SOIL SURVEY OF

Caldwell County, Missouri

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

Issued April 1974

Major fieldwork for this soil survey was done in the period 1964–65. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1965. 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 Caldwell County Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms 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 Caldwell County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

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

Finding and Using Information

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

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

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

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

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

Community planners and others can read about soil properties that affect the choice of sites for recreational areas in the section "Recreational Uses of the Soils."

Engineers and builders can find, under "Engineering Uses of the Soils," 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 the Soils."

Newcomers in Caldwell 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 "General Nature of the County" and in the information given at the beginning of the publication.

Cover: Gently sloping and sloping Lagonda soils farmed on the contour.

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SOIL SURVEY OF CALDWELL COUNTY, MISSOURI

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

CALDWELL COUNTY is located in the northwestern part of Missouri. It is in the third tier of counties south of the Iowa-Missouri State line and in the third column of counties east of the Kansas-Missouri State line (fig. 1). It has a total land area of 430 square miles, or

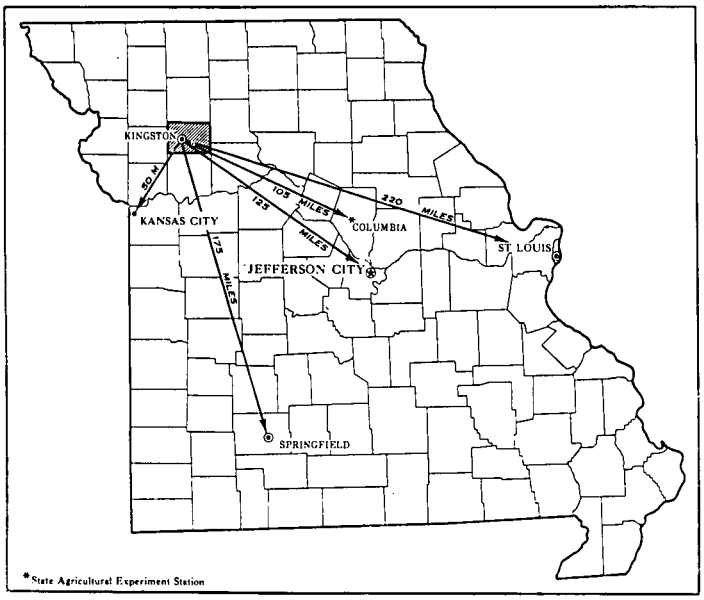

Figure 1.—Location of Caldwell County in Missouri.

275,200 acres. Kingston, the county seat, is located approximately 3 miles west and 1 mile south of the center of Caldwell County. Hamilton, the largest town in the county, is located in the north-central part of the county. The climate of the county is continental, and temperature varies widely from season to season. The largest day-to-day changes are in the fall and winter. Summer temperatures change more slowly.

Farming is the principal enterprise, and general livestock farming is most common. According to reports of the U.S. Bureau of the Census, more than 70 percent of the total farm income in Caldwell County in 1964 was derived from the sale of livestock and livestock products.

How This Survey Was Made

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

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Lagonda and Grundy, 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 soil 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, Lagonda silt loam, 2 to 5 percent slopes, is one of several phases within the Lagonda 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 accu-

rately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning 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 other 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. Only one such kind of mapping unit, an undifferentiated group, is shown on the soil map of Caldwell County.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Lamoni and Adair soils, 2 to 5 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is a land type in Caldwell 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 assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present 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 Caldwell County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

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

If the general soil map and the detailed soil map for Caldwell County are compared with those for adjoining Daviess and Livingston Counties, differences are apparent in many places. Differences can be noted in the kinds of soil and in the boundaries of the soil areas along the boundary of Caldwell County, compared to those in the adjacent Daviess and Livingston Counties. These differences were caused by a lapse of more than 30 years in time between the completion of fieldwork for Daviess and Livingston Counties (1930's) and the completion of fieldwork for Caldwell County (1965). Soil series correlations made in 1965 differ from those made in the thirties because soil classification has been updated. Slope groups used for Caldwell County also differ from those used in the surveys for Daviess and Livingston Counties. In addition, erosion classes, used in the Caldwell County survey, were not used in the surveys for Daviess and Livingston Counties.

