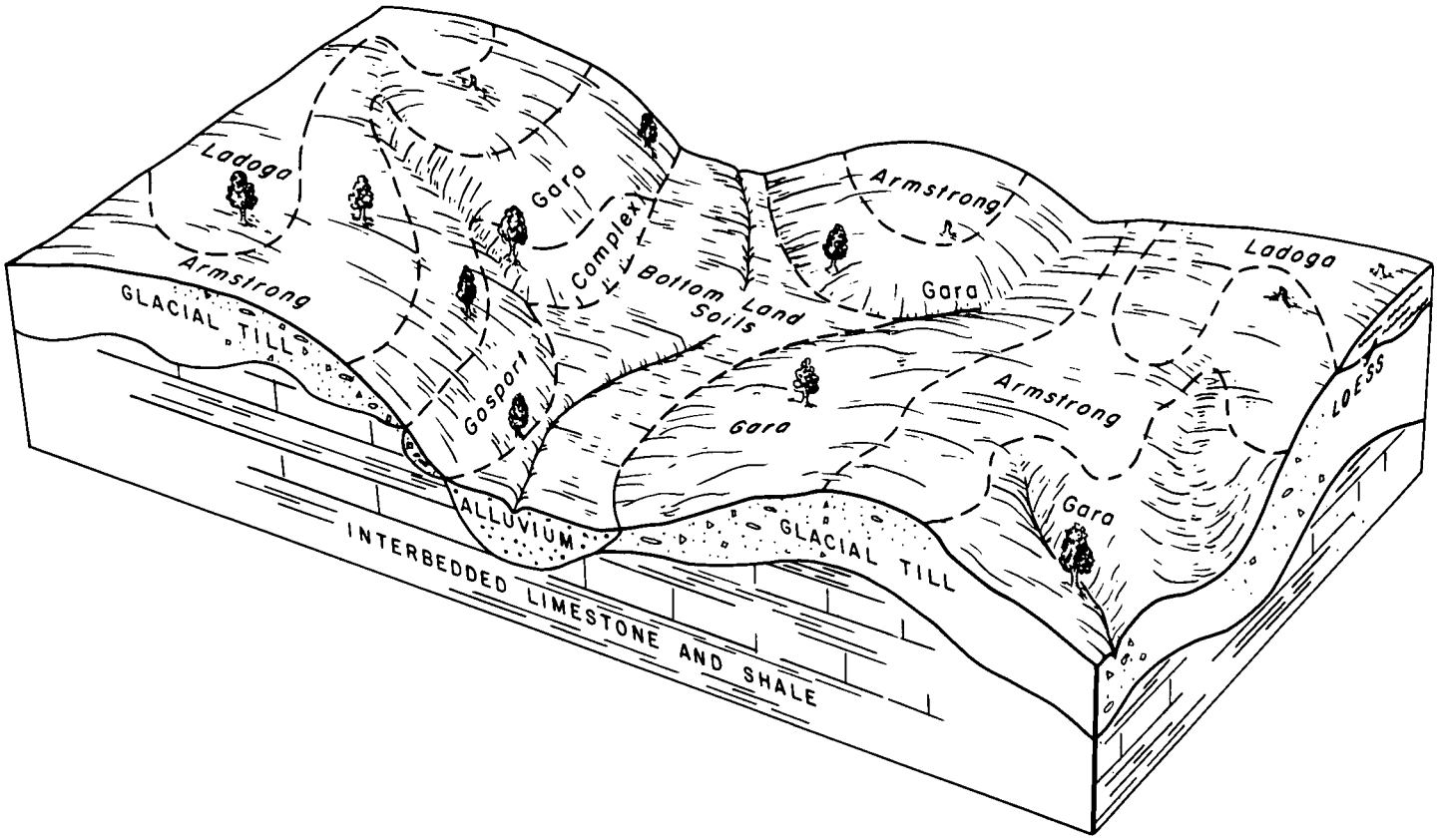

Figure 5.—**Pattern of soils and parent material in association 4.**

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

Soil	Area	Extent
	Acres	*Percent*
Armstrong loam, 5 to 9 percent slopes	6,600	2.4
Armstrong clay loam, 5 to 9 percent slopes, severely eroded	1,060	.4
Clarinda silty clay loam, 5 to 9 percent slopes, eroded	4,200	1.5
Gara loam, 9 to 14 percent slopes	5,050	1.9
Gara loam, 14 to 20 percent slopes	2,050	.8
Gosport complex, 14 to 30 percent slopes	2,800	1.0
Grundy silt loam, 1 to 5 percent slopes	21,100	7.8
Grundy silty clay loam, 2 to 5 percent slopes, eroded	3,750	1.4
Kennebec silt loam	8,100	3.0
Ladoga silt loam, 2 to 5 percent slopes	1,160	.4
Ladoga silt loam, 5 to 9 percent slopes, eroded	2,350	.9
Lagonda silt loam, 2 to 5 percent slopes	8,500	3.2
Lagonda silt loam, 5 to 9 percent slopes, eroded	29,750	11.0
Lamoni clay loam, 4 to 7 percent slopes	9,100	3.4
Lamoni clay loam, 5 to 9 percent slopes, eroded	59,000	21.7
Lamoni soils, 5 to 9 percent slopes, severely eroded	10,300	3.8
Sampsel silty clay loam, 5 to 9 percent slopes	900	.3
Sharpsburg silt loam, 2 to 5 percent slopes	7,500	2.8
Sharpsburg silt loam, 5 to 9 percent slopes	520	.2
Shelby loam, 9 to 14 percent slopes	24,700	9.1
Shelby loam, 14 to 20 percent slopes	1,200	.5
Shelby clay loam, 9 to 14 percent slopes, severely eroded	5,900	2.2
Vesser silt loam	2,600	1.0
Wiota silt loam	3,200	1.2
Zook silty clay loam	46,900	17.3
Zook silty clay	1,120	.4
Quarries	270	.1
Water	710	.3
Total	270,390	100.0

Armstrong Series

The Armstrong series consists of deep, somewhat poorly drained, moderately sloping soils that formed in weathered glacial till. These soils are on the narrow convex tops and the sides of ridges.

In a representative profile, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 67 inches thick. The upper 4 inches is dark yellowish brown, friable heavy clay loam; the next 13 inches is yellowish brown and dark yellowish brown, firm clay mottled with grayish brown, strong brown, and yellowish red; and the lower 50 inches is grayish brown or olive gray, firm clay loam commonly mottled with yellowish brown.

Permeability is slow, and the available water capacity is moderate.

These soils are used mostly for cultivated crops and for hay and pasture.

Representative profile of Armstrong loam, 5 to 9 percent slopes, in a pasture 390 feet east and 1,980 feet south of the center of sec. 20, T. 58 N., R. 30 W.

Ap—0 to 6 inches, very dark grayish brown (10YR 3/2) loam; weak, fine, granular structure; friable; many fine roots; strongly acid; abrupt, smooth boundary.

B1—6 to 10 inches, dark yellowish brown (10YR 4/4) heavy clay loam; weak, fine, subangular blocky structure; friable; many fine roots; very strongly acid; clear, smooth boundary.

IIB21t—10 to 15 inches, dark yellowish brown (10YR 4/4) light clay; few, fine, distinct, strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; firm; common fine roots; few thin clay films; very strongly acid; gradual, smooth boundary.

IIB22t—15 to 23 inches, mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay; moderate, medium, subangular blocky structure; firm; common fine roots; many moderately thick clay films; very strongly acid; gradual, smooth boundary.

IIB23t—23 to 42 inches, grayish brown (10YR 5/2) clay loam; common, medium, distinct, yellowish brown (10YR 5/8) mottles; moderate, medium, prismatic structure; firm; few fine roots; few thin clay films; slightly acid; gradual, smooth boundary.

IIB31—42 to 65 inches, olive gray (5Y 5/2) clay loam; common, medium, distinct, yellowish brown (10YR 5/8) mottles; weak, fine, prismatic structure; firm; slightly acid; gradual, smooth boundary.

IIB32—65 to 73 inches, mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) clay loam; massive; firm; sand is in upper 3 inches; slightly acid.

The solum is very strongly acid or strongly acid in the upper part and slightly acid to alkaline in the lower part. The A1 horizon is black or very dark grayish brown loam 5 to 8 inches thick. Some profiles have an A2 horizon 1 inch to 4 inches thick. The upper part of the B horizon is dark yellowish brown and yellowish brown silty clay or clay mottled with grayish brown, strong brown, and yellowish red. The lower part of the B horizon is grayish brown, olive gray, or gray silty clay or clay loam commonly mottled with yellowish brown. Glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size are throughout the solum in many places. Some calcium concretions and streaks are in the lower part.

Armstrong soils formed in material similar to that of Lamoni soils, but they have a thinner A horizon. They have a higher clay content than Gara soils, and unlike Gara soils, they have red and gray mottles in the upper part of the B horizon.

AmC—Armstrong loam, 5 to 9 percent slopes. This soil is in narrow, irregularly shaped areas on the convex tops and the sides of ridges. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of moderately sloping Ladoga and Lamoni soils and strongly sloping Gara soils on lower slopes. Also included are several small areas of severely eroded Armstrong clay loam on shoulders of side slopes.

Organic-matter content is moderate, and natural fertility is medium. Runoff is medium. The main concern of management is controlling erosion, and a minor concern is maintaining tilth.

This soil is moderately well suited to cultivated crops and well suited to small grain, hay, and pasture. Capability unit IIIe-5..

ArC3—Armstrong clay loam, 5 to 9 percent slopes, severely eroded. This soil is in narrow, irregularly shaped areas on the convex tops and the sides of ridges. It has a profile similar to that described as representative of the series, but the surface layer has been removed by erosion and the surface material is now the upper part of the original subsoil.

Included with this soil in mapping are several small areas of Armstrong loam and Ladoga soils.

Organic-matter content and natural fertility are low. Runoff is rapid. The main concerns of management are controlling erosion and maintaining tilth and the plant cover.

This soil is poorly suited to cultivated crops because erosion is severe. It is best suited to pasture, hay, and wildlife habitat. Capability unit IVe-8.

Clarinda Series

The Clarinda series consists of poorly drained soils that formed in weathered glacial till. This glacial till is a gray clay commonly called gumbotil, which is an old buried soil that has again been exposed by geologic erosion. Clarinda soils are in concave, moderately sloping areas at the heads of small drainageways and on other side slopes. The native vegetation was prairie grasses.

In a representative profile, the surface layer is black silty clay loam about 9 inches thick. The firm subsoil is about 63 inches thick. The upper 7 inches is dark gray silty clay, the next 44 inches is gray clay, and the lower 12 inches is gray light silty clay. The subsoil is mottled with yellowish brown throughout.

Permeability is very slow, and the available water capacity is low.

Most areas of these soils are small and are associated with Lagonda and Lamoni soils. Most are used for cultivated crops and for hay and pasture.

Representative profile of Clarinda silty clay loam, 5 to 9 percent slopes, eroded, in a meadow 1,915 feet west and 425 feet south of the northeast corner of sec. 13, T. 57 N., R. 32 W.

Ap—0 to 9 inches, black (10YR 2/1) silty clay loam; weak, fine; subangular blocky structure; friable; common fine roots; slightly acid; clear, smooth boundary.

IIB21tg—9 to 16 inches, dark gray (10YR 4/1) silty clay; very dark gray (10YR 3/1) in vertical cracks; few, fine, faint, dark gray yellowish brown mottles; moderate, fine, subangular blocky structure; firm; common fine roots; many thick clay films; slightly acid; gradual, smooth boundary.

IIB22tg—16 to 26 inches, gray (5Y 5/1) clay; common, fine and medium, distinct, yellowish brown (10YR 5/4 and 10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; common fine roots; many thick clay films; slightly acid; gradual, smooth boundary.

IIB23tg—26 to 38 inches, gray (5Y 5/1) clay; common, medium, distinct, yellowish brown (10YR 5/4 and 10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; few very fine roots; common thin clay films; few fine sand grains; neutral; gradual, smooth boundary.

IIB31tg—38 to 60 inches, gray (5Y 5/1) clay; common, fine and medium, distinct, yellowish brown (10YR 5/6) mottles; weak, very fine, subangular blocky structure; firm; few sand grains; mildly alkaline; gradual, smooth boundary.

IIB32g—60 to 72 inches, gray (5Y 5/1) light silty clay; common, fine and medium, prominent, yellowish brown (10YR 5/8) mottles; weak, very fine, subangular blocky structure; firm; few sand grains; mildly alkaline.

The solum ranges from slightly acid to strongly acid in the upper part and slightly acid to mildly alkaline in the lower part. The Ap horizon is black or very dark grayish brown silty clay or silty clay loam 5 to 9 inches thick. The subsoil is gray or grayish brown silty clay or clay. It has yellowish brown mottles that increase in number with increasing depth.

Clarinda soils have a thicker and grayer B horizon than Lamoni soils. They have a higher clay content and a grayer subsoil than Lagonda soils. They do not have the pebbles and stones that are common in Lamoni soils.

The dark surface layer of these Clarinda soils is thinner than is de-

fined as the range for the series, but this difference does not alter use or management.

CaC2—Clarinda silty clay loam, 5 to 9 percent slopes, eroded. This soil is in concave areas at the heads of drainageways and on side slopes that extend into the gently sloping uplands. Areas are generally less than 20 acres in size.

Included with this soil in mapping are small areas of eroded Lagonda and Lamoni soils. Also included are several severely eroded areas where the subsoil is exposed. In these severely eroded areas, the soil is plastic when wet, is subject to cracking, and is very difficult to till when dry. The available water capacity is low.

Organic-matter content is moderate, and natural fertility is medium. Runoff is medium, and the hazard of erosion is severe. This soil stays wet for long periods because of very slow permeability and seepage from soils upslope. The main concerns of management are controlling erosion and maintaining tilth.

Many smaller areas of this soil are commonly used for cultivated crops and for hay and pasture. Capability unit IVe-8.

Gara Series

The Gara series consists of deep, moderately well drained soils that formed in glacial till. These soils are in strongly dissected areas on strongly sloping and moderately steep side slopes. The native vegetation was mixed timber and prairie grasses.

In a representative profile, the surface layer is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The firm subsoil is about 34 inches thick. The upper part is brown clay loam, and the lower part is yellowish brown and dark yellowish brown clay loam. The underlying material is yellowish brown and olive gray clay loam that has few to common soft carbonate masses.

Permeability is moderately slow, and the available water capacity is high.

These soils are used mostly for hay, pasture, and some timber.

Representative profile of Gara loam, 9 to 14 percent slopes, in timber, 45 north and 600 feet west of the southeast corner of sec. 14, T. 60 N., R. 32 W.

A1—0 to 7 inches, black (10YR 2/1) loam; weak, fine, granular structure; very friable; few fine roots; neutral; clear, smooth boundary.

A2—7 to 10 inches, dark grayish brown (10YR 4/2) loam; few very dark grayish brown (10YR 3/2) worm casts; weak, fine, granular structure; very friable; few fine roots; medium acid; clear, smooth boundary.

B1—10 to 13 inches, brown (10YR 4/3) light clay loam; weak, fine, subangular blocky structure; firm; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; strongly acid; gradual, smooth boundary.

B21t—13 to 18 inches, brown (10YR 4/3) clay loam; moderate, fine, subangular blocky structure; firm; few medium roots; common thin clay films; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; medium acid; gradual, smooth boundary.

B22t—18 to 25 inches, dark yellowish brown (10YR 4/4) clay loam; moderate, fine, subangular blocky structure; firm; common thin clay films; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; medium acid; clear, smooth boundary.

B23t—25 to 32 inches, yellowish brown (10YR 5/6) clay loam; few, fine, distinct, olive gray (5Y 5/2) mottles; weak, fine, subangular blocky structure; firm; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; slightly acid; gradual, smooth boundary.

B3—32 to 44 inches, yellowish brown (10YR 5/4 and 10YR 5/6) clay loam; few, fine, distinct, grayish brown (2.5Y 5/2) mottles; weak, fine, prismatic structure; firm; few soft carbonate masses; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; neutral; clear, smooth boundary.

C—44 to 65 inches, yellowish brown (10YR 5/4) and olive gray (5Y 5/2) clay loam; massive; firm; few soft carbonate masses; some glacial pebbles 2 to 5 percent in volume and 5 to 10 millimeters in size; neutral.

The solum ranges from 36 to 70 inches in thickness. The A1 horizon is black or very dark grayish brown loam 5 to 8 inches thick. The A2 horizon is black or very dark grayish brown loam 5 to 8 inches thick. The A2 horizon is 1 inch to 3 inches thick. In cultivated areas, the A2 horizon is mixed with the Ap horizon by plowing.

Gara soils formed in material similar to that of Shelby soils, but they have a thinner A horizon. They do not have the yellowish red and grayish brown mottles in the upper part of the B horizon that are common in Armstrong soils.

GaD—Gara loam, 9 to 14 percent slopes. This soil is on side slopes below Armstrong or Ladoga soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Armstrong soils. Also included are several small areas and a few large areas of a Gara soil where the surface layer has been removed by erosion and a few small areas of a Gosport soil that has some small rock outcrops.

Organic-matter content is moderate, and natural fertility is medium. Runoff is medium, and the hazard of erosion is severe. The main concern of management is controlling erosion.

This soil is suited to hay, pasture, and a limited amount of small grain. Capability unit IVe-1.

GaE—Gara loam, 14 to 20 percent slopes. This soil is on hillsides below the strongly sloping Gara and moderately sloping Armstrong soils. It has a profile similar to that described as representative of the series, but the surface layer is lighter colored and is 3 to 4 inches thinner because of natural erosion and erosion caused by overgrazing.

Included with this soil in mapping are small areas of a Gara soil where the surface layer has been removed by erosion and a strongly sloping, eroded Gara soil. Also included are a few small areas of a Gosport soil that has some small rock outcrops.

Organic-matter content is moderate, and natural fertility is medium. Runoff is rapid, and the hazard of erosion is severe. The main concerns of management are controlling erosion and establishing plant cover.

This soil is best suited to pasture, timber, and wildlife habitat. Capability unit VIe-1.

Gosport Variant

The Gosport variant is an alkaline variant of the Gosport series. It consists of moderately deep, well drained, moderately steep and steep soils that formed in thin interbedded limestone and shale. These soils are on side slopes.

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is firm silty clay about 18 inches thick. The upper 5 inches is brown, the next 6 inches is dark yellowish brown, and the lower 7 inches is yellowish brown. The underlying material is about 11 inches thick. The upper 4 inches is brown and olive brown silty clay loam, and the lower 7 inches is light brownish gray platy shale. Hard shale bedrock is at a depth of 36 inches.

Permeability is moderately slow above bedrock, and the available water capacity is low.

These soils are used mostly for timber and pasture.

Representative profile of Gosport silty clay loam, alkaline variant, in an area of Gosport complex, 14 to 30 percent slopes, in timber, 110 feet south and 30 feet west of the center of sec. 23, T. 58 N., R. 30 W.

A1—0 to 4 inches, very dark grayish brown (10YR 3/2) silty clay loam; strong, very fine and fine, subangular blocky structure; friable; many fine roots; few, small, flaggy limestone fragments; medium acid; clear, smooth boundary.

A12—4 to 7 inches, very dark grayish brown (10YR 3/2) heavy silty clay loam; few, fine, faint, dark brown mottles; strong, fine, subangular blocky structure; friable; common fine and medium roots; few, small, brown rock fragments; slightly acid; clear, smooth boundary.

B21—7 to 12 inches, brown (10YR 4/3) silty clay; few, fine, faint, very dark grayish brown mottles; moderate, fine, subangular blocky structure; firm; common fine and medium roots; slightly acid; clear, smooth boundary.

B22—12 to 18 inches, dark yellowish brown (10YR 4/4) silty clay; few, fine, distinct, subangular blocky structure; firm; few fine and medium roots; slightly acid; clear, smooth boundary.

B3—18 to 25 inches, yellowish brown (10YR 5/4) silty clay; weak, medium, subangular blocky structure; firm; few fine and medium roots; slightly acid; clear, smooth boundary.

C1—25 to 29 inches, brown (10YR 4/3) and olive brown (2.5Y 4/4) silty clay loam; massive; firm; few fine roots; moderately alkaline; strong effervescence; abrupt, smooth boundary.

C2—29 to 36 inches, light brownish gray (2.5Y 6/2) shale; platy rock structure; difficult to dig with hand spade; moderately alkaline; strong effervescence; clear, smooth boundary.

R—36 inches, shale bedrock.

The solum ranges from 21 to 31 inches in thickness. Depth to bedrock ranges from 28 to 40 inches. Coarse fragments throughout the profile range from 5 to 25 percent in volume and generally from 5 to 30 millimeters in size. The A horizon is very dark grayish brown or very dark brown. The B horizon is brown, dark brown, or yellowish brown silty clay loam or silty clay. The C horizon is 8 to 13 inches thick.

These soils have a thinner solum and are less gray in the B horizon than Sampsel soils. They have a greater number of coarse fragments than Armstrong and Gara soils.

GdE—Gosport complex, 14 to 30 percent slopes. This mapping unit is about 40 percent Gosport variant, 35 percent shallow soils similar to the Gosport variant, and 25 percent Armstrong, Gara, and Sampsel soils and rock outcrop. It is adjacent to streams. Areas range from 10 to more than 100 acres in size. Armstrong and Gara soils are in less steep areas at higher elevations than the Gosport soil. The Sampsel soil is adjacent to the Gosport soil, but at higher or lower elevations. Small rock outcrop and loose rocks occur throughout the mapping unit.

The Gosport variant formed in shale interbedded with thin layers of limestone (fig. 6). Nearly vertical low rock cliffs or ledges are in a few places adjacent to streams.

Organic-matter content is moderate and natural fertility is low in the Gosport variant. Runoff is rapid. Erosion and droughtiness are the major hazards. The main concerns of management are controlling erosion and establishing and

Figure 6.—**Roadside cut showing a partial profile of the Gosport variant and the effect of the underlying material on root penetration.**

maintaining a continuous plant cover. Minor concerns are protecting the plant cover from fire and overgrazing.

This mapping unit is best suited to timber and wildlife habitat. Capability unit VIIs-7.

Grundy Series

The Grundy series consists of deep, somewhat poorly drained soils that formed in loess. These soils are on the high, gently sloping, wide tops and the sides of ridges. The native vegetation was prairie grasses.

In a representative profile (fig. 7), the surface layer is black and is about 11 inches thick. The upper 8 inches is silt loam, and the lower 3 inches is light silty clay loam. The subsoil is about 36 inches thick. It is, in sequence downward, 3 inches of very dark gray, friable silty clay loam, 3 inches of dark grayish brown, firm silty clay loam, 6 inches of dark grayish brown, firm silty clay that has a few yellowish red and yellowish brown mottles; and 24 inches of grayish brown light silty clay and silty clay loam that has many yellowish brown mottles. The underlying material to a depth of 84 inches is grayish brown silty clay loam that has many dark yellowish brown mottles.

Permeability is slow, and the available water capacity is high.

These soils are used mostly for cultivated crops. Some smaller areas are used for hay and pasture.

Representative profile of Grundy silt loam, 1 to 5 percent slopes, in a cultivated field 470 feet east and 1,020 feet north of the southwest corner of sec. 16, T. 57 N., R. 30 W.

Ap—0 to 8 inches, black (10YR 2/1) heavy silt loam; strong, medium, granular structure; friable; many roots; many worm casts; neutral; abrupt, smooth boundary.

A12—8 to 11 inches, black (10YR 2/1) light silty clay loam; moderate, very fine and fine, granular structure; friable; many roots; many worm casts; some krotovina of very dark grayish brown (10YR 3/2); few fine concretions; slightly acid; clear, smooth boundary.

B1—11 to 14 inches, very dark gray (10YR 3/1) medium silty clay loam; strong, very fine, subangular blocky structure; friable; many roots; many krotovina of dark grayish brown (10YR 4/2); grainy silt coatings on ped surfaces; few fine concretions; medium acid; clear, smooth boundary.

B21t—14 to 17 inches, dark grayish brown (10YR 4/2) medium silty clay loam; strong, very fine, subangular blocky structure; firm; few roots; common thin clay films; few krotovina; common fine concretions; medium acid; clear, smooth boundary.

B22t—17 to 23 inches, dark grayish brown (10YR 4/2) silty clay; few, fine, prominent, reddish brown (5YR 4/4) and yellowish red (5YR 4/6) and few, fine, distinct, dark yellowish brown (10YR 4/4) mottles; very fine and fine, subangular blocky structure; firm; few roots; thick continuous clay films; few krotovina; few fine concretions; medium acid; clear, smooth boundary.

B23t—23 to 34 inches, grayish brown (10YR 5/2) light silty clay; many, medium, distinct, dark yellowish brown (10YR 4/4), and few fine, distinct, dark brown (7.5YR 4/4) mottles; moderate, medium and coarse, prismatic structure; firm; very few fine roots; thick continuous clay films; few black clay flows in vertical cracks and pores; few concretions; medium acid; gradual, smooth boundary.

B31t—34 to 47 inches, grayish brown (2.5Y 5/2) heavy silty clay loam; many, fine, prominent, dark yellowish brown (10YR 4/4) and many, medium, prominent, strong brown (7.5YR 5/6) mottles; weak, medium, subangular blocky and weak, medium and coarse, prismatic structure; firm; very few fine roots; thick clay films in vertical cracks; common fine concretions; neutral; gradual, smooth boundary.

C—47 to 84 inches, grayish brown (2.5Y 5/2) silty clay loam; few, fine, faint, olive gray (5Y 5/2) and many, medium, prominent, dark yellowish brown (10YR 4/4) mottles; massive; firm; few old root channels coated with black stains; common fine concretions; neutral.

The solum ranges from 40 to 84 inches in thickness. The A horizon

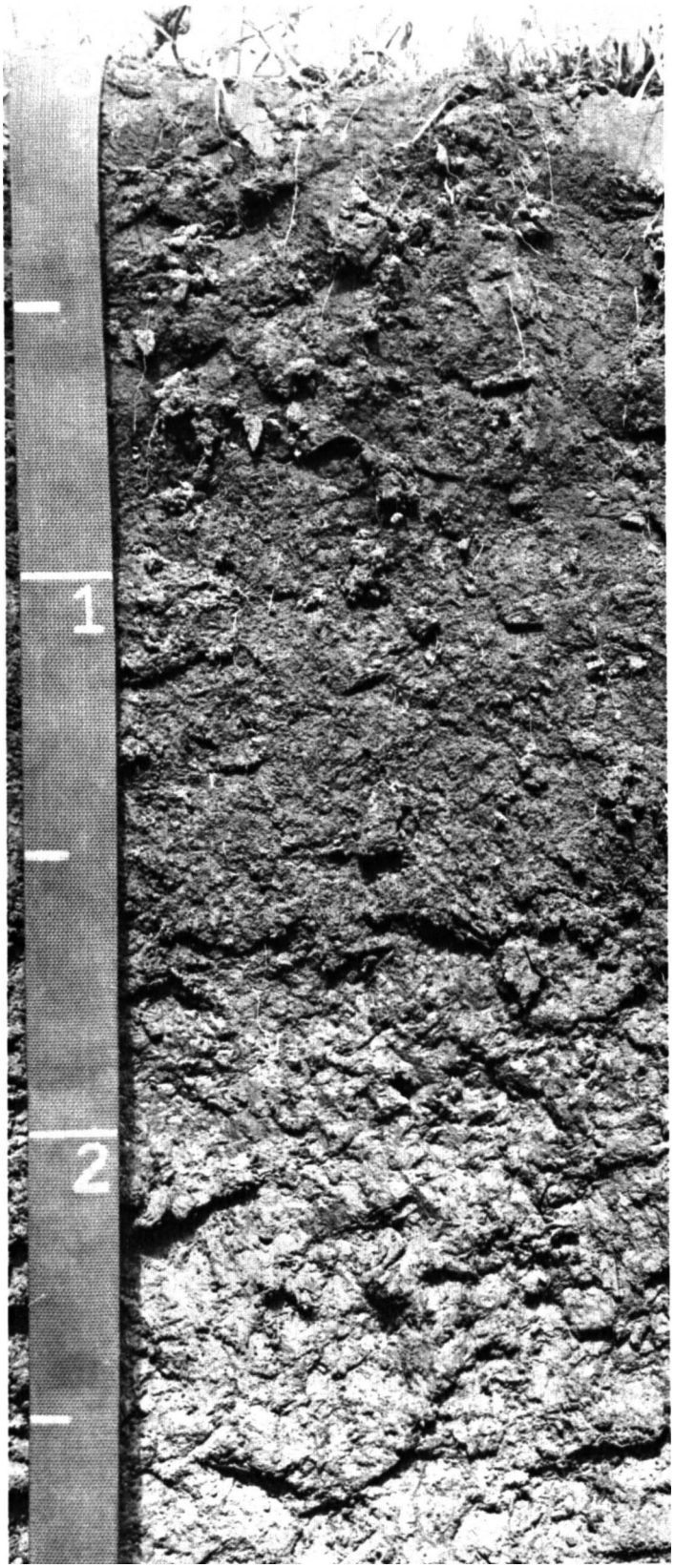

Figure 7.—Typical profile of Grundy silt loam.

is black, very dark gray, or very dark grayish brown silt loam or silty clay loam. The very dark gray colors of the surface layer extend into the B horizon in many places. The upper part of the B horizon is brown, very dark grayish brown, or dark grayish brown silty clay loam or silty clay. The lower part has variable colors of brown, dark grayish brown, and gray and is light silty clay and heavy silty clay loam.

Grundy soils are upslope from Lagonda, Clarinda, and Lamoni soils. They have less sand in the lower part of the solum than Lagonda soils, are less gray in the subsoil than Clarinda soils, and do not have the sand and pebbles that are in Lamoni soils.

GsB—Grundy silt loam, 1 to 5 percent slopes. This soil is on the wide tops and the sides of ridges upslope from Lagonda soils. It has the profile described as representative of the series.

Included with this soil in mapping are several small areas and a few large areas of a more poorly drained, nearly level soil that has a finer textured subsoil. The large areas are north of Osborn. Also included are some small areas of a gently sloping, eroded Grundy soil.

Organic-matter content and natural fertility are high. Runoff is slow. Erosion is the major hazard and the main concern of management.

This soil is well suited to cultivated crops and to hay and pasture. Capability unit IIe-5.

GuB2—Grundy silty clay loam, 2 to 5 percent slopes, eroded. This soil is on the tops and the sides of ridges. It has a profile similar to that described as representative of the series, but the surface layer is only 5 to 8 inches thick, contains more clay, and in places is lighter colored because of the mixing of part of the subsoil with the plow layer.

Included with this soil in mapping are small areas of uneroded Grundy soils and Lagonda soils.

Organic-matter content is moderate, and natural fertility is high. Runoff is medium. Erosion is the major hazard and the main concern of management.

This soil is well suited to cultivated crops and to hay and pasture. Capability unit IIIe-5.

Kennebec Series

The Kennebec series consists of deep, moderately well drained, nearly level soils that formed in recent stratified deposits of silty alluvial sediments. These soils are on stream bottoms and are occasionally flooded for very short periods.

In a representative profile, the surface layer is about 49 inches thick. The upper 40 inches is black silt loam, and the lower 9 inches is very dark brown silt loam. The underlying material to a depth of 84 inches is very dark grayish brown and dark brown silt loam.

Permeability is moderate, and the available water capacity is very high.

These soils are used for cultivated crops. Many narrow areas adjacent to meandering stream channels are used for timber.

Representative profile of Kennebec silt loam, in a cultivated field 70 feet north and 115 feet east of the southwest corner of sec. 10, T. 58 N., R. 30 W.

Ap—0 to 7 inches, black (10YR 2/1) silt loam; weak, very fine, granular structure; friable; common very fine and fine roots; common fine worm holes and pores; slightly acid; clear, smooth boundary.

A12—7 to 19 inches, black (10YR 2/1) silt loam; weak, fine and very fine, granular structure; friable; few fine roots; common, fine worm holes and pores; neutral; diffuse, smooth boundary.

A13—19 to 40 inches, black (10YR 2/1) silt loam; weak, very fine and fine, subangular blocky structure; friable; few very fine roots; few small worm holes and many fine pores; neutral; diffuse, smooth boundary.

AC—40 to 49 inches, very dark brown (10YR 2/2) silt loam; weak, fine; subangular blocky structure; friable; common fine pores; neutral; diffuse, smooth boundary.

C1—49 to 65 inches, very dark grayish brown (10YR 3/2) heavy silt loam; massive; friable; slightly acid; diffuse, smooth boundary.

C2—65 to 84 inches, dark brown and very dark grayish brown (10YR 3/3 and 10YR 3/2) light silt loam; massive; friable; few fine pores; common, fine, clean sand grains; medium acid.

The Ap horizon is silt loam in most places, but it ranges to loam. The A horizon ranges from neutral to medium acid.

Kennebec soils are not so gray in the lower part of the solum as Vesser soils and have less clay than Zook soils. They have less clay than Wiota soils and are not so brown in the lower part of the A horizon.

Ke—Kennebec silt loam. This nearly level soil is on flood plains adjacent to stream channels. Slopes are 0 to 1 percent. Areas are narrow and range from 15 to several hundred acres in size.

Included with this soil in mapping are small areas of somewhat poorly drained Vesser soils and poorly drained Zook soils. Also included are some small areas where the surface layer is loam because of overwash.

Organic-matter content and natural fertility are high.

This soil is well suited to cultivated crops and to pasture and timber. It has no inherent limitation, but it is subject to occasional flooding during the growing season. Capability unit IIw-4.

Ladoga Series

The Ladoga series consists of deep, moderately well drained, gently sloping and moderately sloping soils that formed in loess. These soils are on the narrow tops and the sides of ridges. The native vegetation was timber and prairie grasses.

In a representative profile, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The firm subsoil is about 40 inches thick. It is, in sequence downward, 4 inches of brown light silty clay loam, 7 inches of dark yellowish brown light silty clay, 10 inches of brown heavy silty clay loam that has a few yellowish brown and grayish brown mottles, and 19 inches of grayish brown silty clay loam mottled with brown and yellowish brown. The underlying material to a depth of 72 inches is grayish brown silty clay loam mottled with yellowish brown.

Permeability is moderately slow, and the available water capacity is high.

These soils are used for cultivated crops and for hay and pasture. Some small areas are used for timber and wildlife habitat.

Representative profile of Ladoga silt loam, 2 to 5 percent slopes, in a pasture 1,045 feet east and 80 feet north of the center of sec. 10, T. 57 N., R. 32 W.

Ap—0 to 7 inches, very dark grayish brown (10YR 3/2) silt loam; weak, very fine, granular structure; very friable; common very fine roots; neutral; abrupt, smooth boundary.

A2—7 to 9 inches, dark grayish brown (10YR 4/2) silt loam; weak, very fine, granular structure; few, medium, very dark grayish brown (10YR 3/2) spots; very friable; few fine roots; slightly acid; clear, smooth boundary.

B1t—9 to 13 inches, brown (10YR 4/3) light silty clay loam; moderate, very fine, subangular blocky structure; firm; slightly acid; clear, smooth boundary.

B21t—13 to 20 inches, dark yellowish brown (10YR 4/4) light silty clay; moderate, fine, subangular blocky structure; firm; few very

fine roots; common thin clay films; medium acid; gradual, smooth boundary.

B22t—20 to 30 inches, brown (10YR 5/3) heavy silty clay loam; few, fine, faint, dark yellowish brown and grayish brown mottles; weak, fine, subangular blocky structure; firm; few very fine roots; common thin clay films; medium acid; gradual, smooth boundary.

B3t—30 to 49 inches, grayish brown (10YR 5/2) silty clay loam; few, medium, faint, brown (10YR 5/3) and common, fine and medium, distinct, yellowish brown (10YR 5/8) mottles; weak, fine, prismatic structure; firm; few black soft oxides; medium acid; gradual, smooth boundary.

C—49 to 72 inches, grayish brown (10YR 5/2) light silty clay loam; common, medium, distinct, yellowish brown (10YR 5/8) mottles; massive; firm; few black soft oxides; slightly acid.

The A1 horizon is very dark gray or very dark grayish brown silt loam 5 to 8 inches thick. In cultivated areas, the A2 horizon is mixed with the Ap horizon. The upper part of the B horizon is brown or dark yellowish brown.

Ladoga soils have a thinner A1 horizon than Grundy, Lagonda, and Sharpsburg soils and do not have the glacial sand and pebbles that are in Armstrong and Gara soils.

LaB—Ladoga silt loam, 2 to 5 percent slopes. This soil is in small, long and narrow areas on the tops and the sides of ridges. In places, it is adjacent to moderately sloping Ladoga soils. Typically, this soil is at lower elevations than Grundy and Lagonda soils and is upslope from moderately sloping Ladoga and Armstrong soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of more poorly drained soils and eroded Ladoga soils. Also included are small areas of a soil that has more sand in the lower part of the subsoil than is typical.

Organic-matter content is moderate, and natural fertility is high. Runoff is slow. Erosion is the major hazard and the main concern of management.

This soil is suited to cultivated crops and to alfalfa, hay, pasture, and timber. Capability unit IIe-1.

LaC2—Ladoga silt loam, 5 to 9 percent slopes, eroded. This soil is in small, narrow, irregularly shaped areas on the narrow tops and the sides of ridges. It has a profile similar to that described as representative of the series, but erosion has removed part of the surface layer. In places, the dark grayish brown subsurface layer and part of the brown subsoil have been mixed with the surface layer by plowing.

Included with this soil in mapping are small areas of more poorly drained soils and uneroded Ladoga soils. Also included are small areas of a soil that has more sand in the lower part of the subsoil than is typical.

Organic-matter content is moderate, and natural fertility is high. Runoff is medium. Erosion is the major hazard and the main concern of management.

This soil is moderately well suited to cultivated crops and well suited to small grain, hay, and pasture. Capability unit IIIe-1.

Lagonda Series

The Lagonda series consists of deep, somewhat poorly drained, gently sloping and moderately sloping soils on the tops and the sides of ridges. These soils formed in 20 to 36 inches of loess or silty sediment underlain by highly weathered material washed from glacial till. The native vegetation was mainly prairie grasses.

In a representative profile, the surface layer is black silt loam about 9 inches thick. The firm subsoil is about 46 inches thick. The upper 5 inches is dark grayish brown silty clay loam; the next 14 inches is dark grayish brown silty clay that has many fine mottles of yellowish brown in the upper part; and the lower 27 inches is grayish brown silty clay loam that has many fine mottles of yellowish brown. The underlying material to a depth of 71 inches is gray silty clay commonly mottled with yellowish brown.

Permeability is slow, and the available water capacity is high.

These soils are used mostly for cultivated crops. A few areas are used for hay and pasture.

Representative profile of Lagonda silt loam, 5 to 9 percent slopes, eroded, in a pasture 2,500 feet east and 775 feet south of the center of sec. 17, T. 57 N., R. 30 W.

Ap—0 to 9 inches, black (10YR 2/1) heavy silt loam; weak, very fine, granular structure; friable; common fine roots; neutral; clear, smooth boundary.

B1—9 to 14 inches, dark grayish brown (10YR 4/2) heavy silty clay loam; very dark grayish brown (10YR 3/2) coatings on some peds; moderate, very fine, subangular blocky structure; firm; common fine roots; medium acid; gradual, smooth boundary.

B21t—14 to 20 inches, dark grayish brown (2.5Y 4/2) silty clay; many, fine, distinct, yellowish brown (10YR 5/8) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; common thin clay films; slightly acid; gradual, smooth boundary.

B22t—20 to 28 inches, dark grayish brown (2.5Y 4/2) silty clay; common, medium, prismatic and fine, subangular blocky structure; firm; few fine roots; common moderately thick clay films; few sand grains; slightly acid; gradual, smooth boundary.

IIB31t—28 to 55 inches, grayish brown (2.5Y 5/2) silty clay loam; many, fine, distinct, yellowish brown (10YR 5/4) mottles; weak, medium, prismatic structure; firm; few thin clay films; common fine sand grains; few black concretions; neutral; gradual, smooth boundary.

IIIC1g—55 to 71 inches, gray (5Y 5/1) silty clay; common, medium, yellowish brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; firm; common sand grains; neutral.

The solum ranges from 40 to 60 inches in thickness. The A horizon is black, very dark gray, very dark grayish brown, or very dark brown. It is dominantly silt loam, but the range includes silty clay loam. The upper 4 to 8 inches of the B horizon is very dark gray or very dark grayish brown. The lower part of the B horizon is mostly dark grayish brown and has gray, brown, and yellowish brown mottles that vary in number.