The four soil associations in Caldwell County are discussed in the following pages. The terms for texture used in the title for each of these associations apply to the surface layer. For example, in the title for association 1, the words "medium textured and moderately fine textured" refer to texture of the surface layer.

1. Lagonda-Grundy Association

Deep, nearly level to sloping, somewhat poorly drained, medium-textured and moderately fine textured soils on uplands

This association is on high, rounded ridgetops of the major divides and in low areas that resemble benches (fig. 2). The town of Braymer occupies one area that resembles a bench. All of the other towns in this county are on the high, rounded ridgetops. This association occupies about 62 percent of the county.

Lagonda soils make up about 45 percent of this association, and Grundy soils, about 13 percent. The Lagonda soils are on ridges, on the upper parts of hillsides, and in areas around the heads of small drainageways. They are deep and are gently sloping and sloping. Lagonda soils are medium textured and moderately fine textured. They are slowly permeable and somewhat poorly drained.

Grundy soils are on high, rounded ridgetops and in low areas that resemble benches. They are deep and nearly level to sloping. Grundy soils are medium textured and moderately fine textured. They are slowly permeable and somewhat poorly drained.

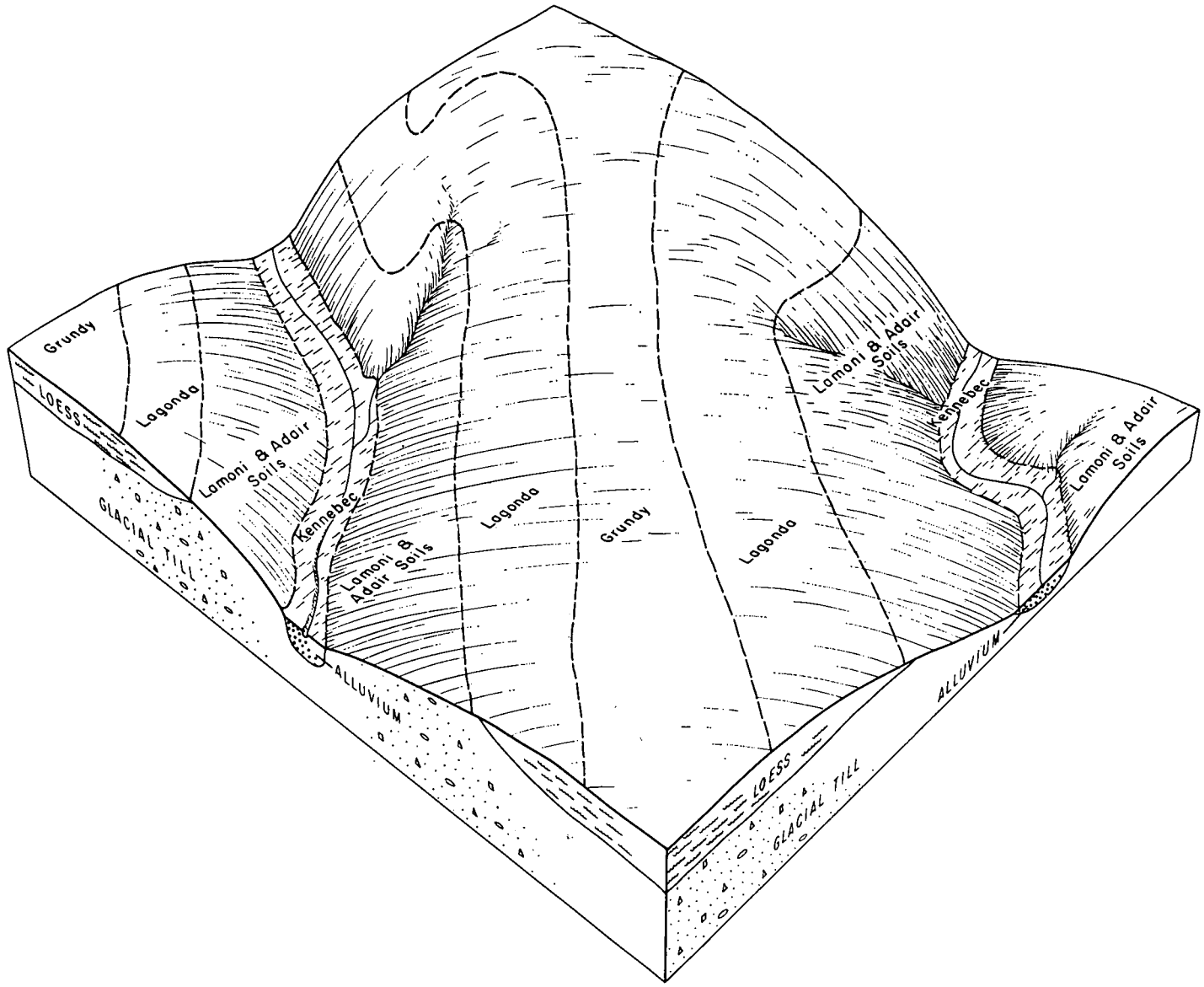

***Figure 2.*—Typical pattern of soils of association 1.**

Minor soils make up the rest of this association, or about 42 percent of the total acreage. They are mainly the Lamoni, Adair, and Armster soils on uplands and the Kennebec, Blackoar, and Zook soils on bottom lands.

Practically all of this association is used for cultivated crops and pasture. A minor part of the acreage is used as woodland and for wildlife habitat. General livestock farming is the main farm enterprise (fig. 3).

2. Armster-Lineville Association