Lagonda soils do not have the glacial pebbles and stones that are in Lamoni and Shelby soils. They have more sand in the lower part of the solum than Grundy soils and have a less gray subsoil than Clarinda soils.

The dark colored surface layer of these Lagonda soils is thinner than is defined as the range for the series, but this difference does not alter the use or management.

LgB—Lagonda silt loam, 2 to 5 percent slopes. This soil is in narrow areas at the ends of long ridges. It is at slightly lower elevations than Grundy soils. It has a profile similar to that described as representative of the series, but the surface layer is thicker.

Included with this soil in mapping are small areas of Grundy soils. Also included are several small areas of a Lagonda soil in which the plow layer is several inches thinner or is partly mixed with the subsoil.

Organic-matter content and natural fertility are high. Runoff is slow. Erosion is the major hazard and the main concern of management.

This soil is well suited to cultivated crops and to hay and pasture. Capability unit IIe-5.

LgC2—Lagonda silt loam, 5 to 9 percent slopes, eroded. This soil is on side slopes along small drainageways and is downslope from the gently sloping Grundy and Lagonda soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of

Clarinda, Grundy, and Lamoni soils. Also included are small areas of a Lagonda soil where the surface layer has been removed by erosion.

Organic-matter content is moderate, and natural fertility is high. Runoff is medium. The main concern of management is controlling erosion, and a minor concern is maintaining tilth.

This soil is moderately well suited to cultivated crops and well suited to hay and pasture. Capability unit IIIe-5.

Lamoni Series

The Lamoni series consists of deep, somewhat poorly drained, moderately sloping soils that formed in glacial till. These soils are on the narrow tops and the sides of ridges. The native vegetation was prairie grasses.

In a representative profile, the surface layer is about 9 inches thick. The upper part is black clay loam, and the lower part is very dark grayish brown clay loam. The firm subsoil is about 29 inches thick. The upper 12 inches is dark grayish brown clay that has a few yellowish brown and dark brown mottles; the next 8 inches is light olive brown clay; and the lower 9 inches is gray heavy clay loam. The underlying material to a depth of 72 inches is gray and yellowish brown clay loam.

Permeability is slow, and the available water capacity is moderate.

These soils are used mostly for cultivated crops and for hay and pasture.

Representative profile of Lamoni clay loam, 5 to 9 percent slopes, eroded, in a pasture 2,335 feet east and 630 feet south of the northwest corner of sec. 28, T. 59 N., R. 31 W.

Ap—0 to 6 inches, black (10YR 2/1) clay loam; moderate, fine, granular structure; friable; common very fine roots; slightly acid; clear, smooth boundary.

A3—6 to 9 inches, very dark grayish brown (10YR 3/2) clay loam; moderate, very fine, subangular blocky structure; friable; common very fine roots; medium acid; clear, smooth boundary.

IIB21t—9 to 14 inches, dark grayish brown (10YR 4/2) light clay; very dark grayish brown (10YR 3/2) coatings on some peds; few, fine, faint, dark yellowish brown and few, fine, distinct, yellowish red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; firm; common very fine roots; common thin clay films; medium acid; gradual, smooth boundary.

IIB22t—14 to 21 inches, dark grayish brown (10YR 4/2) clay; few, fine, distinct, yellowish brown (10YR 4/6) and dark brown (7.5YR 4/4) mottles; moderate, fine, subangular blocky structure; firm; common very fine roots; many moderately thick clay films; common fine black concretions; slightly acid; gradual, smooth boundary.

IIB23t—21 to 29 inches, light olive brown (2.5Y 5/4) light clay; common, fine, faint, grayish brown (2.5Y 5/2), few, fine, distinct, gray (5Y 5/1), and few, fine, faint, light olive brown mottles; weak, medium, subangular blocky structure; firm; few fine roots; common thin clay films; moderately alkaline; gradual, smooth boundary.

IIB3t—29 to 38 inches, gray (5Y 5/1) heavy clay loam; common, medium, distinct, light olive brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; firm; few very fine roots; few thin clay films; slight effervescence; moderately alkaline; gradual, smooth boundary.

C1—38 to 56 inches, gray (10YR 6/1) and yellowish brown (10YR 5/4) heavy clay loam; common, fine, faint, yellowish brown (10YR (5/8) mottles; weak, fine, prismatic structure; strong effervescence; moderately alkaline; gradual, smooth boundary.

C2—56 to 72 inches, yellowish brown (10YR 5/8) clay loam; few, fine, distinct, gray (10YR 6/1) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is typically 3 to 4 feet thick. The Ap horizon is black, very dark gray, or very dark grayish brown. It is dominantly clay loam and silty clay, but the range includes loam. The upper part of the B horizon has fine yellowish red mottles in some pedons, and the lower part is mottled gray, light brown, or yellowish brown.

Lamoni soils are grayer and have more clay in the B horizon than Shelby soils. They are not so gray as Clarinda soils. They have more clay, sand, and pebbles in the upper part of the solum than Lagonda soils.

The dark colored surface layer and the solum of these soils are thinner than is defined as the range for the series, but this difference does not alter the use or management.

LmC—Lamoni clay loam, 4 to 7 percent slopes. This soil is in long, narrow areas on the tops and the sides of ridges along small drainageways or upslope from strongly sloping Shelby or Gara soils. It has a profile similar to that described as representative of the series, but the surface layer is thicker.

Included with this soil in mapping are small areas of Clarinda and Lagonda soils around the heads of drainageways. Also included are many small areas on the tops of ridges where the slope is less than 4 percent.

Organic-matter content and natural fertility are high. Runoff is medium. Erosion is the major hazard and the main concern of management.

This soil is suited to cultivated crops and to hay and pasture. Capability unit IIIe-5.

LmC2—Lamoni clay loam, 5 to 9 percent slopes, eroded. This soil is in long, narrow areas on ridges and side slopes along small drainageways or upslope from strongly sloping Shelby or Gara soils. It has the profile described as representative of the series.

Included with this soil in mapping are some areas of Clarinda and Lagonda soils around the heads of drainageways. Also included are a few small areas of uneroded and severely eroded Lamoni soils and a few where the slope is greater than 9 percent.

Organic-matter content is moderate, and natural fertility is high. Runoff is medium. The hazard of erosion is severe. The main concern of management is controlling erosion.

This soil is moderately well suited to cultivated crops and well suited to hay and pasture. Capability unit IIIe-5.

LnC3—Lamoni soils, 5 to 9 percent slopes, severely eroded. This mapping unit is on the shoulders of side slopes and along small drainageways. It is also in areas upslope from strongly sloping Shelby or Gara soils. It has a profile similar to that described as representative of the series, but in many areas the original surface layer has been removed by erosion and the surface material is now the upper part of the dark grayish brown subsoil. Surface texture is dominantly silty clay, but in some areas it is clay loam.

Included in this unit in mapping are small areas of Clarinda and Lagonda soils. Also included are small areas where the slope is greater than 9 percent.

Organic-matter content is low, and natural fertility is medium. Runoff is rapid. The hazard of erosion is severe. Small gullies have formed in places. The main concerns of management are controlling erosion and maintaining tilth and the plant cover.

This mapping unit is best suited to pasture, timber, and wildlife habitat. Capability unit IVe-8.

Sampsel Series

The Sampsel series consists of deep, somewhat poorly drained, moderately sloping soils that formed in material weathered from shale. These soils are generally on the low concave side slopes and foot slopes.

In a representative profile, the surface layer is light silty clay loam about 16 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsoil is about 40 inches thick. The upper 10 inches is dark grayish brown silty clay loam that has common fine mottles of yellowish brown and dark gray; the next 12 inches is dark grayish brown silty clay that has common fine mottles of grayish brown and yellowish brown; and the lower 18 inches is olive gray silty clay that has common medium mottles of yellowish brown. The underlying material, to a depth of 77 inches, is olive and gray silty clay and olive shaly silty clay loam.

Permeability is slow, and the available water capacity is high.

These soils are used mostly for hay and pasture. A few areas are used for cultivated crops and timber.

Representative profile of Sampsel silty clay loam, 5 to 9 percent slopes, in a bluegrass pasture 765 feet north and 55 feet west of the northeast corner of sec. 23, T. 59 N., R. 30 W.

A11—0 to 10 inches, black (10YR 2/1) light silty clay loam; moderate, fine, granular structure; friable; common fine roots; slightly acid; clear, smooth boundary.

A12—10 to 16 inches, very dark grayish brown (10YR 3/2) light silty clay loam; moderate, fine, granular structure; firm; common fine roots; medium acid; gradual, smooth boundary.

B1t—16 to 26 inches, dark grayish brown (2.5Y 4/2) silty clay loam; common, fine, distinct, dark gray (10YR 4/1) and yellowish brown (10YR 5/6) and few, fine, distinct, very dark gray (10YR 3/1) mottles; moderate, very fine, subangular blocky structure; firm; many thin clay films; many fine concretions; strongly acid; gradual, smooth boundary.

B21t—26 to 38 inches, dark grayish brown (2.5Y 4/2) silty clay; common, fine, distinct, grayish brown (10YR 5/2) and many, fine, distinct, yellowish brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; many moderately thick clay films; common fine concretions; medium acid; gradual, smooth boundary.

B22t—38 to 44 inches, olive gray (5Y 5/2) silty clay; common, medium, distinct, light olive brown (2.5Y 5/4) and few, fine, distinct, yellowish brown (10YR 5/6) mottles; few, fine, black vertical streaks; weak, fine, prismatic structure; firm; many thin clay films; few fine concretions; slightly acid; gradual, smooth boundary.

B3—44 to 56 inches, olive gray (5Y 5/2) light silty clay; common, medium, distinct, yellowish brown (10YR 5/6) mottles; weak, medium, prismatic structure; firm; neutral; clear, smooth boundary.

C1—56 to 64 inches, olive (5Y 5/3) and gray (N 5/0) light silty clay; massive; firm; neutral; clear, smooth boundary.

C2—64 to 77 inches, olive (5Y 5/3), soft, platy, shaly silty clay loam; olive yellow (2.5Y 6/6) mottles; neutral.

R—77 inches, weathered shale bedrock.

The solum ranges from 36 to 70 inches in thickness. Depth to bedrock ranges from 40 to 70 inches or more. The A horizon is silt loam or silty clay loam 10 to 16 inches thick.

Sampsel soils have a thicker solum and a grayer B horizon than Gosport soils. They differ from Grundy and Lagonda soils in having bright mottles in the lower part of the A horizon or some dark gray mottles in the upper part of the B horizon. They do not have the glacial sand and pebbles that are in Armstrong and Gara soils.

SaC—Sampsel silty clay loam, 5 to 9 percent slopes. This soil is on concave side slopes upslope or downslope from Gosport soils.

Included with this soil in mapping are some areas of a soil that is moderately well drained. Also included are a few small areas where glacial pebbles or limestone fragments are in the surface layer, areas of a Sampsel soil that has a thinner surface layer, and several small areas where the slope is greater than 9 percent.

Organic-matter content and natural fertility are high. Runoff is medium. Erosion is the major hazard. Runoff from soils upslope can result in seasonal wet and seepy areas. The main concern of management is controlling erosion, and a minor concern is controlling excess water.

This soil is moderately well suited to cultivated crops and well suited to hay and pasture. Capability unit IIIe-5.

Sharpsburg Series

The Sharpsburg series consists of deep, moderately well drained, gently sloping and moderately sloping soils that formed in moderately deep loess. These soils are on the narrow tops and the sides of ridges. The native vegetation was prairie grasses.

In a representative profile, the surface layer is about 12 inches thick. The upper 9 inches is very dark brown silt loam, and the lower 3 inches is very dark grayish brown light silty clay loam. The firm subsoil is about 48 inches thick. It is, in sequence downward, 10 inches of brown silty clay loam, 9 inches of brown and dark yellowish brown silty clay loam, 6 inches of dark yellowish brown silty clay loam commonly mottled with grayish brown and strong brown, and 23 inches of yellowish brown and grayish brown silty clay loam commonly mottled with strong brown.

Permeability is moderately slow, and the available water capacity is high.

These soils are used mostly for cultivated crops and hay.

Representative profile of Sharpsburg silt loam, 2 to 5 percent slopes, 1,980 feet east and 660 feet north of the southwest corner of sec. 34, T. 57 N., R. 33 W.

Ap—0 to 9 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A3—9 to 12 inches, very dark grayish brown (10YR 3/2) light silty clay loam; moderate, fine, subangular blocky structure; friable; few very thin brown (10YR 4/3) coatings on ped faces; slightly acid; gradual, smooth boundary.

B21t—12 to 22 inches, brown (10YR 4/3) silty clay loam; weak, medium, prismatic and weak, fine, subangular blocky structure; firm; common, thin, very dark grayish brown (10YR 3/2) clay films; medium acid; gradual, smooth boundary.

B22t—22 to 31 inches, brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam; few, fine, distinct, strong brown (7.5YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate, medium, prismatic and weak, fine, subangular blocky structure; firm; common moderately thick clay films; medium acid; gradual, smooth boundary.

B23t—31 to 37 inches, dark yellowish brown (10YR 4/4) silty clay loam; common, medium, faint, grayish brown (2.5Y 5/2) and few, fine, distinct, strong brown (7.5YR 5/6) mottles; moderate, medium, prismatic and weak, fine, subangular blocky structure; firm; few thin clay films; medium acid; gradual, smooth boundary.

B3—37 to 60 inches, yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) silty clay loam; common, medium, distinct, strong brown (7.5YR 5/6 and 7.5YR 5/8) mottles; massive; firm; many fine dark masses; medium acid.

The solum ranges from 40 to 70 inches in thickness. The A horizon is silt loam or light silty clay loam 10 to 18 inches thick. The B2 horizon has a clay content of 36 to 42 percent.

Sharpsburg soils are less gray than Grundy and Lagonda soils and have less clay in the subsoil. They have a thicker A horizon than Ladoga soils and do not have the glacial sand and pebbles that are in Lamoni and Shelby soils.

SbB—Sharpsburg silt loam, 2 to 5 percent slopes. This soil is in long areas on the narrow tops of ridges. It is at slightly lower elevations than Grundy soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Grundy and Lagonda soils.

Organic-matter content and natural fertility are high. Runoff is slow. Erosion is the major hazard and the main

concern of management.

This soil is well suited to cultivated crops and to hay and pasture. Capability unit IIe-1.

ShC—Sharpsburg silt loam, 5 to 9 percent slopes. This soil is in narrow and long areas on the tops and the sides of ridges. It is at slightly lower elevations than the gently sloping Sharpsburg soil.

Included with this soil in mapping are small areas of Lagonda soils and gently sloping Sharpsburg soils.

Organic-matter content and natural fertility are high. Runoff is medium. Erosion is the major hazard and the main concern of management.

This soil is well suited to cultivated crops and to hay and pasture. Capability unit IIIe-1.

Shelby Series

The Shelby series consists of deep, moderately well drained, strongly sloping and moderately steep soils that formed in glacial till in strongly dissected areas. The native vegetation was prairie grasses.

In a representative profile, the surface layer is very dark brown loam about 7 inches thick. The firm subsoil is about 40 inches thick. It is, in sequence downward, 4 inches of very dark grayish brown clay loam, 6 inches of brown clay loam, 7 inches of dark yellowish brown clay loam, and 23 inches of yellowish brown clay loam that has few fine mottles of grayish brown and strong brown. The underlying material to a depth of 80 inches is mottled yellowish brown, strong brown, and grayish brown clay loam.

Permeability is moderately slow, and the available water capacity is high.

These soils are used mostly for hay and pasture.

Representative profile of Shelby loam, 9 to 14 percent slopes, in a pasture 820 feet east and 870 feet south of the northwest corner of sec. 31, T. 59 N., R. 30 W.

Ap—0 to 7 inches, very dark brown (10YR 2/2) heavy loam; weak, fine, granular structure; friable; common fine roots; medium acid; clear, smooth boundary.

B1—7 to 11 inches, very dark grayish brown (10YR 3/2) clay loam; moderate, very fine, subangular blocky structure; friable; common fine roots; medium acid; gradual, smooth boundary.

B21t—11 to 17 inches, brown (10YR 4/3) clay loam; moderate, fine and very fine, subangular blocky structure; firm; few fine roots; common thin clay films; slightly acid; gradual, smooth boundary.

B22t—17 to 24 inches, dark yellowish brown (10YR 4/4) clay loam; moderate, fine, subangular blocky structure; firm; few fine roots; few fine black concretions; common moderately thick clay films; slightly acid; gradual, smooth boundary.

B23t—24 to 34 inches, yellowish brown (10YR 5/4) heavy clay loam; few, fine, faint, grayish brown and yellowish brown mottles; weak, medium and fine, subangular blocky structure; firm; common thin clay films; slightly acid; gradual, smooth boundary.

B3—34 to 47 inches, yellowish brown (10YR 5/4) clay loam; common, fine, faint, grayish brown (10YR 5/2) and few, fine, distinct, strong brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; neutral; gradual, smooth boundary.

C1—47 to 67 inches, yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) clay loam; few, medium, distinct, strong brown (7.5YR 5/6) mottles; massive; firm; few soft carbonate masses; strong effervescence; mildly alkaline; gradual, smooth boundary.

C2—67 to 80 inches, mottled strong brown (7.5YR 5/8), grayish brown (10YR 5/2), and yellowish brown (10YR 5/4) clay loam; massive; firm; few soft carbonate masses; strong effervescence; mildly alkaline.

The Ap horizon is very dark gray, very dark grayish brown, or black loam. The B horizon is 24 to 42 inches thick. Depth to free carbonates ranges from 36 to 60 inches.

Shelby soils are less gray than Lamoni soils and have less clay in the B horizon. They have a thicker A horizon than Armstrong and Gara soils and have sand and pebbles that do not occur in Sharpsburg soils.

ShD—Shelby loam, 9 to 14 percent slopes. This soil is in large, irregularly shaped areas on side slopes adjacent to streams and large drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are several small areas of a severely eroded Shelby soil. Also included are small areas of a soil that has a grayer subsoil than is typical and several small areas of a moderately steep Shelby soil.

Organic-matter content and natural fertility are high. Runoff is medium. The hazard of erosion is severe. The main concern of management is controlling erosion.

This soil is suited to cultivated crops and to hay and pasture. Capability unit IIIe-1.

ShE—Shelby loam, 14 to 20 percent slopes. This soil is in small, irregularly shaped areas on side slopes adjacent to streams and large drainageways.

Included with this soil in mapping are small areas of an eroded Shelby soil and Gara soils. Also included are small areas of a strongly sloping Shelby soil.

Organic-matter content and natural fertility are high. Runoff is rapid. The hazard of erosion is severe. The main concerns of management are controlling erosion and establishing permanent grasses.

This soil is not suited to cultivated crops. It is best suited to pasture. Capability unit IVe-1.

SyD3—Shelby clay loam, 9 to 14 percent slopes, severely eroded. This soil is in irregularly shaped areas on side slopes adjacent to streams and large drainageways. Areas are 10 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but the original surface layer has been removed by erosion and the surface material is now the upper part of the yellowish brown subsoil.

Included with this soil in mapping are small areas of an uneroded Shelby soil. Also included are small areas of a soil that has a grayer subsoil than is typical.

Organic-matter content is low, and natural fertility is medium. Runoff is rapid. The hazard of erosion is severe. The main concerns of management are controlling erosion and maintaining tilth and plant cover.

This soil is suited to cultivated crops, but is best suited to hay and pasture because the hazard of erosion is severe. Capability unit IVe-4.

Vesser Series

The Vesser series consists of deep, somewhat poorly drained, nearly level soils that formed in alluvium eroded from local upland soils. These soils are on bottom land and low stream terraces. They are subject to occasional flooding.

In a representative profile, the surface layer is about 20 inches thick. The upper part is very dark grayish brown silt loam, and the lower part is very dark brown silt loam. The subsurface layer is grayish brown silt loam about 11 inches thick. The subsoil is dark grayish brown light silty clay loam about 13 inches thick. The underlying material to a depth of 70 inches is dark grayish brown light silty clay loam that has common fine mottles of grayish brown and yellowish brown.

Permeability is moderate, and the available water capac-

ity is very high.

These soils are used mostly for cultivated crops. Some small areas are used for pasture and timber.

Representative profile of Vesser silt loam, in wheat stubble and weeds, 990 feet south and 1,320 feet west of the northeast corner of sec. 10, T. 58 N., R. 30 W.

Ap—0 to 11 inches, very dark grayish brown (10YR 3/2) silt loam; weak, very fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

A12—11 to 20 inches, very dark brown (10YR 2/2) silt loam; weak, very fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

A2—20 to 31 inches, grayish brown (10YR 5/2) silt loam; weak, fine, granular structure; friable; thin light gray silt coatings on ped faces; few very fine roots; neutral; gradual, smooth boundary.

B2t—31 to 44 inches, dark grayish brown (10YR 4/2) light silty clay loam; few, fine, faint, dark yellowish brown and grayish brown mottles; weak, very fine, subangular blocky structure; thin, light gray silt and very fine sand coatings on ped faces; friable; medium acid; gradual, smooth boundary.

C—44 to 70 inches, dark grayish brown (10YR 4/2) light silty clay loam; common, fine, faint, grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) mottles; massive; firm; slightly acid.

The A1 horizon is 12 to 20 inches thick and is black to very dark grayish brown. The A2 horizon is 9 to 16 inches thick. The B horizon is 12 to 30 inches thick.

Vesser soils are grayer in the lower part of the solum than Kennebec and Wiota soils and have more clay in the lower part of the solum than Kennebec soils. They have less clay and are less black than Zook soils.

Ve—Vesser silt loam. This nearly level soil is on bottom land and low stream terraces. Slopes are 0 to 1 percent. Areas range from 15 to more than 100 acres in size.

Included with this soil in mapping are small areas of Wiota and Zook soils and several small areas where the surface layer is lighter colored than is typical. Also included are two large areas of a soil that has a light colored surface layer and is poorly drained. One is 1 mile north of Gridley, and the other is 2 miles southwest of Gridley.

Organic-matter content and natural fertility are high. Runoff is very slow. Wetness and occasional flooding during the growing season are the main hazards. A minor concern of management is surface drainage.

This soil is well suited to cultivated crops and to pasture and timber. Capability unit IIw-1.

Wiota Series

The Wiota series consists of deep, well drained, nearly level soils that formed in silty alluvium eroded from local upland soils. These soils are on bottom land and low stream terraces.

In a representative profile, the surface layer is about 29 inches thick. The upper 8 inches is very dark grayish brown silt loam; the next 15 inches is very dark grayish brown silty clay loam; and the lower 6 inches is very dark grayish brown and brown silty clay loam. The subsoil is about 21 inches thick. The upper 14 inches is brown silty clay loam, and the lower 7 inches is brown silt loam. The underlying material to a depth of 68 inches is brown light silty clay loam.

Permeability is moderate, and the available water capacity is very high.

These soils are used mostly for cultivated crops.

Representative profile of Wiota silt loam, in a cultivated field 530 feet east and 500 feet south of the center of sec. 12, T. 59 N., R. 30 W.

Ap—0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam; weak, very fine, granular structure; friable; common fine roots; neutral; clear, smooth boundary.

A12—8 to 16 inches, very dark grayish brown (10YR 3/2) light silty clay loam; weak, fine, granular structure; friable; common fine roots; slightly acid; gradual, smooth boundary.

A13—16 to 23 inches, very dark grayish brown (10YR 3/2) light silty clay loam; moderate, fine, subangular blocky structure; friable; few fine roots; strongly acid; gradual, smooth boundary.

A3—23 to 29 inches, brown (10YR 4/3) and very dark grayish brown (10YR 3/2) silty clay loam; weak, fine, subangular blocky structure; friable; few fine roots; medium acid; gradual, smooth boundary.

B21—29 to 43 inches, brown (10YR 4/3) silty clay loam; few, fine, faint, dark yellowish brown mottles; weak, fine, subangular blocky structure; friable; medium acid; gradual, smooth boundary.

B3—43 to 50 inches, brown (10YR 4/3) heavy silt loam; weak, very fine, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

C—50 to 68 inches, brown (10YR 4/3) light silty clay loam; common, fine, faint, dark yellowish brown (10YR 4/4) mottles; massive; friable; medium acid.

The A horizon is 15 to 30 inches thick. The B horizon is brown or dark yellowish brown silt loam or light silty clay loam.

Wiota soils are less gray in the B horizon than Vesser soils and have more clay and a thinner A horizon than Kennebec soils. They have less clay and are less black than Zook soils.

Wo—Wiota silt loam. This nearly level soil is in irregularly shaped areas on bottom land and low stream terraces. Slopes are 0 to 1 percent. Areas are from 15 to more than 100 acres in size.

Included with this soil in mapping are small areas of Vesser soils. Also included are several large areas of a Kennebec soil (fig. 8) that is subject to occasional flooding and small areas on terrace escarpments where the slope is as much as 3 percent.

Organic-matter content and natural fertility are high. This soil has no inherent limitation, but it is subject to occasional flooding during the growing season.

This soil is well suited to cultivated crops and to pasture and hay. Capability unit I-1.

Zook Series

The Zook series consists of deep, poorly drained, nearly level soils that formed in fine textured alluvium eroded from local upland soils. These soils are on bottom land. They are subject to occasional flooding.

In a representative profile, the surface layer is black silty clay loam about 36 inches thick. The underlying material to a depth of 84 inches is silty clay loam. The upper 28 inches is very dark gray, and the lower 20 inches is dark gray.

Permeability is slow, and the available water capacity is moderate. Organic-matter content is high.

These soils are used for cultivated crops and for hay and pasture.

Representative profile of Zook silty clay loam, in a bluegrass pasture 260 feet north and 990 feet east of the southwest corner of sec. 20, T. 59 N., R. 32 W.

A11—0 to 10 inches, black (10YR 2/1) silty clay loam; weak, very fine, subangular blocky structure; friable; common fine roots; slightly acid; clear, smooth boundary.

A12—10 to 18 inches, black (N 2/0) silty clay loam; moderate, very fine and fine, subangular blocky structure; firm; few fine roots; neutral; gradual, smooth boundary.

A13—18 to 36 inches, black (N 2/0) silty clay loam; moderate, very fine and fine, subangular blocky structure; firm; few fine roots; neutral; gradual, smooth boundary.

Clg—36 to 64 inches, very dark gray (N 3/0) silty clay loam; weak,

Figure 8.—Corn on a Kennebec soil that is subject to occasional flooding.

medium, blocky structure; firm; few fine concretions; neutral; diffuse, smooth boundary.

C2g—64 to 84 inches, dark gray (N 4/0) silty clay loam; few, fine, faint, dark yellowish brown mottles; massive; firm; neutral.

The A horizon is silty clay loam or light silty clay 30 to 40 inches thick. The C horizon is very dark gray, dark gray, or grayish brown silty clay loam or light silty clay.

Zook soils have more clay than Kennebec, Vesser, and Wiota soils and are blacker than Vesser and Wiota soils.

Zo—Zook silty clay loam. This nearly level soil is on small and large bottom lands and along drainageways. Slopes are 0 to 1 percent. Areas on the small bottom lands and the drainageways are narrow, long, and irregularly shaped. Some are more than a mile in length. On the large bottom lands the soil is more nearly level and is ponded in many small areas. This soil has the profile described as representative of the series.

Included with this soil in mapping are several small areas where the surface layer is loam or clay loam and small areas of Kennebec soils and other well drained and moderately well drained silty soils. Also included on the small bottom lands and the drainageways adjacent to the upland are many small areas where the slope is as much as 3 percent.

Organic-matter content and natural fertility are high. The main hazards on the small bottom lands are wetness and ditchbank erosion and the main concerns of management are diversion of hill water, control of ditchbanks, and inaccessibility. The main concerns of management on the large bottom lands are surface drainage and flood control.

This soil is suited to cultivated crops and to hay and pasture. Many of the long, narrow, and irregularly shaped areas are best suited to pasture. Capability unit IIw-2.

Zs—Zook silty clay. This nearly level to slightly depressional soil is on the flood plains of streams. Slopes are 0 to 1 percent. Areas are from 20 to more than 100 acres in size. This soil has a profile similar to that described as representative of the series, but the surface layer differs in texture.

Included with this soil in mapping are small areas of Zook silty clay loam.

Organic-matter content and natural fertility are high. Runoff is very slow or is ponded. Wetness and occasional flooding during the growing season are the main hazards. The main concerns of management are surface drainage (fig. 9) and flood control.

This soil is best suited to corn and soybeans. Capability unit IIIw-14.

Use and Management of the Soils

This section explains the system of capability classification used by the Soil Conservation Service and describes

Figure 9.—Wheat on Zook silty clay. Most areas of this soil require surface drainage.

the management of the soils by capability units. It also shows the predicted average yields per acre of the principal crops grown in the county and suggests the management of the soils for woodland, wildlife, recreation, and engineering.

Cultivated Crops and Pasture[2]

About 27 percent of DeKalb County is in cultivated crops, mainly corn, soybeans, sorghum, and wheat. Another 32 percent is in rotation pasture that is used occasionally for cultivated crops (*6*).

The main considerations in managing cultivated soils are controlling erosion on the uplands and providing surface drainage and flood control on the bottom land.

Many areas in DeKalb County have been damaged to a moderate or severe degree by erosion. Many on bottom land are low lying and marshy or occur as narrow bands along brushy, meandering streams. Watershed protection, which includes control of erosion, flooding, and drainage, is essential for maximum yields on bottom land and along small drainageways.

Measures that help to control erosion are contour farming, terraces, waterways, and management of crop residue. Controlled grazing helps to maintain vegetative cover and control erosion. Drainage ditches and land leveling help to drain off excess water on the wet bottom land soils. Diversion terraces can be used to protect some areas from upland runoff. Generally, a combination of measures is used.

Measures that help to maintain fertility are the application of chemical fertilizer and green manure and the inclusion in the cropping system of cover crops, grasses, and legumes. Control of erosion helps to conserve fertility.

Fertilizer applications should be determined by testing the soil.

The following pages explain the system of capability grouping used by the Soil Conservation Service, describe the soils in each capability unit, and suggest suitable management for these soils.

Capability grouping

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

Those familiar with the capability classification can

[2] CARL H. PIERCE, district conservationist, Soil Conservation Service, helped prepare this section.

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

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

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode, but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife. (None in DeKalb County.)

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

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

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

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-5 or IIIe-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Capability unit numbers generally are assigned locally, but are a part of a statewide system. All of the units in the system are not represented by the soils of DeKalb County; therefore, the capability unit numbers in this soil survey are not consecutive.

The following paragraphs describe the capability units in DeKalb County and suggest the use and management of the soils.

CAPABILITY UNIT I-1

The one soil in this unit, Wiota silt loam, is a deep, well drained, nearly level soil on bottom land. It has a medium textured surface layer and a medium textured subsoil.

Organic-matter content and natural fertility are high. The available water capacity is very high, and permeability is moderate. Runoff is slow. Flooding during the growing season, the only hazard, occasionally occurs in some low-lying areas, but damage to crops is minor. The major management practices required are those that maintain organic-matter content and improve and maintain fertility and soil tilth. Land grading in undulating areas and drainage of old channels help to improve field surface drainage.

This soil is well suited to corn, soybeans, small grain, and alfalfa. It is also well suited to hardwoods. It is generally used for row crops, except in small inaccessible areas. Minimum tillage, management of crop residue, and green manure crops help to improve and maintain organic-matter content and soil tilth.

CAPABILITY UNIT IIe-1

This unit consists of deep, moderately well drained, gently sloping soils on uplands. These soils have a medium textured surface layer and a moderately fine textured or fine textured subsoil.

Natural fertility is high, and organic-matter content is moderate to high. The available water capacity is high, and permeability is moderately slow. Runoff is slow. Erosion is the major hazard. The major management practices required are those that improve and maintain organic-matter content, soil tilth, and fertility and those that control erosion.

These soils are well suited to corn, soybeans, small grain, and alfalfa. In areas where the level of organic matter is only moderate, the soils are also well suited to hardwoods and conifers. Contour farming, winter cover crops, terraces, and grass waterways help to control erosion. Minimum tillage and management of crop residue also help to control erosion and to maintain organic-matter content, fertility, and good soil tilth.

CAPABILITY UNIT IIe-5

This unit consists of deep, somewhat poorly drained, gently sloping soils on uplands. These soils have a medium textured surface layer and a moderately fine textured or fine textured subsoil.

Natural fertility and organic-matter content are high. The available water capacity is high, and permeability is slow. Runoff is slow. Erosion is the major hazard. The

major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

These soils are well suited to corn, soybeans, small grain, pasture, and hay. Contour farming, winter cover crops, terraces, and grass waterways help to control erosion. Minimum tillage and management of crop residue also help to control erosion and to maintain organic-matter content, fertility, and good soil tilth.

CAPABILITY UNIT IIw-1

The one soil in this unit, Vesser silt loam, is a deep, somewhat poorly drained, nearly level soil on bottom land. It has a medium textured surface layer and a moderately fine textured subsoil.

Organic-matter content and natural fertility are high. The available water capacity is very high, and permeability is moderate. Runoff is very slow. Wetness, a result of moderate permeability and flooding, is the major hazard. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that improve surface drainage and control flooding.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Minimum tillage and management of crop residue help to improve and maintain organic-matter content, fertility, and soil tilth. Land grading helps to improve surface drainage. Some drainage ditches may also be needed.

CAPABILITY UNIT IIw-2

The one soil in this unit, Zook silty clay loam, is a poorly drained, nearly level soil on bottom land. It has a black, moderately fine textured surface layer and a moderately fine textured subsoil.

Organic-matter content and natural fertility are high. The available water capacity is moderate, and permeability is slow. Runoff is slow to very slow. Wetness is a major hazard. Ditchbank erosion and runoff from uplands are hazards on the narrow bottom land. Occasional flooding is a hazard on the large bottom land. The major management practices required are those that improve surface drainage and soil tilth and those that control ditchbank erosion.

This soil is suited to corn and soybeans. Management of crop residue and deep tillage in the fall help to improve tilth and internal drainage. Land grading helps to improve surface drainage. Drainage ditches may also be needed. Runoff from uplands can be diverted from the narrow bottom lands.

CAPABILITY UNIT IIw-4

The one soil in this unit, Kennebec silt loam, is a deep, moderately well drained, nearly level soil on bottom land. It has a medium textured surface layer and a medium textured subsurface layer.

Natural fertility and organic-matter content are high. The available water capacity is very high, and permeability is moderate. Runoff is slow. Flooding during the growing season, the only hazard, occasionally occurs, but damage to crops is minor in most years. The major management practices required are those that control flooding, improve fertility, and maintain organic-matter content and soil tilth. Land grading in undulating areas and filling old channels help to improve field surface drainage.

This soil is well suited to corn, soybeans, small grain, and alfalfa. It is also well suited to hardwoods. It is generally used for row crops, except in small inaccessible areas. Minimum tillage, management of crop residue, and green manure crops help to improve and maintain organic-matter content and soil tilth.

CAPABILITY UNIT IIIe-1

This unit consists of deep, moderately well drained, moderately sloping to strongly sloping soils on uplands. These soils have a medium textured surface layer and a moderately fine textured subsoil.

Organic-matter content is moderate to high, and natural fertility is high. The available water capacity is high, and permeability is moderately slow. Runoff is medium. Erosion is the major hazard. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

These soils are moderately well suited to corn and soybeans and well suited to alfalfa and small grain. In areas where the level of organic matter is only moderate, the soils are also well suited to hardwoods and conifers. Contour farming, winter cover crops, terraces, and grass waterways help to control erosion. Minimum tillage and management of crop residue also help to control erosion and to maintain organic-matter content, fertility, and good soil tilth. Unless erosion control measures are adequate, a rotation of mainly small grain, grasses, and legumes is needed.

CAPABILITY UNIT IIIe-5

This unit consists of deep, somewhat poorly drained, gently sloping to moderately sloping soils on uplands. These soils have a medium textured and moderately fine textured surface layer and a fine textured subsoil.

Organic-matter content is moderate to high, and natural fertility is medium to high. The available water capacity is moderate to high, and permeability is slow. Runoff is medium. Erosion is the major hazard. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

These soils are moderately well suited to corn and soybeans and well suited to small grain, hay, and pasture. Minimum tillage (fig. 10), contour farming, terraces, and grass waterways (fig. 11) help to control erosion and runoff. Management of crop residue and minimum tillage help to improve organic-matter content and soil tilth. Unless erosion control measures are adequate, a rotation of mainly small grain, grasses, and legumes is needed.

CAPABILITY UNIT IIIw-14

The one soil in this unit, Zook silty clay, is a deep, poorly drained, nearly level soil on bottom land. It has a fine textured surface layer and a fine textured subsoil.

Organic-matter content and natural fertility are high. The available water capacity is moderate, and permeability is slow. Runoff is very slow. Wetness, occasional flooding, and poor soil tilth are the major hazards. This soil is plastic when wet and hard when dry. The moisture range within which this soil can be tilled is narrow. The major management practices required are those that improve fertility, soil tilth, and surface drainage and those that

Figure 10.—Corn stubble after no-till planting on Lagonda silt loam, 5 to 9 percent slopes. The yield is 150 bushels per acre.

control flooding.

This soil is best suited to soybeans and corn. Short-season summer crops are least likely to be damaged by wetness and flooding. Deep fall plowing helps to improve soil tilth. Land grading helps to improve surface drainage. Drainage ditches may also be needed.

CAPABILITY UNIT IVe-1

This unit consists of deep, moderately well drained, strongly sloping to moderately steep soils on uplands. These soils have a medium textured surface layer and a moderately fine textured subsoil.

Organic-matter content is moderate to high, and natural fertility is medium to high. The available water capacity is high, and permeability is moderately slow. Runoff is medium to rapid. Erosion is the major hazard. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

These soils are not well suited to row crops because the slope is steep. They are well suited to small grain, alfalfa, and pasture. Minimum tillage, contour farming, terraces, and grass waterways help to control erosion and runoff. Management of crop residue and minimum tillage help to improve organic-matter content and soil tilth. If erosion control measures are adequate, corn and soybeans can be grown in a rotation with small grain, grasses, and legumes.

CAPABILITY UNIT IVe-4

The one soil in this unit, Shelby clay loam, 9 to 14 percent slopes, severely eroded, is a deep, moderately well drained soil on uplands. It has a moderately fine textured surface layer and a moderately fine textured subsoil.

Organic-matter content is low, and natural fertility is medium. The available water capacity is high, and permeability is moderately slow. Runoff is rapid. Erosion and poor soil tilth are major hazards. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

This soil is suited to small grain, hay, and pasture. Small inaccessible areas can be used for wildlife habitat. Minimum tillage on the contour and grass waterways help to control erosion and runoff. Fertilization of seedings and periodic topdressing are needed to provide the necessary plant growth for good continuous cover. Overgrazing should be avoided. Small areas within fields planted to row crops should be seeded to grass and left idle or used for hay.

CAPABILITY UNIT IVe-8

This unit consists of somewhat poorly drained and poorly drained, eroded and severely eroded, moderately sloping soils on uplands. These soils have a moderately fine textured or fine textured surface layer and a moderately

Figure 11.—Good grass waterway on Lamoni clay loam, 5 to 9 percent slopes, eroded.

fine textured and fine textured subsoil.

Organic-matter content is low to moderate, and natural fertility is low to medium. The available water capacity is low to moderate, and permeability is slow to very slow. Runoff is medium to rapid. Erosion and poor soil tilth are the major hazards. The major management practices required are those that improve and maintain organic-matter content, fertility, and soil tilth and those that control erosion.

These soils are best suited to small grain and pasture. In small areas they can be used for wildlife habitat. Minimum tillage on the contour and grass waterways help to control erosion and runoff. Fertilization of seedings and periodic topdressing are needed to provide the necessary plant growth for good continuous cover. Overgrazing should be avoided. Small areas within fields used more intensively for row crops (fig. 12) should be seeded to grass and left idle or used for hay.

CAPABILITY UNIT VIe-1

The one soil in this unit, Gara loam, 14 to 20 percent slopes, is a deep, moderately well drained, moderately steep soil on uplands. It has a medium textured surface layer and a moderately fine textured subsoil.

Organic-matter content is moderate, and natural fertility is medium. The available water capacity is high, and permeability is moderately slow. Runoff is rapid. Erosion is the major hazard. The major management practices required are those that improve and maintain organic-matter content and fertility and those that control erosion.

This soil is not suited to row crops because the slope is steep. It is best suited to hay and pasture. If reseeding is necessary, minimum tillage on the contour helps to control erosion and runoff. Overgrazing should be avoided.