Deep, gently sloping to moderately steep, moderately well drained and well drained, moderately fine textured and medium-textured soils on uplands

This association is on hillsides, low-lying ridges, and narrow bottom lands along minor streams (fig. 4, p. 5). It makes up about 13 percent of the county.

Armster soils make up about 70 percent of the association, and Lineville soils about 8 percent. The remaining 22 percent is minor soils.

Armster soils occupy the lower parts of hillsides adjacent, to large streams and small waterways (fig. 5, p. 6). They are deep and are gently sloping to moderately steep. Armster soils are moderately fine textured and medium textured. They are moderately slowly permeable and moderately well drained to well drained.

Lineville soils are on ridges and the upper parts of hillsides. They are deep and are gently sloping to sloping. Lineville soils are moderately fine textured and medium textured. They are moderately slowly permeable and moderately well drained.

The minor soils of this association that are on uplands are the Ladoga, Sampsel, Snead, and Greenton soils and Rock land, a miscellaneous land type. The Kennebec and

Figure 3.—**Area of Lagonda soils in association 1 used for pasture and hay that provide feed for livestock.**

Zook soils are minor soils on bottom lands; and Moniteau and Nevin are minor soils on stream terraces.

A minor part of this association is used as woodland and for wildlife habitat. About half of the remaining part is used for cultivated crops, and the rest is used for pasture. The raising of livestock is the principal farm enterprise.

3. Sampsel-Greenton-Snead Association

Deep and moderately deep, gently sloping to moderately steep, somewhat poorly drained and moderately well drained, moderately fine textured and medium-textured soils on uplands

This association occupies ridges, hillsides, and bottom lands (fig. 6, p. 7). It makes up about 13 percent of the county.

Sampsel soils make up about 30 percent of the association, Greenton soils about 20 percent, and Snead soils about 20 percent. The remaining 30 percent is minor soils.