CAPABILITY UNIT VIIs-7

The only soils in this unit are in the Gosport complex, 14 to 30 percent slopes. These are moderately deep or shallow, rocky soils on uplands. They have a moderately fine textured surface layer and a fine textured subsoil.

Organic-matter content is moderate, and natural fertility is low. The available water capacity is low, and permeability is moderately slow. Runoff is rapid. Erosion and droughtiness are the major hazards. Tillage of any kind is difficult because of shallow, rocky areas and rock outcrops. The major management requirement is maintaining good continuous cover to control erosion.

These soils are best suited to timber and wildlife habitat. In some small areas they can be seeded to grass or to wildlife food plots, which can also be planted on the better adjacent soils. Minimum tillage and applications of fertilizer should be used when preparing seedbeds. Timber stands can be thinned for the best selected trees, or new stands can be established under proper management. Wooded areas should be protected from fire and grazing if used for timber production.

Predicted yields

Table 2 lists, for each mapping unit in DeKalb County, the predicted average yield per acre of principal crops

Figure 12.—**Soybeans on Lamoni soils, 5 to 9 percent slopes, severely eroded. The field has been terraced and planted on the contour.**

TABLE 2.—*Estimated average yields per acre of principal crops under two levels of management*

[Figures in columns A are yields to be expected under ordinary management; those in columns B, under improved management. Dashes indicate that the crop is not ordinarily grown on the soil]

Soil	Corn		Soybeans		Wheat		Alfalfa hay		Pasture	
	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*Aum*[1]	*Aum*
Armstrong loam, 5 to 9 percent slopes	41	68	14	24	16	27	2.1	3.0	4.3	6.1
Armstrong clay loam, 5 to 9 percent slopes, severely eroded	29	58	10	20	12	24	1.6	2.6	3.2	5.3
Clarinda silty clay loam, 5 to 9 percent slopes, eroded	30	50	10	17	13	21	1.7	2.4	3.8	4.7
Gara loam, 9 to 14 percent slopes	44	74	16	27	19	31	2.4	3.4	4.7	6.7
Gara loam, 14 to 20 percent slopes							1.9	2.7	3.9	5.5
Gosport complex, 14 to 30 percent slopes							1.1	1.9	2.3	3.9
Grundy silt loam, 1 to 5 percent slopes	74	98	28	37	31	41	3.5	4.4	7.0	8.7
Grundy silty clay loam, 2 to 5 percent slopes, eroded	71	94	26	35	29	39	3.4	4.2	6.7	8.4
Kennebec silt loam	89	118	34	45	37	49	4.1	5.1	8.2	10.2
Ladoga silt loam, 2 to 5 percent slopes	68	91	26	34	29	38	3.3	4.1	6.5	8.1
Ladoga silt loam, 5 to 9 percent slopes, eroded	59	79	22	29	25	33	2.8	3.5	5.7	7.1
Lagonda silt loam, 2 to 5 percent slopes	71	94	26	35	29	39	3.4	4.2	6.7	8.4
Lagonda silt loam, 5 to 9 percent slopes, eroded	56	74	20	27	23	31	2.7	3.4	5.4	6.7
Lamoni clay loam, 4 to 7 percent slopes	58	77	21	28	24	32	2.8	3.5	5.5	6.9
Lamoni clay loam, 5 to 9 percent slopes, eroded	54	72	20	26	23	30	2.6	3.3	5.3	6.6
Lamoni soils, 5 to 9 percent slopes, severely eroded	41	68	14	24	16	27	2.1	3.0	4.3	6.1
Sampsel silty clay loam, 5 to 9 percent slopes	62	82	23	30	26	34	2.9	3.6	5.8	7.2
Sharpsburg silt loam, 2 to 5 percent slopes	76	101	29	38	32	42	3.6	4.5	7.1	8.9
Sharpsburg silt loam, 5 to 9 percent slopes	71	94	26	35	29	39	3.4	4.2	6.7	8.4
Shelby loam, 9 to 14 percent slopes	65	86	24	32	27	36	3.0	3.8	6.1	7.6
Shelby loam, 14 to 20 percent slopes	59	78	22	29	24	32	2.8	3.5	5.6	7.0

TABLE 2.—*Estimated average yields per acre of principal crops under two levels of management*—Continued

Soil	Corn		Soybeans		Wheat		Alfalfa hay		Pasture	
	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*Aum* [1]	*Aum*
Shelby clay loam, 9 to 14 percent slopes, severely eroded	46	77	17	28	19	32	2.5	3.5	4.8	6.9
Vesser silt loam	72	96	27	36	30	40	3.4	4.3	6.9	8.6
Wiota silt loam	83	110	32	42	35	46	3.9	4.9	7.8	9.8
Zook silty clay loam	68	91	26	34	29	38	3.3	4.1	6.5	8.1
Zook silty clay	54	72	20	26	23	30	2.6	3.3	5.3	6.6

[1] Animal-unit-month, a term expressing the number of months one animal unit can graze 1 acre without injury to the pasture. An animal unit is one cow or steer, five hogs, or seven sheep.

under two levels of management. Estimates are based on the observations of the soil scientists who made the survey, along with information obtained from local farmers, professional agronomists, public and private agencies, demonstration plots, and research data.

Management practices, weather conditions, plant diseases, and insect infestations vary from year to year and place to place. Differences in any of these factors, especially droughts during summer, cause great fluctuations in crop yields. Crop damage can be locally heavy as a result of wind, hail, torrential rains, or flooding.

Column A in table 2 shows the yields that can be expected, over a period of years, under the management most commonly used by farmers growing the crop. Crops are generally planted according to field boundaries. Only a small acreage is terraced, and not all the fields are contour cultivated. Wet areas are naturally drained, but artificial drainage is generally needed. Lime and fertilizer

Figure 13.—Walnut trees on Kennebec silt loam.

are regularly used, but only about half the amount shown to be needed by soil tests is applied. Some farm operations are not timely.

Column B shows the predicted yields under the improved management used by some farmers in the county. A systematic cropping plan consistent with the capability of the soils is followed. Sloping upland is terraced, and most slopes of more than 2 percent are farmed on the contour. Adequate drainage is installed as needed. Suitable high-yielding varieties of crops are planted. Lime and fertilizer are regularly applied according to soil tests. Considerable attention is given to new methods of weed control and crop residue management. All farm operations are timely.

The yields in table 2 are approximate figures and are intended to serve as guides. Many users will consider the comparative yields among soils to be of more value than the actual yields. These relationships are likely to remain constant over a period of years.

Wood Crops[3]

In 1967 about 27,600 acres, or 10 percent of the land area, in DeKalb County was used for growing trees (*5*). The wooded tracts are small, and about two-thirds of the acreage, or 19,500 acres, is grazed. On about 18,600 of these grazed acres, the grazing should be reduced or eliminated because the most suitable land use is timber production. The 1969 Census of Agriculture indicates that 21 farms in DeKalb County reported sales of wood products totaling $17,831, which is further evidence of the potential of the wooded acres (fig. 13) in the county.

To assist the land manager in utilizing the soils for timber production, the major soils on which timber is being grown have been rated according to their potential productivity. In table 3 these soils have been assigned to woodland suitability groups (*3,4*). Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management if the vegetation on them is similar, and that have about the same potential productivity.

Each woodland suitability group is identified by a three-part symbol, such as 2o4, 4c7, and 5w6. The first part of the symbol, a number, indicates the relative productivity of the soils in the group: *1* means very high; *2*, high; *3*, moderately high; *4*, moderate; and *5*, low. These ratings are based on site index. In this survey site index is the height, in feet, that the dominant trees of a given species will reach in an unmanaged stand in 50 years. Site indexes for this survey were estimated.

The second part of the symbol identifying a woodland group, a small letter, indicates an important soil property that imposes a slight to severe hazard or limitation in managing the soils of the group for wood crops. The letter *w* shows that water in or on the soil, either seasonally or year round, is the chief limitation; *d*, that rooting depth is restricted by hard rock, a hardpan, or other impervious layers; *c*, that the kind or amount of clay in the upper part of the soil is a restriction; and *o*, that the soils have few limitations that restrict their use for trees.

The third part of the symbol indicates the degree of hazard or limitation and the general suitability of the soils for certain kinds of trees.

The numeral *1* indicates soils that have no or only slight limitations and that are best suited to coniferous species.

The numeral *2* indicates soils that have one or more moderate limitations and are best suited to coniferous species.

The numeral *3* indicates soils that have one or more severe limitations and are best suited to coniferous species.

The numeral *4* indicates soils that have no or only slight limitations and are best suited to deciduous species.

The numeral *5* indicates soils that have one or more moderate limitations and are best suited to deciduous species.

The numeral *6* indicates soils that have one or more severe limitations and are best suited to deciduous species.

The numeral *7* indicates soils that have no or only slight limitations and are best suited to either coniferous or deciduous species.

The numeral *8* indicates soils that have one or more moderate limitations and are best suited to either coniferous or deciduous species.

The numeral *9* indicates soils that have one or more severe limitations and are best suited to either coniferous or deciduous species.

The hazards or limitations that affect management of soils for woodland are seedling mortality, erosion hazard, windthrow hazard, plant competition, and equipment limitations. These hazards or limitations are rated for each woodland suitability group in table 3 and are briefly described in the following paragraphs.

Seedling mortality refers to the expected degree of mortality of naturally occurring or planted seedlings, as influenced by soil texture, soil depth, drainage, flooding, depth to the water table, and degree of erosion. Mortality is *slight* if the expected loss is less than 25 percent; *moderate* if 25 to 50 percent; and *severe* if more than 50 percent.

Erosion hazard is rated according to the risk of erosion on woodland where normal practices are used in managing and harvesting trees. It is *slight* if erosion control is not an important concern; *moderate* if some attention must be given to reduce soil losses; and *severe* if intensive and generally expensive measures must be taken to control erosion.

Windthrow hazard indicates the danger of trees being blown over by commonly occurring high winds. Tornadoes are not considered in the ratings. The hazard is *slight* if windthrow is no special concern. It is *moderate* if roots hold the trees firmly, except when the soil is excessively wet or when the wind is strongest.

Plant competition expected from other plants is rated as slight, moderate, or severe. A rating of *slight* means that competition from other plants is no special concern. A rating of *moderate* means that plant competition occurs but generally does not prevent an adequate stand from becoming established. A rating of *severe* means that plant competition prevents trees from restocking naturally.

Equipment limitations are rated on the basis of the degree that soils and topographic features restrict or prohibit the use of equipment normally employed in tending a crop of trees. The limitation is *slight* if there is little or no restriction of the type of equipment that can be used or the

[3] FRANCIS T. HOLT, forester, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Woodland*

Woodland suitability groups and map symbols	Potential productivity			Management
	Species	Estimated site index [1]	Annual growth rate [2]	Seedling mortality
			Board feet per acre	
Group 2o4: Well drained and moderately well drained soils on bottom land; high productivity potential; suited to hardwoods. Kennebec: Ke. Wiota: Wo.	Upland oak	79	320	Slight
Group 3o8: Moderately well drained soils on uplands; moderately high productivity potential; suited to hardwoods or conifers. Ladoga: LaB, LaC2.	Upland oak	70	320	Slight
Group 4c7: Somewhat poorly drained soils on uplands; low productivity potential; suited to hardwoods or conifers. Armstrong: AmC, ArC3. Lamoni: LmC, LmC2, LnC3. Sampsel: SaC.	Upland oak	55	130	Slight
Group 4c9: Moderately deep, well drained soils on uplands; moderate productivity potential; suited to hardwoods or conifers. Gosport variant: GdE.	Upland oak	55	100	Moderate
Group 4o4: Moderately well drained soils on uplands; moderate productivity potential; suited to hardwoods. Gara: GaD, GaE.	Upland oak	55	160	Slight
Group 5o7: Somewhat poorly drained soils on bottom land; low productivity potential; suited to hardwoods or conifers. Vesser: Ve.	Pin oak	50	130	Slight
Group 5w6: Poorly drained soils on bottom land; low productivity potential; suited to hardwoods. Zook: Zo, Zs.	Pin oak	50	130	Moderate on Zo; severe on Zs.

[1] Site index is the height, in feet, that the dominant trees of a specified species will reach in an unmanaged stand in 50 years.

time or year that equipment can be used. It is *moderate* if the use of equipment is seasonally limited or if modified equipment or methods of harvesting are needed. The limitation is *severe* if special equipment is needed or if the use of such equipment is severely restricted by one or more unfavorable soil characteristics, such as drainage, slope, number or size of stones, and soil texture.

Trees and Shrubs[4]

This section gives information about some of the trees, shrubs, and other plants used in landscaping sites for homes, schools, industrial structures, and recreational areas. In planning, consideration should be given to wind protection, cover for critical areas, screening of unsightly areas, wildlife food and cover, and the general beauty of neighborhoods.

Trees and shrubs of different species vary widely in suitability to different soils and site conditions. In table 4 the soils are assigned to tree and shrub groups mainly on the basis of the degree of wetness resulting from a seasonal high water table and the available water capacity.

Soils in a specific group have similar suitability for trees and shrubs and can be identified by referring to the "Guide to Mapping Units" at the back of this survey.

[4] FRANCIS T. HOLT, forester, Soil Conservation Service, helped prepare this section.

Table 4 lists, by five tree and shrub groups, plants suitable for specified uses. This listing assists land users in planning for environmental improvement. This table also lists some trees that grow naturally on soils in each of the five groups and that may be retained when an area is developed for more intensive use. The table gives only a partial listing of plants suited to soils in the county. Many plants can be used both in landscaping and in providing food and cover for wildlife. If more detail is needed and pertinent landscaping plans are desired, landowners and others should contact local landscape specialists.

Tree and shrub groups generally are assigned locally, but are part of a statewide system. All of the groups in the system are not represented by the soils of DeKalb County; therefore the group numbers in table 4 are not consecutive.

Wildlife

The soils and climate of DeKalb County, along with native and domestic plant suitability, offer several favorable features for developing wildlife habitat. Many areas which are now in crops or timber have high potential for various kinds of wildlife through the development of good wildlife habitat.

The quality of cover can be improved throughout the county by planting hedgerows and field borders, excluding livestock, establishing field windbreaks, planting cover crops, using conservation cropping systems, planting trees,

management and productivity

Management—*Continued*				Species to be favored—	
Erosion hazard	Windthrow hazard	Plant competition	Equipment limitations	In existing stands	For planting
Slight	Slight	Slight	Slight	Upland oak	Green ash, black walnut, yellow-poplar, hackberry, black cherry.
Slight	Slight	Moderate	Slight	Upland oak	Green ash, black walnut, yellow-poplar, hackberry, shortleaf pine, red pine.
Slight	Slight	Slight	Slight	Upland oak	Yellow-poplar, sweetgum, shortleaf pine, green ash.
Moderate	Slight	Slight	Severe	Upland oak	Hackberry, shortleaf pine, eastern redcedar, black walnut.[3]
Slight if slope is 9 to 14 percent; moderate if more than 14 percent.	Slight	Slight	Slight if slope is 9 to 14 percent; moderate if more than 14 percent.	Upland oak	Green ash, hackberry, black walnut.[3]
Slight	Slight	Slight	Slight	Pin oak	Black oak, green ash, pin oak, silver maple.
Slight	Moderate	Severe	Severe	Pin oak	Pin oak, white oak, black oak, American basswood.

[2] Doyle rule. [3] Black walnut should be planted only on selected sites.

TABLE 4.—*Trees and shrubs suitable for environmental improvement*

Trees and shrub groups and map symbols	Trees to retain at homesites and parks	Plantings for beauty and shade	Plantings that attract songbirds and wildlife	Plantings for critical areas [1]	Plantings for windbreaks, screens, and sound barriers
Group 2: Moderately deep, moderately steep to steep, well drained soils; low available water capacity; sometimes droughty in summer; water table below a depth of 6 feet. Gosport variant: GdE	Bur oak, white oak.	American cranberrybush, American sycamore, Amur honeysuckle, Amur maple, Austrian pine, autumn-olive, black oak, bur oak, Carolina laurelcherry, coralberry, eastern redbud, English yew, flowering dogwood, fragrant sumac, Japanese yew, lilac, mallow ninebark, mockorange, Nanking cherry, persimmon, red pine, rose-of-Sharon, Siberian elm, silky dogwood, spreading cotoneaster, sugar maple, Tartarian honeysuckle, white ash, white oak, winged euonymous, yellow-poplar.	American cranberrybush, American hazel, American plum, Amur honeysuckle, Austrian pine, autumn-olive, boxelder, bur oak, Carolina laurelcherry, coralberry, crabapple, eastern redcedar, English yew, flowering dogwood, fragrant sumac, Japanese yew, multiflora rose, Nanking cherry, persimmon, red pine, shrub lespedeza, silky dogwood, spreading cotoneaster, Tartarian honeysuckle, winged euonymous.	American hazel, American sycamore, Amur honeysuckle, Austrian pine, autumn-olive, coralberry, eastern redcedar, English yew, fragrant sumac, Japanese yew, mallow ninebark, multiflora rose, shrub lespedeza, Tartarian honeysuckle.	Ailanthus, American cranberrybush, American plum, Amur honeysuckle, Amur maple, Austrian pine, autumn-olive, boxelder, crabapple, eastern redcedar, lilac, mallow ninebark, mockorange, multiflora rose, Nanking cherry, osageorange, red pine, rose-of-Sharon, Siberian elm, Tartarian honeysuckle, winged euonymous.

TABLE 4.—*Trees and shrubs suitable for environmental improvement*—Continued

Tree and shrub groups and map symbols	Trees to retain at homesites and parks	Plantings for beauty and shade	Plantings that attract songbirds and wildlife	Plantings for critical areas [1]	Plantings for windbreaks, screens, and sound barriers
Group 4: Deep, moderately sloping to steep, moderately well drained soils; high available water capacity; water table below a depth of 6 feet most of the year. Gara: GaD, GaE Ladoga: LaC2 Sharpsburg: SbC Shelby: ShD, ShE, SyD3.	Bur oak, white oak.	Ailanthus, alternateleaf dogwood, American basswood, American sycamore, Amur honeysuckle, Amur maple, Amur privet, Austrian pine, autumn-olive, black cherry, black locust, black oak, black walnut, bur oak, coralberry, eastern cottonwood, eastern redbud, eastern white pine, English yew, flowering dogwood, fragrant sumac, green ash, hackberry, hawthorn, Japanese yew, lilac, Lombardy poplar, mallow ninebark, mockorange, Nanking cherry, Norway maple, Norway spruce, Ohio buckeye, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, rose-of-Sharon, Siberian elm, silky dogwood, silver buffaloberry, silver maple, spreading cotoneaster, sugar maple, Tartarian honeysuckle, white ash, white oak, winged euonymous, yellow-poplar.	Alternateleaf dogwood, American basswood, American hazel, American plum, Amur honeysuckle, Amur privet, Austrian pine, autumn-olive, black cherry, black walnut, bur oak, coralberry, crabapple, eastern redcedar, eastern white pine, English yew, flowering dogwood, fragrant sumac, Japanese yew, multiflora rose, Nanking cherry, Norway spruce, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, shrub lespedeza, silky dogwood, silver buffaloberry, spreading cotoneaster, Tartarian honeysuckle, winged euonymous.	American hazel, American sycamore, Amur honeysuckle, Austrian pine, autumn-olive, black locust, coralberry, eastern redcedar, English yew, European alder, fragrant sumac, Japanese yew, mallow ninebark, medium purple willow, multiflora rose, pussy willow, redosier dogwood, shrub lespedeza, silver buffaloberry, silver maple, Tartarian honeysuckle.	American plum, Amur honeysuckle, Amur maple, Amur privet, Austrian pine, autumn-olive, crabapple, eastern cottonwood, eastern redcedar, eastern white pine, green ash, hackberry, hawthorn, lilac, Lombardy poplar, mallow ninebark, medium purple willow, mockorange, multiflora rose, Nanking cherry, Norway spruce, Oriental arborvitae, osageorange, pin oak, redosier dogwood, red pine, rose-of-Sharon, Siberian elm, silver buffaloberry, Tartarian honeysuckle, winged euonymous.
Group 5: Deep, nearly level to gently sloping, well drained and moderately well drained soils; high and very high available water capacity; water table below a depth of 5 feet most of the year. Kennebec: Ke Ladoga: LaB Sharpsburg: SbB Wiota: Wo	Bur oak, white oak.	Ailanthus, alternateleaf dogwood, American basswood, American sycamore, Amur honeysuckle, Amur privet, black oak, bur oak, coralberry, eastern cottonwood, eastern redbud, eastern white pine, English yew, flowering dogwood, fragrant sumac, green ash, hackberry, hawthorn, Japanese yew, lilac, Lombardy poplar, mallow ninebark, Nanking cherry, Norway maple, Norway spruce, Ohio buckeye, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, rose-of-Sharon, Siberian elm, silky dogwood, silver buffaloberry, silver maple, spreading cotoneaster, sugar maple, Tartarian honeysuckle, white ash, white oak, winged euonymous, yellow-poplar.	Alternateleaf dogwood, American basswood, American hazel, Amur honeysuckle, Amur privet, bur oak, coralberry, crabapple, eastern redcedar, eastern white pine, English yew, flowering dogwood, fragrant sumac, Japanese yew, multiflora rose, Nanking cherry, Norway spruce, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, shrub lespedeza, silky dogwood, silver buffaloberry, spreading cotoneaster, Tartarian honeysuckle, winged euonymous.	American hazel, American sycamore, Amur honeysuckle, coralberry, eastern redcedar, English yew, European alder, fragrant sumac, Japanese yew, mallow ninebark, medium purple willow, multiflora rose, Nanking cherry, pussy willow, redosier dogwood, shrub lespedeza, silver buffaloberry, silver maple, Tartarian honeysuckle.	Ailanthus, Amur honeysuckle, Amur privet, crabapple, eastern cottonwood, eastern redcedar, eastern white pine, green ash, hackberry, hawthorn, lilac, Lombardy poplar, mallow ninebark, medium yellow willow, multiflora rose, Norway spruce, Oriental arborvitae, osageorange, pin oak, redosier dogwood, red pine, rose-of-Sharon, Siberian elm, silver buffaloberry, Tartarian honeysuckle, winged euonymous.