Sampsel soils are deep, are gently sloping to strongly sloping, and are on hillsides. They are moderately fine textured, slowly permeable, and somewhat poorly drained.

Greenton soils are deep, are gently sloping to strongly sloping, and are on ridges and hillsides. They are moderately fine textured and medium textured. They are moderately permeable, and moderately well drained.

Snead soils are sloping to moderately steep and are on hillsides. They are moderately deep, moderately fine textured, slowly permeable, and moderately well drained.

The minor soils of the association are the Lagonda, Armster, and Lineville soils and Rock land, a miscellaneous land type, on uplands, and Kennebec soils on bottom lands.

This association is used for cultivated crops and pasture, and to some extent as woodland. Some areas of all the soils in this association are used as woodland and for wildlife habitat (fig. 7, p. 8), and nearly all the areas of Rock land are used for these purposes. General livestock farming is the principal farm enterprise.

4. Kennebec-Zook Association

Deep, nearly level, well-drained and poorly drained, medium-textured to fine-textured soils on bottom lands

This association occupies bottom lands along streams (fig. 8, p. 9). It makes up about 12 percent of Caldwell County.

This association is about 55 percent Kennebec soils and about 15 percent Zook soils. The rest is minor soils.

Kennebec soils are nearly level, deep, medium textured, moderately permeable, and well drained. Zook soils are nearly level, deep, moderately fine textured and fine textured, slowly permeable, and poorly drained.

Minor soils in this association are the Blackoar and Colo soils on flood plains, the Nevin and Moniteau on stream terraces, and the Armster and Sampsel on adjacent uplands.

The soils in this association are used mostly for cultivated crops and pasture. Most of the steep streambanks and narrow areas along stream channels are used as woodland and for wildlife habitat.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors and consistence given in the descriptions are those of a moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rock land, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

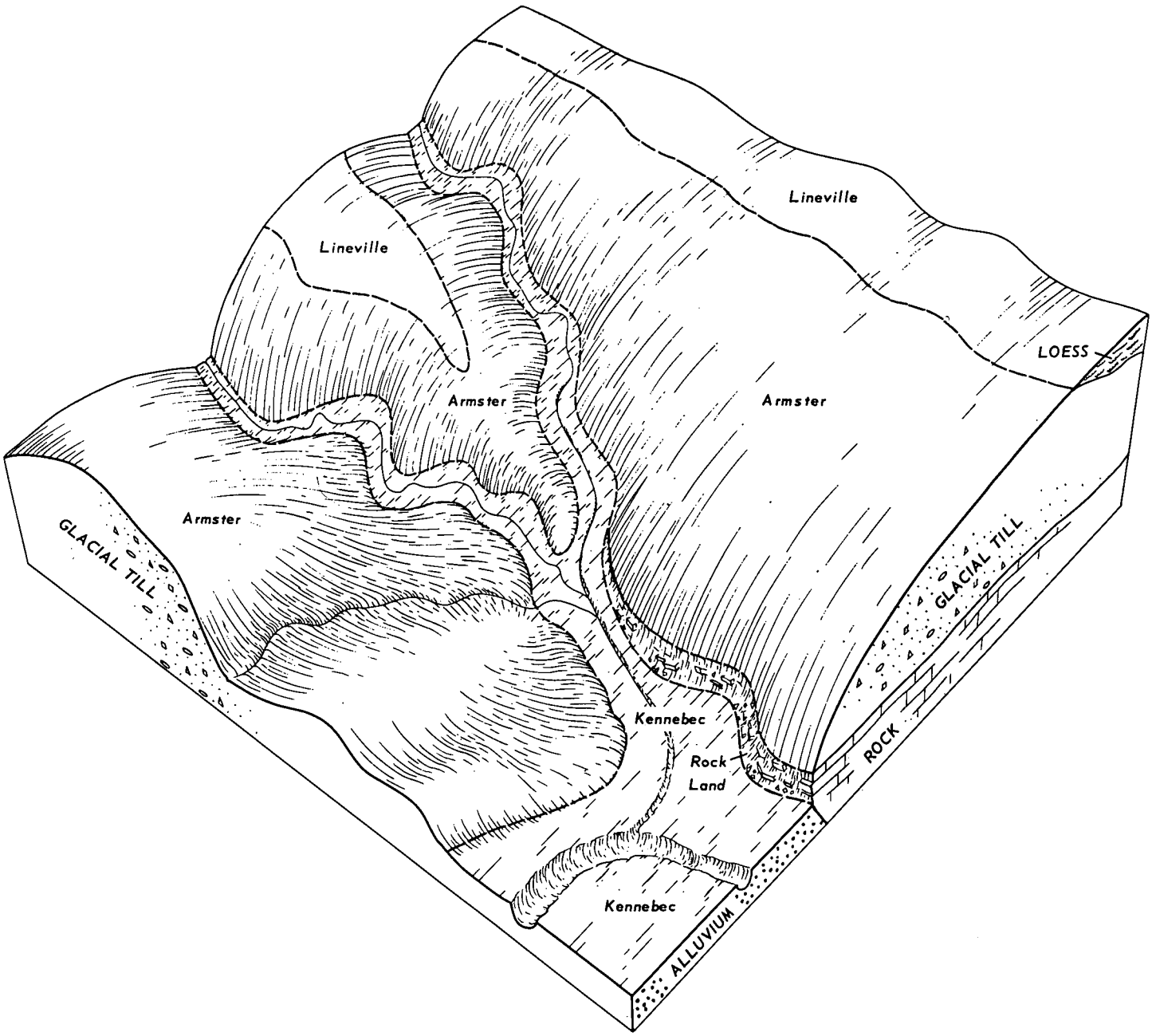

Figure 4.—**Typical pattern of soils in association 2.**

The acreage and proportionate extent of each mapping unit are shown in table 1, p. 11. 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 (*8*).[1]

A given soil series in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soil series described in this county are considered to be within the range defined for that series. In those instances where a soil series has one or more features outside the defined range, the differences are explained.

Adair Series

The Adair series consists of gently sloping to strongly sloping soils that are deep and moderately well drained or somewhat poorly drained. These soils are on short ridges, the ends of ridges, and entire hillsides, in small, short valleys, and on the upper side slopes in the larger, longer valleys. These soils formed in sand, silt, clay, and gravel deposited by glacial action.

[1] Italic numbers in parentheses refer to Literature Cited, p. 54.

Figure 5.—**Well-managed, moderately eroded Armster soils in association 2 used to grow beans and corn.**

In a representative profile the surface layer is about 15 inches thick. The upper 7 inches is black loam, and the lower 8 inches is very dark grayish-brown loam. The subsoil extends to a depth of 60 inches. The uppermost 6 inches of the subsoil is mottled, dark grayish-brown heavy clay loam; the next 23 inches is yellowish-brown and gray clay loam; and the lower 16 inches is mottled, yellowish-brown clay loam.

The Adair soils have a moderate to high content of organic matter, slow permeability, and moderate available water capacity.

Representative profile of an Adair loam that has slopes of 7 percent and is in mixed pasture (1¾ miles south and ½ mile west of Kidder, 300 feet west of the SE. corner of sec. 11, T. 57 N., R. 29 W.):

A11—0 to 7 inches, black (10YR 2/1) loam; weak, very fine, granular structure; very friable; many roots; very strongly acid; clear, smooth boundary.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2) loam; weak, very fine, granular structure; very friable; many roots; very strongly acid; gradual, smooth boundary.

B21t—15 to 21 inches, dark grayish-brown (10YR 4/2) heavy clay loam; common, fine, distinct, yellowish-red (5YR 5/6) mottles and few, fine, prominent, red (2.5YR 5/8) mottles; weak, very fine, subangular blocky structure; firm; thin clay films; common roots; fine gravel line containing many pebbles; very strongly acid; gradual, smooth boundary.