TABLE 4.—*Trees and shrubs suitable for environmental improvement*—Continued

Tree and shrub groups and map symbols	Trees to retain at homesites and parks	Plantings for beauty and shade	Plantings that attract songbirds and wildlife	Plantings for critical areas [1]	Plantings for windbreaks, screens, and sound barriers
Group 6: Deep, nearly level to moderately sloping, somewhat poorly drained soils; moderate, high, and very high available water capacity; seasonal high water table. Armstrong: AmC, ArC3 Grundy: GsB, GuB2 Lagonda: LgB, LgC2 Lamoni: LmC, LmC2, LnC3 Sampsel: SaC Vesser: Ve	Bur oak, pin oak, white oak.	Ailanthus, alternateleaf dogwood, American basswood, American cranberrybush, Amur honeysuckle, Amur privet, black oak, bur oak, coralberry, green ash, mallow ninebark, northern catalpa, Ohio buckeye, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, swamp white oak, Tartarian honeysuckle, white oak.	Alternateleaf dogwood, American basswood, American cranberrybush, Amur honeysuckle, Amur privet, bur oak, coralberry, eastern redcedar, gray dogwood, multiflora rose, Oriental arborvitae, persimmon, pin oak, pussy willow, redosier dogwood, red pine, Tartarian honeysuckle.	Amur honeysuckle, coralberry, eastern redcedar, European alder, gray dogwood, mallow ninebark, medium purple willow, multiflora rose, pussy willow, redosier dogwood, Tartarian honeysuckle.	Ailanthus, American cranberrybush, Amur honeysuckle, Amur privet, eastern redcedar, gray dogwood, green ash, mallow ninebark, medium purple willow, multiflora rose, Oriental arborvitae, pin oak, redosier dogwood, red pine, Tartarian honeysuckle.
Group 7: Deep, nearly level to moderately sloping, poorly drained soils; low and moderate available water capacity; seasonal high water table; ponded at some time during the year in places. Clarinda: CaC2 Zook: Zo, Zs	Pin oak	Ailanthus, alternateleaf dogwood, American basswood, American cranberrybush, Amur honeysuckle, Amur privet, bur oak, coralberry, green ash, mallow ninebark, northern catalpa, Ohio buckeye, pin oak, pussy willow, redosier dogwood, red pine, silky dogwood, swamp white oak, Tartarian honeysuckle, white oak.	Alternateleaf dogwood, American basswood, Amur honeysuckle, Amur privet, bur oak, coralberry, eastern redcedar, gray dogwood, multiflora rose, pin oak, pussy willow, redosier dogwood, red pine, shrub lespedeza, silky dogwood, Tartarian honeysuckle.	Amur honeysuckle, coralberry, eastern redcedar, European alder, gray dogwood, mallow ninebark, medium purple willow, multiflora rose, pussy willow, redosier dogwood, shrub lespedeza, Tartarian honeysuckle.	American cranberrybush, Amur honeysuckle, Amur privet, eastern redcedar, gray dogwood, green ash, mallow ninebark, medium purple willow, multiflora rose, northern catalpa, pin oak, redosier dogwood, red pine, Tartarian honeysuckle.

[1] Critical areas are sediment-producing, highly erodible or severely eroded areas, such as dams, dikes, cuts, fills, and denuded or gullied areas, where plant cover is difficult to establish under ordinary seeding and planting methods.

and managing upland wildlife habitat. The overall habitat can be greatly improved by interspersing throughout the habitat a diverse plant cover that edges into areas where food for wildlife is produced.

In table 5 the soils of the county have been rated according to their limitations for development as wildlife habitat. In rating the soils the main soil characteristics considered were effective depth, surface texture, natural drainage class, surface stoniness, flooding, slope gradient, permeability, and available water capacity. Important factors not considered were the existing vegetation; the present land use; the size, shape, and location of areas; and the movement of wildlife from place to place.

The estimated degree and kind of limitations affecting the use of the soils for wildlife habitat are shown in table 5. The ratings are helpful in selecting sites and planning and developing wildlife habitat. They also indicate the potential of the soils for openland, woodland, and wetland wildlife habitat.

A rating of *good* indicates that wildlife habitat generally is easily created, improved, or maintained. There are few or no soil limitations that affect wildlife habitat management, and satisfactory results can be expected. A rating of *fair* indicates that wildlife habitat generally can be created, improved, or maintained, but there are moderate soil limitations that affect wildlife habitat management. Moderately intense management and fairly frequent attention are required to assure satisfactory results. A rating of *poor* indicates that wildlife habitat generally can be created, improved, or maintained, but soil limitations are severe. Wildlife habitat management is difficult and expensive, or it requires intensive effort. A rating of *very poor* indicates that it is impractical to create, improve, or maintain wildlife habitat.

Most managed wildlife habitats are created, improved, or maintained by planting suitable vegetation, manipulating existing vegetation, inducing natural establishment of desired plants, or combinations of such measures. The eight wildlife habitat elements selected for ratings are described in the following paragraphs.

Grain and seed crops are grain or seed-producing annuals planted to produce food for wildlife. These crops include corn, soybeans, wheat, oats, millet, and sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted to provide wildlife food and cover. These plants include fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, and lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses and weeds that provide food and cover, principally to upland wildlife, and that are established mainly through natural processes. These plants include big bluestem, little bluestem, some of the panicums and other native grasses and partridge peas, beggarticks, and various native lespedezas and other native herbs.

Hardwood woody plants are nonconiferous trees, shrubs,

TABLE 5.—

Soil series and map symbols	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Armstrong: AmC, ArC3	Fair: slope; drainage	Good	Fair: clay loam	Good
Clarinda: CaC2	Poor: drainage	Fair: drainage	Fair: drainage	Fair: drainage
Gara:				
GaD	Fair: slope	Good	Good	Good
GaE	Poor: slope	Fair: slope	Good	Good
Gosport variant: GdE	Very poor: soil depth; available water capacity; slope.	Fair: soil depth	Fair: soil depth; available water capacity.	Poor: available water capacity.
Grundy:				
GsB	Fair: drainage	Good	Good	Good
GuB2	Fair: drainage	Good	Good	Good
Kennebec: Ke	Good	Good	Good	Good
Ladoga:				
LaB	Good	Good	Good	Good
LaC2	Fair: slope	Good	Good	Good
Lagonda: LgB, LgC2	Fair: drainage	Good	Good	Good
Lamoni: LmC, LmC2, LnC3	Fair: slope	Good	Good	Good
Sampsel: SaC	Fair: slope; drainage	Good	Fair: silty clay loam	Good
Sharpsburg:				
SbB	Good	Good	Good	Good
SbC	Fair: slope	Good	Good	Good
Shelby:				
ShD, SyD3	Fair: slope	Good	Good	Good
ShE	Poor: slope	Fair: slope	Good	Good
Vesser: Ve	Fair: drainage	Good	Fair: silt loam	Good
Wiota: Wo	Good	Good	Good	Good
Zook:				
Zo	Fair: drainage	Fair: drainage	Fair: drainage	Fair: drainage
Zs	Fair: drainage	Fair: silty clay; drainage.	Poor: silty clay	Fair: drainage

and woody vines that produce fruits, nuts, buds, catkins, twigs, or foliage used extensively as food by wildlife. They are commonly established through natural processes, but are also planted. These plants include dogwood, sumac, sassafras, persimmon, hazelnut, shrub lespedezas, wild cherry, autumn-olive, various oaks, hickory, grape, plum, blackberry, blackhaw, honeysuckle, and roses.

Coniferous woody plants are cone-bearing trees and shrubs that are important to wildlife primarily as cover but also as food in the form of browse, seeds, or fruitlike cones. Examples are Virginia pine, white pine, shortleaf pine, Scotch pine, red pine, and redcedar. Ratings are based on growth rate limitations that produce dense, low foliage and delayed canopy closure, rather than on timber production.

Wetland food and cover plants are annual and perennial wild herbaceous plants on moist to wet sites, exclusive of floating or submerged aquatic plants, that produce food or cover used mainly by wetland wildlife. Examples are smartweed, bulrush, barnyardgrass, duckweed, pondweed, pickerelweed, cattail, and various sedges.

Shallow water developments are impoundments or excavations for control of water. They are generally not more than 5 feet in depth. Examples are low dikes and levees; shallow dugouts, such as borrow pits along highways and levees; level ditches; and divides for water level control in marshy streams or channels.

Excavated ponds are dugout water areas or combination dugout and dammed areas that have ample supplies of water of suitable quality and depth for the production of fish or wildlife. Hillside ponds or embankment ponds are suitable in places, but are not rated because they generally are constructed on sites not typical of the mapping unit and are influenced by other site factors.

As shown in table 5, there are three main classes of wildlife. These classes are defined as follows:

Openland wildlife consists of birds and mammals that normally inhabit cropland, pastures, lawns, and areas overgrown by grasses, herbs, and shrubs. Examples are bobwhite quail, prairie chicken, meadowlark, field sparrow, redwinged blackbird, dove, cottontail rabbit, jack rabbit, red fox, and woodchuck.

Woodland wildlife consists of birds and mammals that normally inhabit wooded areas covered with hardwood

Wildlife habitat

Potential for habitat elements—*Continued*			Potential as habitat for kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Openland	Woodland	Wetland
Good	Poor: slope	Very poor: slope	Fair	Good	Very poor.
Fair: drainage	Poor: slope	Very poor: slope	Fair	Fair	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Poor: available water capacity.	Very poor: slope	Very poor: slope	Poor	Poor	Very poor.
Good	Fair: slope	Poor: slope	Good	Good	Poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: drainage	Poor: drainage	Good	Good	Poor.
Good	Poor: slope; drainage.	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope; drainage.	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Fair	Good	Very poor.
Good	Poor: slope; drainage.	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope; drainage.	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Good	Good	Fair: permeability	Good	Good	Fair.
Good	Poor: drainage	Very poor: drainage	Good	Good	Very poor.
Fair: drainage	Good	Good	Fair	Fair	Good.
Fair: drainage	Poor: silty clay	Good	Fair	Fair	Fair.

trees and shrubs, coniferous trees and shrubs, or mixtures of such plants. Examples are thrush, vireo, scarlet tanager, turkey, squirrel, gray fox, deer, and raccoon.

Wetland wildlife consists of birds and mammals that normally inhabit wet areas, such as ponds, marshes, and swamps. Examples are duck, geese, heron, mink, muskrat, and raccoon.

Additional information that can be related to the use of the soils for wildlife habitat can be found in other sections of this survey. For example, the management suggested for crops and pasture in the section "Cultivated Crops and Pasture" also applies to planted patches of food and cover for wildlife. Table 3 in the section "Wood Crops" lists the trees suited to various soils. Trees undesirable for commercial timber, however, are not necessarily undesirable for wildlife habitat. The section "Engineering" contains information on water control and pond construction that can be useful in developing desirable wildlife habitat.

Recreation

DeKalb County has potential for several kinds of recreation. There are some public and several privately developed recreation areas in the county. Kansas City and St. Joseph, which have large populations, are less than 60 miles from the county. Watershed developments on uplands offer potential (fig. 14) for multipurpose impoundments of various areas of water.

Additional information that is helpful in planning recreational facilities can be found in the sections on engineering, woodland, environmental plantings, and wildlife.

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

In table 6 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good plant cover can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can easily be overcome. A *moderate* limitation can be overcome or modified by planning, design, or special maintainance. A *severe* limitation means

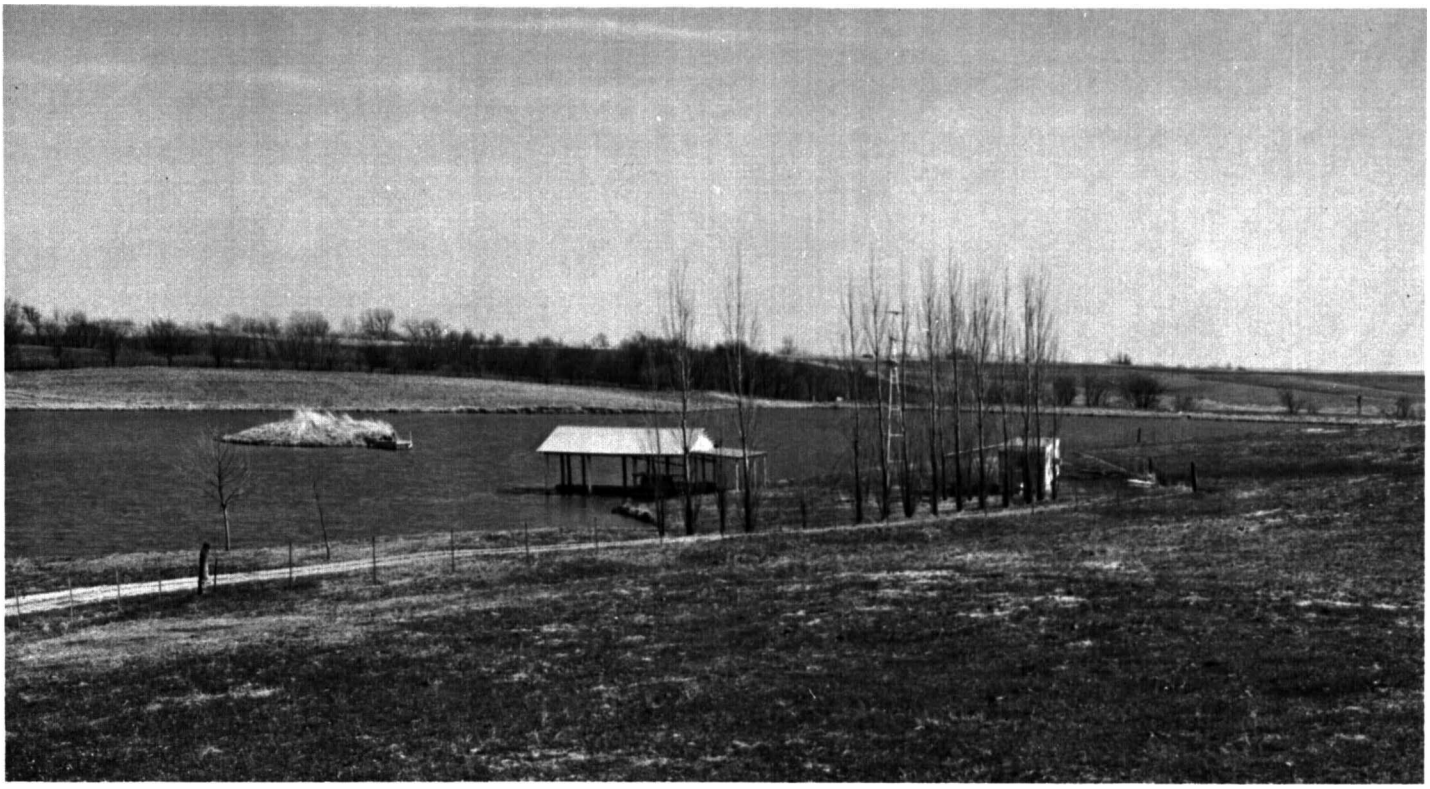

Figure 14.—**Watershed grade stabilization structure on a privately developed recreation area on Shelby loam, 9 to 14 percent slopes.**

TABLE 6.—*Degree and kind of limitation for recreational facilities*

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails	Golf fairways
Armstrong:					
AmC	Moderate: wetness; percs slowly.	Severe: slope	Moderate: wetness	Moderate: wetness	Slight.
ArC3	Moderate: wetness; percs slowly; too clayey.	Severe: slope	Moderate: wetness	Moderate: wetness	Slight.
Clarinda: CaC2	Severe: wetness	Severe: wetness; percs slowly; slope.	Severe: wetness	Severe: wetness	Severe: wetness.
Gara:					
GaD	Moderate: percs slowly; slope.	Severe: slope	Moderate: wetness; slope.	Slight	Moderate: slope.
GaE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Moderate: slope.
Gosport variant: GdE	Severe: slope	Severe: slope; rock outcrop.	Severe: slope	Severe: slope	Severe: slope.
Grundy: GsB, GuB2	Moderate: wetness; percs slowly.	Moderate: wetness; percs slowly; slope.	Moderate: wetness	Moderate: wetness	Slight.
Kennebec: Ke	Severe: occasional flooding.	Moderate: occasional flooding.	Moderate: occasional flooding.	Slight	Moderate: occasional flooding.
Ladoga:					
LaB	Moderate: percs slowly.	Moderate: slope	Slight	Slight	Slight.
LaC2	Moderate: percs slowly.	Severe: slope	Slight	Slight	Slight.
Lagonda:					
LgB	Moderate: percs slowly.	Moderate: percs slowly; slope.	Moderate: wetness	Moderate: wetness	Slight.
LgC2	Moderate: wetness; percs slowly.	Severe: slope	Moderate: wetness	Moderate: wetness	Slight.

TABLE 6.—*Degree and kind of limitation for recreational facilities*—Continued

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails	Golf fairways
Lamoni: LmC, LmC2, LnC3.	Moderate: wetness; percs slowly.	Severe: slope	Moderate: wetness; too clayey.	Moderate: wetness; too clayey.	Slight.
Sampsel: SaC	Moderate: wetness; percs slowly; too clayey.	Severe: slope	Moderate: wetness; too clayey.	Moderate: wetness; too clayey.	Slight.
Sharpsburg:					
SbB	Moderate: percs slowly.	Moderate: slope	Slight	Slight	Slight.
SbC	Moderate: percs slowly.	Severe: slope	Slight	Slight	Slight.
Shelby:					
ShD	Moderate: percs slowly; slope.	Severe: slope	Moderate: slope	Slight	Moderate: slope.
ShE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Moderate: slope.
SyD3	Moderate: percs slowly; slope.	Severe: slope	Moderate: slope	Moderate: clay loam surface material.	Moderate: slope.
Vesser: Ve	Severe: occasional flooding.	Severe: occasional flooding.	Moderate: wetness; occasional flooding.	Moderate: wetness; occasional flooding.	Moderate: occasional flooding.
Wiota: Wo [1]	Moderate: rare flooding during season of use.	Moderate: rare flooding during season of use.	Moderate: rare flooding during season of use.	Slight	Moderate: rare flooding during season of use.
Zook: Zo, Zs	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; too clayey.	Severe: wetness; flooding.

[1] Included in this mapping unit are several large areas of Kennebec soil at lower elevations adjacent to the main drainage channels. This Kennebec soil is subject to occasional flooding.

that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Camp areas are subject to heavy foot traffic and limited vehicular traffic. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of intensive use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are subject to intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrop, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increases the cost of leveling sites or of building access roads.