B22t—21 to 44 inches, yellowish-brown (10YR 5/8) and gray (10YR 5/1) clay loam; moderate, fine, subangular blocky structure; firm; medium acid; gradual, smooth boundary.

B3—44 to 60 inches, yellowish-brown (10YR 5/6) clay loam; common, fine, distinct, grayish-brown mottles; weak, coarse, subangular blocky structure; firm; slightly acid.

The A horizon ranges from 10 to 15 inches in thickness and from black to very dark brown or very dark grayish brown in color. In places it is clay loam. The A horizon is least thick and is clay loam in areas where it is eroded or where the slope exceeds 9 percent.

Adair soils have a less grayish B horizon than the associated Lamoni soils, and they lack the loess-derived, silty A horizon of the associated Lagonda soils. Adair soils are similar to the Lineville soils, but they have a darker colored A horizon and lack an A2 horizon.

Adair soils are mapped only in undifferentiated units with the Lamoni soils.

Armster Series

The Armster series consists of deep, moderately well drained and well-drained soils that occupy the lower parts of hillsides. These gently sloping to moderately steep soils are on uplands adjacent to streams. These soils formed in silt, sand, clay, and gravel deposited by glacial action.

In a representative profile the surface layer is about 7 inches thick. The upper 3 inches is black loam; the lower 4 inches is dark-brown loam. The subsoil extends to a depth of 80 inches. The uppermost 5 inches is dark yellowish-brown clay loam. Then, in sequence downward, is 5 inches of reddish-brown heavy clay loam; 11 inches of yellowish-brown heavy clay loam; 23 inches of mottled yellowish-brown clay loam; and 10 inches of mottled grayish-brown and yellowish-brown clay loam. The last 19 inches is mottled grayish-brown silty clay loam.

Armster soils have a moderately low content of organic matter, moderately slow permeability, and high available water capacity. A large part of the acreage is moderately eroded, and the hazard of further erosion is high.

Except for a small acreage that is used as woodland, Armster soils are used in about equal amounts for the production of cultivated crops and pasture.

Representative profile of an Armster loam, 9 to 14 percent slopes, in timber (4 miles north and 3 miles west of Mirabile, 100 feet west and 250 feet south of the NE. corner of the SE¼ sec. 8, T. 56 N., R. 29 W.):

A11—0 to 3 inches, black (10YR 2/1) loam, gray (10YR 5/1) when dry; moderate, very fine, granular structure; very friable; many roots; very strongly acid; clear, smooth boundary.

A12—3 to 7 inches, dark-brown (10YR 3/3) loam, dark-brown (10YR 4/3) when dry; moderate, very fine, granular structure; very friable; many roots; very strongly acid; clear, smooth boundary.

B1—7 to 12 inches, dark yellowish-brown (10YR 4/4) clay loam, yellowish-brown (10YR 5/4) when dry; moderate, medium, subangular blocky structure; friable; common roots; few small pebbles; very strongly acid; clear, smooth boundary.

IIB21t—12 to 17 inches, reddish-brown (5YR 4/4) heavy clay loam; strong, medium, subangular blocky structure; firm; thin, continuous, dark-brown (7.5YR 4/4) clay films; common roots; many small pebbles; very strongly acid; clear, smooth boundary.

IIB22t—17 to 28 inches, yellowish-brown (10YR 5/8) heavy clay loam; strong, medium, subangular blocky structure; firm; thin continuous clay films; common roots; many pebbles; very strongly acid; clear, smooth boundary.

IIB31t—28 to 51 inches, yellowish-brown (10YR 5/8) clay loam; many, fine, distinct, pale-brown (10YR 6/3) mottles; weak, medium and coarse, subangular blocky structure; very firm; thin patchy clay films; few roots; many pebbles; strongly acid; gradual, smooth boundary.