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

Golf fairways are subject to heavy foot traffic. The best soils are firm when wet but not dusty when dry, are free of flooding during the seasons of use, and have a surface free of rocks and coarse fragments. The soils should be well suited to grass.

Engineering[5]

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

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

Information in this section can be helpful to those who—

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

[5] WILLIAM N. RIGGS, agricultural engineer, Soil Conservation Service, helped prepare this section.

TABLE 7.—*Engineering*

[The symbol > means more than;

Soil series and map symbols	Depth to—		Depth from surface	Dominant USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Armstrong: AmC, ArC3	>6	[1] 1-3	0-10	Loam and clay loam	CL-ML or CL	A-4 or A-6	0
			10-23	Clay	CH	A-7	0
			23-73	Clay loam	CL	A-7	0
Clarinda: CaC2	>6	[1] 1-2	0-9	Silty clay loam	CL	A-6 or A-7	0
			9-60	Clay	CH	A-7	0
Gara: GaD, GaE	>6	>5	0-10	Loam	CL-ML or CL	A-4 or A-6	0
			10-44	Clay loam	CL	A-6 or A-7	0
			44-65	Clay loam	CL	A-6	0
Gosport variant: GdE	2½-3½	>5	0-7	Silty clay loam	CL	A-7	0-5
			7-25	Silty clay	CL or CH	A-7	0-5
			25-36	Silty clay loam and shale	CL or CH	A-7	0-5
			36	Shale bedrock.			
Grundy: GsB, GuB2	>6	[1] 1-3	0-11	Silt loam and silty clay loam	ML	A-4, A-6, or A-7	0
			11-17	Silty clay loam	CL or CH	A-7	0
			17-34	Silty clay	CH	A-7	0
			34-84	Silty clay loam	CL or CH	A-7	0
Kennebec: Ke	>6	2-5	0-40	Silt loam	CL	A-6 or A-7	0
			40-84	Silt loam	CL	A-6 or A-7	0
Ladoga: LaB, LaC2	>6	>6	0-9	Silt loam	ML or CL	A-4 or A-6	0
			9-49	Silty clay loam and silty clay	CL or CH	A-7	0
			49-72	Silty clay loam	CL	A-6	0
Lagonda: LgB, LgC2	>6	[1] 2-3	0-9	Silt loam	ML or CL	A-4, A-6, or A-7	0
			9-14	Silty clay loam	CL or CH	A-7	0
			14-28	Silty clay	CH	A-7	0
			28-71	Silty clay loam and silty clay	CL or CH	A-7	0
Lamoni: LmC, LmC2, LnC3	>6	1-3	0-9	Clay loam	CL	A-6 or A-7	0
			9-29	Clay	CH	A-7	0
			29-72	Clay loam	CL	A-7	0
Sampsel: SaC	3½-7	[1] 1½-3	0-26	Silty clay loam	CL	A-6 or A-7	0
			26-64	Silty clay	CH	A-7	0
			64-77	Shaley silty clay loam	CH or SC	A-7	5-10
			77	Weathered shale bedrock.			
Sharpsburg: SbB, SbC	>6	>5	0-12	Silt loam	CL	A-7	0
			12-37	Silty clay loam	CH	A-7	0
			37-60	Silty clay loam	CL	A-7	0
Shelby: ShD, ShE, SyD3	>6	>5	0-7	Loam and clay loam	CL-ML or CL	A-4 or A-6	0
			7-80	Clay loam	CL	A-7	0
Vesser: Ve	>6	1-3	0-31	Silt loam	ML or CL	A-4 or A-6	0
			31-70	Silty clay loam	CL or CH	A-7	0
Wiota: Wo	>6	>5	0-23	Silt loam and silty clay loam	CL-ML or CL	A-4 or A-6	0
			23-43	Silty clay loam	CL	A-6 or A-7	0
			43-68	Silt loam and silty clay loam	CL-ML or CL	A-4 or A-6	0
Zook: Zo, Zs	>6	0-1	0-36	Silty clay loam and silty clay	CL or CH	A-7	0
			36-84	Silty clay loam and silty clay	CH	A-7	0

[1] Seasonal perched water table.

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

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

Most of the information in this section is presented in tables 7 and 8, which show, respectively, several estimated soil properties significant in engineering and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 7 and 8, and it can also be used to make other maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineer-

properties and classifications

the symbol < means less than]

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
95-100	90-95	85-95	65-80	18-30	4-15	0.6-2.0	0.20-0.22	4.5-5.5	Moderate	Moderate	High.
95-100	90-95	85-95	80-95	50-60	30-36	0.06-0.2	0.11-0.13	4.5-5.5	High	High	High.
95-100	90-95	85-95	65-80	42-50	23-28	0.2-0.6	0.14-0.16	6.1-6.5	Moderate	High	Low.
95-100	95-100	95-100	85-95	35-46	15-25	0.2-0.6	0.21-0.23	6.1-6.5	Moderate	High	Low.
95-100	95-100	95-100	85-95	55-60	35-45	<0.06	0.09-0.11	6.1-7.8	High	High	Low.
95-100	85-95	80-90	55-75	18-30	4-15	0.6-2.0	0.20-0.22	5.6-7.3	Low	Moderate	Low.
95-100	85-95	80-95	55-75	32-44	16-25	0.2-0.6	0.15-0.17	5.1-7.3	Moderate	Moderate	Moderate.
95-100	85-95	80-90	55-75	30-40	15-25	0.2-0.6	0.12-0.16	6.6-7.3	Moderate	Moderate	Low.
65-95	65-95	60-90	55-85	41-50	21-26	0.2-0.6	0.11-0.16	5.1-6.5	Moderate	Moderate	Moderate.
65-95	65-95	60-90	60-90	45-55	24-32	0.2-0.6	0.09-0.13	6.1-6.5	High	Moderate	Low.
80-90	60-90	55-85	55-85	45-65	24-40	0.2-0.6	0.03-0.12	7.4-7.8	High	Moderate	Low.
	100	95-100	90-98	30-45	5-15	0.6-2.0	0.22-0.24	6.1-7.3	Low	Moderate	Low.
	100	97-100	95-99	45-55	30-40	0.2-0.6	0.18-0.20	5.6-6.0	High	High	Moderate.
	100	97-100	95-99	50-70	30-45	0.06-0.2	0.11-0.13	5.6-6.0	High	High	Moderate.
	100	97-100	95-99	45-55	30-40	0.06-0.2	0.18-0.20	6.6-7.3	High	High	Low.
	100	95-100	90-100	35-50	15-25	0.6-2.0	0.22-0.24	6.1-7.3	Moderate	Moderate	Low.
	100	95-100	90-100	35-50	11-20	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	Moderate	Low.
	100	95-100	95-100	25-40	5-15	0.6-2.0	0.22-0.24	6.1-7.3	Low	Moderate	Low.
	100	97-100	95-100	41-55	25-35	0.2-0.6	0.18-0.20	5.6-6.5	Moderate	Moderate	Moderate.
	100	97-100	95-100	30-40	15-20	0.2-0.6	0.18-0.20	6.1-6.5	Moderate	Moderate	Low.
	100	95-100	90-95	30-45	7-17	0.6-2.0	0.22-0.24	6.6-7.3	Moderate	Moderate	Low.
	100	95-100	90-95	41-55	25-40	0.2-0.6	0.18-0.20	5.6-6.0	High	High	Moderate.
95-100	90-100	97-100	95-99	52-70	35-45	0.06-0.2	0.11-0.13	6.1-6.5	High	High	Low.
95-100	90-99	90-99	80-90	45-60	35-45	0.06-0.2	0.18-0.20	6.6-7.3	High	High	Low.
95-100	95-100	90-95	75-85	35-45	11-20	0.2-0.6	0.17-0.19	6.1-6.5	Moderate	Moderate	Low.
95-100	95-100	90-95	70-85	55-70	35-45	0.06-0.2	0.11-0.13	5.6-8.4	High	High	Moderate.
95-100	95-100	90-95	70-80	41-50	25-35	0.06-0.2	0.12-0.16	7.9-8.4	Moderate	High	Low.
	100	95-100	90-99	35-50	15-25	0.2-0.6	0.21-0.23	5.1-6.5	Moderate	Moderate	Low.
	100	97-100	95-100	50-75	35-45	0.06-0.2	0.11-0.13	5.6-7.3	High	High	Low.
55-75	40-70	50-65	40-60	50-70	35-45	0.06-0.2	0.10-0.12	6.6-7.3	High	High	Low.
	100	97-100	95-100	41-50	20-25	0.6-2.0	0.22-0.24	6.1-6.5	Moderate	Moderate	Low.
	100	97-100	95-100	50-60	25-35	0.2-0.6	0.18-0.20	5.6-6.0	High	Moderate	Moderate.
	100	97-100	95-100	41-50	20-30	0.6-2.0	0.18-0.20	5.6-6.0	Moderate	Moderate	Moderate.
95-100	85-98	85-95	55-70	18-30	4-15	0.6-2.0	0.20-0.22	5.6-6.0	Low	Moderate	Moderate.
95-100	85-98	80-95	55-70	41-50	20-30	0.2-0.6	0.12-0.16	5.6-7.8	Moderate	Moderate	Low.
	100	90-100	90-100	30-40	5-15	0.6-2.0	0.22-0.24	6.6-7.3	Low	Moderate	Low.
	100	95-100	90-100	45-55	30-35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate	High	Moderate.
	100	95-100	85-100	25-40	5-18	0.6-2.0	0.22-0.24	5.1-7.3	Low	Moderate	Moderate.
	100	95-100	85-100	30-45	11-22	0.6-2.0	0.18-0.20	5.6-6.0	Moderate	Moderate	Moderate.
	100	95-100	85-100	25-40	5-18	0.6-2.0	0.18-0.20	5.6-6.5	Low	Moderate	Moderate.
	100	95-100	95-100	45-60	25-35	0.06-0.2	0.21-0.23	6.1-7.3	High	High	Low.
	100	95-100	95-100	52-75	40-50	0.06-0.2	0.12-0.16	6.6-7.3	High	High	Low.

ing works, especially works that involve heavy loads or that require excavations to depths greater than 6 feet. Also, inspection of sites, especially small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used in this soil survey have special meanings in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*) used by the Soil Conservation Service engineers, the Department of Defense, and others and the AASHTO sys-

TABLE 8.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill	Local roads and streets
Armstrong: AmC, ArC3.	Severe: slow permeability; seasonal high water table.	Moderate: 5 to 9 percent slopes.	Severe: somewhat poorly drained; seasonal high water table; clay.	Severe: high shrink-swell potential.	Moderate: clay loam; somewhat poorly drained.	Severe: high shrink-swell potential; low strength.
Clarinda: CaC2	Severe: very slow permeability; seasonal high water table.	Moderate: 5 to 9 percent slopes.	Severe: poorly drained; high shrink-swell potential; seasonal high water table; clay.	Severe: poorly drained; high shrink-swell potential; seasonal high water table.	Severe: poorly drained; clay; seepage.	Severe: poorly drained; high shrink-swell potential.
Gara: GaD, GaE	Severe: moderately slow permeability.	Severe: more than 9 percent slopes.	Moderate if slope is 9 to 14 percent; clay loam. Severe if slope is more than 14 percent.	Moderate if slope is 9 to 14 percent; moderate shrink-swell potential. Severe if slope is more than 14 percent.	Moderate: clay loam.	Severe: low strength.
Gosport variant: GdE.	Severe: 28 to 40 inches deep over bedrock; more than 14 percent slopes; moderately slow permeability.	Severe: 28 to 40 inches deep over bedrock; more than 14 percent slopes.	Severe: more than 14 percent slopes; 28 to 40 inches deep over bedrock.	Severe: more than 14 percent slopes; high shrink-swell potential.	Severe: 28 to 40 inches deep over bedrock; silty clay.	Severe: more than 14 percent slopes; high shrink-swell potential; 28 to 40 inches deep over bedrock.
Grundy: GsB, GuB2	Severe: slow permeability; seasonal high water table.	Slight if slope is less than 2 percent, moderate if more than 2 percent.	Severe: somewhat poorly drained; seasonal high water table.	Severe: high shrink-swell potential; seasonal high water table.	Moderate: somewhat poorly drained; silty clay loam.	Severe: low strength; high shrink-swell potential.
Kennebec: Ke	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding.
Ladoga: LaB, LaC2	Severe: moderately slow permeability.	Moderate: 2 to 9 percent slopes.	Moderate: moderately well drained.	Moderate: moderate shrink-swell potential.	Moderate: silty clay loam.	Severe: low strength.
Lagonda: LgB, LgC2	Severe: slow permeability; seasonal high water table.	Moderate: 2 to 9 percent slopes.	Severe: somewhat poorly drained; seasonal high water table; silty clay.	Severe: high shrink-swell potential; seasonal high water table.	Moderate: somewhat poorly drained; silty clay loam.	Severe: high shrink-swell potential; low strength.
Lamoni: LmC, LmC2, LnC3.	Severe: slow permeability; seasonal high water table.	Moderate: 5 to 9 percent slopes.	Severe: somewhat poorly drained; seasonal high water table; clay.	Severe: high shrink-swell potential; low strength.	Severe: clay	Severe: high shrink-swell potential; low strength.
Sampsel: SaC	Severe: slow permeability; seasonal high water table.	Moderate: 5 to 9 percent slopes.	Severe: somewhat poorly drained; seasonal high water table; silty clay.	Severe: high shrink-swell potential; seasonal high water table.	Severe: silty clay; depth to bedrock.	Severe: high shrink-swell potential; low strength.

interpretations

Suitability as a source of—		Soil features affecting—				
Road fill	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: low strength.	Poor: less than 8 inches thick; hard to reclaim.	Local sand layers; 5 to 9 percent slopes.	Medium to low strength; medium compressibility; fair to good compaction characteristics; erodes easily.	Not needed	5 to 9 percent slopes; erodes easily; slow intake.	Clay; slow permeability; erodes easily; 5 to 9 percent slopes.
Poor: low strength; high shrink-swell potential; poorly drained.	Poor: poorly drained; too clayey; hard to reclaim.	5 to 9 percent slopes.	High shrink-swell potential; medium to low strength; high compressibility; fair to poor compaction characteristics; erodes easily.	Very slow permeability; clay.	Low available water capacity; 5 to 9 percent slopes; erodes easily; slow intake.	Clay; very slow permeability; 5 to 9 percent slopes; erodes easily.
Poor: low strength.	Fair to poor: 3 to 10 inches thick; 9 to 20 percent slopes.	Local sand layers; 9 to 20 percent slopes.	Medium to low strength; medium compressibility; fair to good compaction characteristics.	Not needed	9 to 20 percent slopes; erodes easily.	9 to 20 percent slopes; erodes easily.
Poor: high shrink-swell potential; low strength; 28 to 40 inches deep over bedrock.	Poor: less than 8 inches thick; more than 14 percent slopes.	28 to 40 inches deep over bedrock; more than 14 percent slopes.	28 to 40 inches deep over bedrock; high shrink-swell potential; low strength.	Not needed	More than 14 percent slopes; low available water capacity; shallow rooting depth.	More than 14 percent slopes; 28 to 40 inches deep over bedrock.
Poor: low strength; high shrink-swell potential.	Fair: more than 10 inches thick.	Favorable	High shrink-swell potential; medium to low strength; high compressibility; fair to poor compaction.	Not needed	1 to 5 percent slopes; slow permeability.	Slow permeability.
Poor: low strength.	Good	0 to 2 percent slopes; moderate permeability.	Low strength; medium compressibility; fair to poor compaction characteristics.	Occasional flooding.	Favorable	Favorable.
Poor: low strength.	Fair: 9 inches thick.	Favorable	Medium to low strength; medium to high compressibility; fair compaction.	Not needed	2 to 9 percent slopes; erodes easily.	Favorable.
Poor: low strength; high shrink-swell potential.	Fair for LgB: more than 8 inches thick. Fair to poor for LgC2: 5 to 10 inches thick.	Favorable	High shrink-swell potential; medium to low strength; high compressibility; fair to poor compaction.	Not needed	2 to 9 percent slopes; erodes easily; slow intake.	Slow permeability.
Poor: low strength; high shrink-swell potential.	Fair for LmC and LmC2: 9 inches thick. Poor for LnC3: severely eroded.	Local sand layers; 5 to 9 percent slopes.	High shrink-swell potential; medium to low strength; high compressibility; fair compaction characteristics; erodes easily.	Not needed	5 to 9 percent slopes; erodes easily; slow intake.	Slow permeability; 5 to 9 percent slopes; erodes easily.
Poor: low strength; high shrink-swell potential.	Fair: silty clay loam.	Depth to bedrock; 5 to 9 percent slopes.	High shrink-swell potential; medium to low strength; high compressibility; fair to poor compaction characteristics.	Slow permeability; seepage from upslope.	5 to 9 percent slopes; erodes easily; slow intake.	Slow permeability; seepage.

TABLE 8.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill	Local roads and streets
Sharpsburg: SbB, SbC.	Severe: moderately slow permeability.	Moderate: 2 to 9 percent slopes.	Moderate: moderately well drained.	Severe: high shrink-swell potential.	Moderate: silty clay loam.	Severe: low strength; high shrink-swell potential.
Shelby: ShD, ShE, SyD3.	Severe: moderately slow permeability.	Severe: more than 9 percent slopes.	Moderate if slope is less than 14 percent, severe if more than 14 percent.	Moderate if slope is less than 14 percent, severe if more than 14 percent.	Moderate: clay loam.	Severe: low strength.
Vesser: Ve	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.	Severe: occasional flooding; seasonal high water table.
Wiota: Wo	Slight [1]	Moderate: seepage; moderate permeability.	Slight [1]	Severe: rare flooding.	Slight [1]	Moderate: moderate shrink-swell potential.
Zook: Zo, Zs	Severe: occasional flooding; slow permeabil- seasonal high water table.	Severe: occasional flooding.	Severe: occasional flooding; poorly drained; seasonal high water table.	Severe: occasional flooding; poorly drained; seasonal high water table.	Severe: occasional flooding; seasonal high water table; silty clay.	Severe: occasional flooding; poorly drained; low strength.

[1] Included in this mapping unit are several large areas of Kennebec soil at lower elevations adjacent to the main drainage channel. This Kennebec soil is subject to occasional flooding.

tem (*1*) adopted by the American Association of State Highway and Transportation Officials.

The Unified system classifies soils according to engineering uses for building materials or for the support of structures other than highways. Soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils, which are divided on the basis of gravel and sand content. These classes are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are divided on the basis of plasticity. Nonplastic classes are ML, MH, OL, and OH, and plastic classes are CL and CH. There is one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL–ML.

The AASHTO system is used to classify soils according to those properties that affect their use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity. In group A-1 are gravelly soils, which have high bearing strength and are the best soils for foundation, or subgrade. At the other extreme, in group A-7, are clay soils, which have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6.

Soil properties significant in engineering

Estimates of soil properties significant in engineering (*9*) are given in table 7. They are made for typical soil profiles, by layers having significantly different soil properties. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 7.

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

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

Soil texture is described in table 7 in the standard terms used by the Department of Agriculture (*7*). These terms are based on the percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example,

interpretations—Continued

Suitability as a source of—		Soil features affecting—				
Road fill	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: low strength; high shrink-swell potential.	Good	Favorable	Medium to low strength; medium to high compressibility; fair to good compaction.	Not needed	9 to 20 percent slopes; erodes easily.	Favorable.
Poor: low strength.	Fair if slope is less less than 14 percent, poor if more than 14 percent.	Local sand layers; 9 to 20 percent slopes.	Medium to low strength; medium compressibility; fair to good compaction characteristics.	Not needed	9 to 20 percent slopes; erodes easily.	9 to 20 percent slopes.
Poor: low strength.	Good	Favorable	Medium to low strength; medium compressibility; fair to good compaction characteristics.	Occasional flooding.	Favorable	Not needed.
Fair: moderate shrink-swell potential.	Good	Moderate permeability.	Medium to low strength; medium compressibility; fair to good compaction characteristics.	Not needed	Favorable	Not needed.
Poor: low strength; high shrink-swell potential.	Poor: poorly drained; silty clay.	Favorable	Medium to low strength; high compressibility; fair to poor compaction characteristics.	Occasional flooding; slow permeability; poorly drained.	Occasional flooding; slow intake.	Not needed.

"gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the water content of a clayey soil from which the particles coarser than 0.42 millimeter have been removed is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic.

Permeability, as used in table 7, is the rate at which saturated soil transmits water in a vertical direction under a unit head of pressure. It is estimated on the basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

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

Reaction refers to the acidity or alkalinity of a soil, expressed in pH values for a stated soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential refers to the change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when dry or swells when wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils can damage building foundations, roads, and other structures. Soils having a *high* shrink-swell potential are the most hazardous.

The risk of corrosion, as used in table 7, refers to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion on uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. The rate of corrosion on concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. A corrosivity rating of *low* indicates a low probability of soil-induced corrosion damage. A rating of *high* indicates a high probability of damage, so

that protective measures for steel and more resistant concrete should be used to reduce damage.

Engineering interpretations of soils

The interpretations in table 8 are based on the estimated engineering properties of soils shown in table 7; on test data for soils in this survey area and others nearby or adjoining; and on the experience of engineers and soil scientists with the soils of DeKalb County. Ratings in table 8 summarize the limitations of the soils for septic tank absorption fields, sewage lagoons, shallow excavations, dwellings without basements, sanitary landfill, and local roads and streets and summarize the suitability of the soils as sources of road fill and topsoil. They also list those soil features that affect the planning, installation, and maintenance of pond reservoir areas; embankments, dikes, and levees; drainage systems; irrigation systems; and terraces and diversions.

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

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

Following are explanations of some of the columns in table 8.

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

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

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

Dwellings without basements, as rated in table 8, are not more than three stories high and are supported by foundation footings in undisturbed soil. Features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill refers to a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of ground water pollution, and trafficability. The best soils have moderately slow permeability, are able to withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 8 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be deeper than that. Reliable predictions can be made to a depth of 10 to 15 feet for some soils, but all sites should be investigated before selection.

Local roads and streets, as rated in table 8, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from the soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are the load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect the ease of excavation and the amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect: (1) the predicted performance of the soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and (2) the ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, for example, in preparing a seedbed; the natural fertility of the material or the response of plants when fertilizer is applied; and the absence of substances toxic to plants. It is also affected by the texture of the soil material and the content of stone fragments. Also considered in the ratings is the damage that will result in the area from which topsoil is removed.

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

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and that has favorable stability, shrink-swell potential, shear strength, and compactibility. The presence of stones or organic material in a soil is among factors that are unfavorable.

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

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

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

Formation and Classification of Soils

This section describes the factors that have affected the formation of soils in DeKalb County and the kinds of parent material that are in the county. It also explains the system of soil classification used in the United States. Soil series represented in DeKalb County are placed in some categories of this system. The soil series of the county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time that these soil-forming forces have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil that has distinct horizons. Although it varies, some time is always required for differentiation of soil horizons. Generally a long time is required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made regarding the effect of any one factor on soil formation unless conditions are specified for the other factors. Many of the processes of soil formation are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It determines the limits of the chemical and mineral composition of the soil. In DeKalb County, the soils formed in loess, glacial till, alluvium, or residual material, or in a combination of these parent materials.

Loess is wind-deposited silty material probably blown from the larger flood plains. Loess remains on most of the wider ridges and is as much as 10 feet thick in some areas. In DeKalb County, Grundy, Ladoga, and Sharpsburg soils formed in loess. Lagonda soils formed in thin loess and the underlying glacial till.

Prior to the deposit of loess, thick layers of material known as glacial till were deposited over the bedrock of the county. This material is generally yellowish brown and is a heterogeneous mass of sand, silt, and clay and some material ranging in size from pebbles to boulders. Depth of the glacial till ranges from a few feet to more than 100 feet. In some areas, soil formed in the glacial till before the loess was deposited. Many of these areas are now exposed. They are generally narrow, and the surface layer, which formed at a later time, varies in thickness. Armstrong, Clarinda, and Lamoni soils formed in these areas. In steeper areas unweathered glacial material was later exposed by geologic erosion. Gara and Shelby soils formed in this material.

Alluvium is water-transported soil material deposited on the nearly level flood plains of streams. Most of this material was eroded from the surrounding upland soils. The material varies in size from clay and silt to fine sand. Zook soils formed in the clayey material and Kennebec, Vesser, and Wiota soils formed in the more silty alluvial material.

Residual material in DeKalb County consists of shale and limestone beds. The limestone layers are generally thin and fractured. Gosport and Sampsel soils formed in residual material.

Climate

DeKalb County has a subhumid, midcontinental climate that has changed little for several thousand years. Studies indicate, however, that there have been periods since the beginning of the ice age when temperatures and the amount of rainfall have varied considerably. These variations greatly affect the rate of erosion, the blowing of loess, and the types of plants. The prevailing winds are from the southwest. Most of the loess was therefore blown in a northeasterly direction, probably from bottom land of the Missouri River and other large streams. On some of the lower slopes, the loess is thicker on the north and east sides of the smaller streams than on the south and west sides. This difference may be caused by some loess blowing from the bottom land of the small streams.

Plants and animals

Plants, burrowing animals, insects, bacteria, and fungi are important in the formation of soils. They affect the or-

ganic matter, plant nutrients, structure, and porosity of soils.

Many soils formed when the vegetation was mainly tall prairie grasses. These soils, generally known as "prairie soils," have a thick, dark colored surface layer that is high in organic matter because of abundant bacteria and decay of the fine grass roots. Soils formed under this plant cover are in the Clarinda, Grundy, Sharpsburg, Shelby, Lagonda, Lamoni, and Sampsel series.

Soils that formed under forest vegetation have a thin surface layer low in organic matter.

Several soils in DeKalb County have been influenced by both grass and trees. These soils have properties intermediate between those formed under grass and those formed under trees. Soils in this category, generally known as "transitional soils," are in the Gara, Ladoga, and Armstrong series.

Relief

Relief influences soil formation mostly through its effect on drainage, runoff, erosion, and to some extent the exposure to the sun and wind.

The amount of water entering and passing through the soil depends upon the permeability of the soil material, the relief, and the climate. On steep soils where very little water passes through the soil material because of runoff or where water passes through quickly because of the permeability of the soil material, the subsoil colors are generally bright and uniform, indicating good soil drainage. Where two soils formed in similar soil material, one soil will have more clearly defined soil horizons than the other if more water moves through the soil. Rapid runoff on a steep soil results in less water entering the soil. In many places, depending on the type of soil material, rapid runoff significantly affects the degree of soil profile differentiation and the internal soil drainage.

Grundy soils, for example, have slow to medium runoff and are slowly permeable and somewhat poorly drained. As a result, they have maximum profile differentiation. Sharpsburg soils have moderately slow permeability and are moderately well drained. Consequently they have less distinct horizons.

In general, the soils formed in similar soil material are more droughty on the steeper south-facing slopes than those on north-facing slopes. This difference results from more direct sunrays. Droughtiness influences soil formation through its effect on the amount and kind of vegetation, erosion, and freezing and thawing.

Time

The degree of soil profile differentiation is reflected by the length of time the parent material has been in place. Some of the alluvial soils in DeKalb County are young and have little horizon differentiation. An example is Kennebec soils, which may be only a few hundred years old. Other soils are considered to be several thousands of years old. An example is Grundy soils. In these soils, the horizons are distinct and clay moves downward into a well defined, leached subsoil that is mottled.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*8*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[6]

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or divisions of a property may be used in several different categories. In table 9, the soil series of DeKalb County are placed in three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions are the Entisols, Histosols, and Vertisols, which occur in many different climates. Each order is identified by a word ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than the orders. The soil properties used to separate suborders are mainly those that reflect the presence or absence of a water table near the surface; the soil climate; the accumulation of clay, iron, or organic carbon in the upper part of the solum; the cracking of soils caused by a decrease in soil moisture; and fine stratification. The last syllable in the name of a suborder indicates the order. An example is *Udoll* (*Ud*, meaning humid climate, and *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed and those having pans that interfere with growth of roots, movement of water, or both. Among features used are soil acidity, soil climate, soil composition, and soil color. The names of great groups are made by adding a prefix to the name of the suborder. An example is *Argiudoll* (*Arg*, meaning clay accumulation, *ud* for humid climate, and

[6] See the unpublished working document "Selected Chapters from the Unedited Text of the Soil Taxonomy" available in the SCS State Office, Columbia, Missouri.

TABLE 9.—*Classification of the soils*

Series	Family	Subgroup	Order
Armstrong	Fine, montmorillonitic, mesic	Aquollic Hapludalfs	Alfisols.
Clarinda [1]	Fine, montmorillonitic, mesic, sloping	Typic Argiaquolls	Mollisols.
Gara	Fine-loamy, mixed, mesic	Mollic Hapludalfs	Alfisols.
Gosport variant	Fine, mixed, mesic	Typic Eutrochrepts	Inceptisols.
Grundy	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Kennebec	Fine-silty, mixed, mesic	Cumulic Hapludolls	Mollisols.
Ladoga	Fine, montmorillonitic, mesic	Mollic Hapludalfs	Alfisols.
Lagonda [1]	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Lamoni [2]	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Sampsel	Fine, montmorillonitic, mesic, sloping	Typic Argiaquolls	Mollisols.
Sharpsburg	Fine, montmorillonitic, mesic	Typic Argiudolls	Mollisols.
Shelby	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Vesser	Fine-silty, mixed, mesic	Arqiaquic Argialbolls	Mollisols.
Wiota	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Zook	Fine, montmorillonitic, mesic	Cumulic Haplaquolls	Mollisols.

[1] These soils are taxadjuncts to the series because they have no mollic epipedon.
[2] These soils are taxadjuncts to the series because they have no mollic epipedon and have a solum that is thinner than is defined as the range for the series.

oll, from Mollisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central, or typic, segment of the group, and others, called intergrades, which have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Argiudolls (a typical Argiudoll).

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for such properties as texture and mineralogy, which are used as family differentiae in table 9. An example is the fine silty, mixed, mesic family of Typic Argiudolls.

SERIES. The soil series has the narrowest range of characteristics of the categories in the classification system. It is defined in the section "How This Survey Was Made."

Environmental Factors Affecting Soil Use

This section describes some of the natural and cultural factors of DeKalb County that affect the use and management of soils. These factors are relief of the county, water resources, and climate. Also described are trends in soil use.

Relief

Relief in DeKalb County ranges from nearly level flood plains to moderately dissected, gently sloping to moderately steep uplands. The elevation on the upland ridges varies from 1,080 feet in the northern part to 1,000 feet in the southern part. The elevation of the valleys varies from 850 feet to 900 feet.

The eastern part of the county generally drains to the northeast, and the western part drains to the southwest. Bedrock is exposed in many areas adjacent to the larger streams.

Water

Most upland soils in DeKalb County are suitable for building ponds and small lakes. In a few areas, however, small sand pockets or layers cause difficulty in construction. Generally, they are not apparent until construction is underway.

In previous years, many wells were dug in the small valleys for livestock water. The yield, however, has been low, and many wells are far from a source of electricity.

Water from the consolidated rock formations, which underlie DeKalb County, is generally too mineralized even for irrigation (*5*). Wells of moderate depth, reaching into the consolidated rock, may have limited yields of water of marginal quality.

All streams in the county have intermittent flow and are undependable for irrigation or municipal use.

The best possibility for well water is that attained from glacial drift. The most favorable areas are in sand- and gravel-filled channels and valleys of preglacial streams. Nearly two-thirds of the county is favorably located for obtaining sufficient water for domestic needs. Yields seldom exceed 15 gallons per minute. In one-third of the county the glacial drift has no sand and gravel deposits, and in some areas it is thin or does not occur.

Most of the water is high in iron, total dissolved solids, and sulfates. Some is unsuited to domestic use.

Approximately 9,000 acres in DeKalb County is favorably located for wells that have potential for irrigation. Yields of 200 to 1,000 gallons per minute can be obtained under proper development.

TABLE 10.—

[Based on records kept during a 9- to 30-year period at St. Joseph, Missouri, elevation

Month	Temperature							Average heating-degree-days [1]	Precipitation		
	Average daily maximum	Average daily minimum	Average monthly	Record high	Year	Record low	Year		Rainfall		
									Average monthly	Maximum in 24 hours	Year
	°F	°F	°F	°F		°F			Inches	Inches	
January	37.2	17.1	27.2	71	1939	-24	1912	1,172	1.20	2.46	1965
February	41.4	20.7	31.1	83	1930	-19	1971	949	1.09	1.88	1955
March	51.0	29.4	40.2	90	1966	-11	1960	769	2.33	2.48	1961
April	64.9	42.3	53.6	96	1970	13	1936	348	3.15	2.33	1951
May	75.1	53.0	64.1	103	1934	30	1961	133	4.39	7.12	1962
June	85.0	63.0	74.0	105	1936	43	1945	15	5.93	5.83	1964
July	91.0	67.8	79.4	108	1936	41	1972	0	3.22	4.03	1961
August	89.0	66.0	77.5	110	1936	43	1971	6	4.21	3.31	1960
September	81.0	56.2	68.6	107	1947	30	1967	60	3.44	4.46	1961
October	70.1	44.7	57.4	97	1963	11	1925	285	2.18	3.48	1954
November	52.2	30.5	41.4	82	1964	4	1964	708	1.68	2.24	1958
December	41.2	21.7	31.5	72	1935	-15	1972	1,039	1.36	1.59	1953
Year	64.9	42.7	53.8	110	1936	-24	1912	5,484	34.18	7.12	1962

[1] Based on a temperature of 65° F and computed from average monthly temperatures for a 30-year period. These data show heating requirements for dwellings.

Climate[7]

The climate of DeKalb County is typically continental. The highest amount of precipitation falls in summer. The maximum annual precipitation was 53.99 inches in 1951, and the smallest annual total was 21.81 inches in 1953. The highest temperature recorded was 110° F in August 1936, and the lowest recorded was -24° in January 1912.

During winter, a comparatively small amount of precipitation occurs. During the period from November through February, the county receives only 15 percent of the annual average precipitation. Snow falls every year, the greatest average amount in March. Only 1 out of 7 years receives less than 10 inches of snow.

The highest amount of rainfall occurs in May and June. In June, 1 out of 7 years receives more than 10 inches of rain and 4 out of 10 years more than 7 inches. The amount of rainfall declines in July and August. This decrease in water supply is associated with increased evapotranspiration.

Tables 10 and 11 show, respectively, temperature and precipitation data and the probability of freezing temperatures in spring and fall. In preparing the text and tables for this section, weather records for St. Joseph, Missouri, were used to represent DeKalb County. St. Joseph is about 20 miles west of DeKalb County.

In table 10, the column "average heating-degree-days" provides a comparative number, or average, for calculating relative heating requirements for dwellings. Fuel consumption for heating is proportional to total degree-days; that is, a month that has twice as many degree-days as another month requires twice as much fuel for heating.

Trends in Soil Use

In general, large farms have increased in acreage, and small farms have decreased in size and number. Many small acreages that are still classified as farms have very little or no farm income. City dwellers have purchased old farmhouses or built new homes on many of these small acreages. The land used for new home development is commonly prime farmland.

[7] Prepared by WAYNE L. DECKER, chairman, Atmospheric Science, College of Agriculture, University of Missouri, Columbia.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Climatic data

850 feet. Record high and low temperatures are based on a 63-year period]

Precipitation—*Continued*					Average number of days with—				
Snow and sleet					Precipitation of 0.01 inch or more	Maximum temperature of—		Minimum temperature of—	
Average monthly	Maximum monthly	Year	Maximum in 24 hours	Year		90° F or higher	32° F or lower	0° to 32° F	0° F or lower
Inches	*Inches*		*Inches*						
5.6	15.7	1958	11.3	1958	7	0	11	28	3
3.1	10.8	1955	9.0	1955	6	0	5	25	1
4.9	23.1	1960	8.9	1948	8	(2)	1	19	(2)
.7	4.3	1959	2.3	1959	10	1	0	4	0
0	0	----------	0	----------	11	4	0	(2)	0
0	0	----------	0	----------	11	9	0	0	0
0	0	----------	0	----------	10	14	0	0	0
0	0	----------	0	----------	8	10	0	0	0
0	0	----------	0	----------	8	3	0	(2)	0
(3)	(3)	1967	(3)	1967	6	1	0	5	0
.5	3.2	1958	3.2	1958	5	0	1	17	0
4.9	15.6	1961	5.8	1948	6	0	7	25	1
19.7	23.1	1960	11.3	1958	95	42	25	123	6

[2] Less than half a day. [3] Trace.

TABLE 11.—*Probability of freezing temperatures in spring and fall*

[St. Joseph, Missouri, elevation 850 feet]

Probability	Dates for given probability and temperature		
	24° F or lower	28° F or lower	32° F or lower
Spring:			
1 year in 10 later than	April 12	April 22	May 5
2 years in 10 later than	April 8	April 17	May 1
5 years in 10 later than	March 30	April 8	April 18
Fall:			
1 year in 10 earlier than	October 20	October 12	October 2
2 years in 10 earlier than	October 27	October 17	October 14
5 years in 10 earlier than	November 5	October 27	October 17

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

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.

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

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

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

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

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

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

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

Gumbotil. Leached deoxidized clay, containing siliceous stones, the product of thorough chemical decomposition of clay-rich till.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of

these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Krotovinas. Irregular tubular streaks of material transported from one horizon to another.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

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

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

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

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

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

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

Somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly are mottled at a depth 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.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of decomposition.

Percolation. The downward movement of water through the soil.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

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

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degree of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher.

Residuum. 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 a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.02 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

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

Soil depth. The depth of the soil profile to bedrock or other strongly contrasting nonconforming rock material. In this survey the terms describing soil depth are as follows:

Shallow	10 to 20 inches
Moderately deep	20 to 36 inches
Deep	More than 36 inches

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

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans).

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

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

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

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, 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 proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by adding the words "coarse," "fine," or "very fine" to the name of the textural class.

Tilth, soil. The condition of the soil, especially soil structure, in relation to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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 upper limit 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

Map symbol	Mapping unit	Described on page	Capability unit		Tree and shrub group
			Symbol	Page	Number
AmC	Armstrong loam, 5 to 9 percent slopes	7	IIIe-5	20	6
ArC3	Armstrong clay loam, 5 to 9 percent slopes, severely eroded	7	IVe-8	21	6
CaC2	Clarinda silty clay loam, 5 to 9 percent slopes, eroded	8	IVe-8	21	7
GaD	Gara loam, 9 to 14 percent slopes	8	IVe-1	21	4
GaE	Gara loam, 14 to 20 percent slopes	8	VIe-1	22	4
GdE	Gosport complex, 14 to 30 percent slopes	9	VIIs-7	22	2
GsB	Grundy silt loam, 1 to 5 percent slopes	11	IIe-5	19	6
GuB2	Grundy silty clay loam, 2 to 5 percent slopes, eroded	11	IIIe-5	20	6
Ke	Kennebec silt loam	11	IIw-4	20	5
LaB	Ladoga silt loam, 2 to 5 percent slopes	12	IIe-1	19	5
LaC2	Ladoga silt loam, 5 to 9 percent slopes, eroded	12	IIIe-1	20	4
LgB	Lagonda silt loam, 2 to 5 percent slopes	12	IIe-5	19	6
LgC2	Lagonda silt loam, 5 to 9 percent slopes, eroded	12	IIIe-5	20	6
LmC	Lamoni clay loam, 4 to 7 percent slopes	13	IIIe-5	20	6
LmC2	Lamoni clay loam, 5 to 9 percent slopes, eroded	13	IIIe-5	20	6
LnC3	Lamoni soils, 5 to 9 percent slopes, severely eroded	13	IVe-8	21	6
SaC	Sampsel silty clay loam, 5 to 9 percent slopes	14	IIIe-5	20	6
SbB	Sharpsburg silt loam, 2 to 5 percent slopes	14	IIe-1	19	5
SbC	Sharpsburg silt loam, 5 to 9 percent slopes	15	IIIe-1	20	4
ShD	Shelby loam, 9 to 14 percent slopes	15	IIIe-1	20	4
ShE	Shelby loam, 14 to 20 percent slopes	15	IVe-1	21	4
SyD3	Shelby clay loam, 9 to 14 percent slopes, severely eroded	15	IVe-4	21	4
Ve	Vesser silt loam	16	IIw-1	20	6
Wo	Wiota silt loam	16	I-1	19	5
Zo	Zook silty clay loam	17	IIw-2	20	7
Zs	Zook silty clay	17	IIIw-14	20	7

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