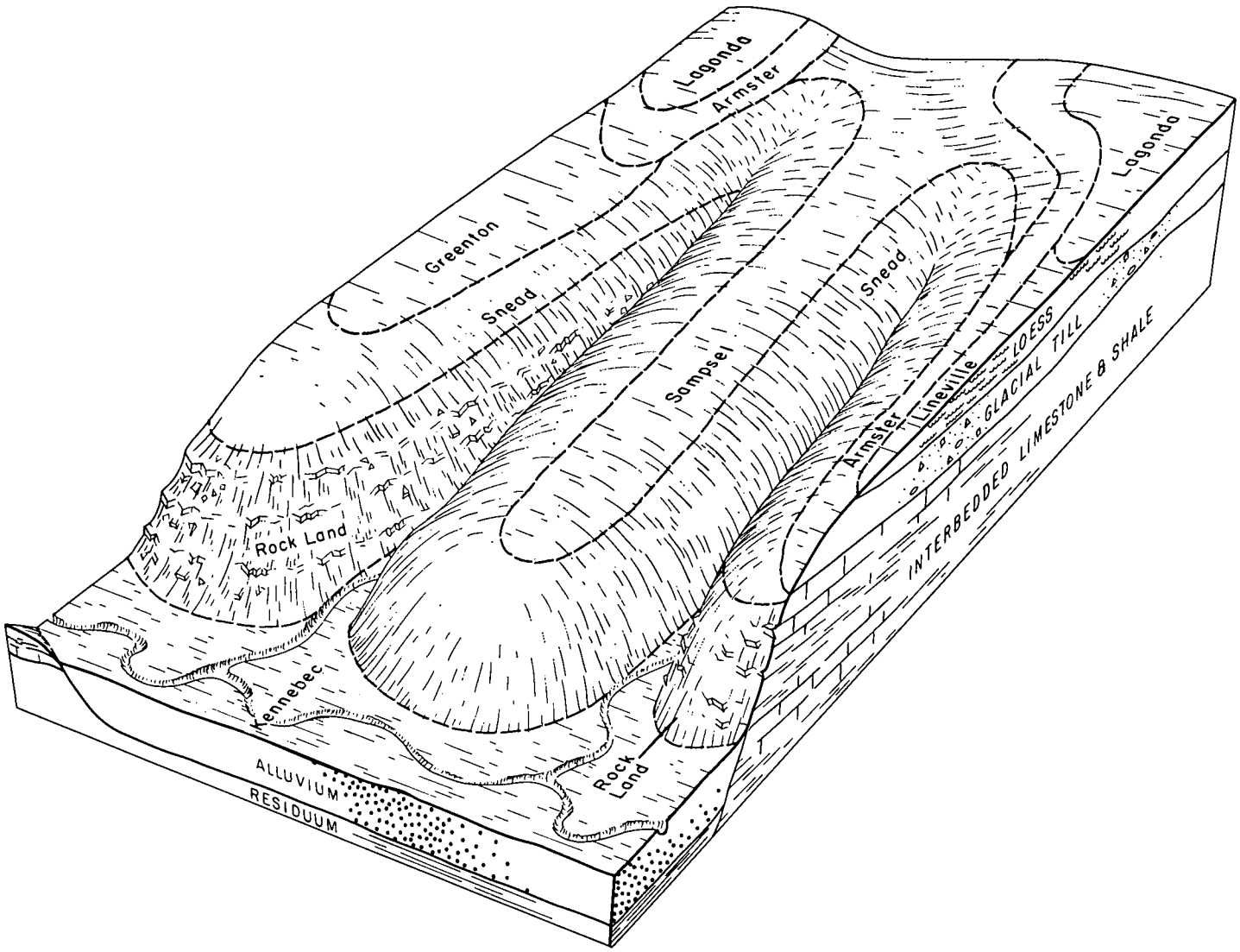

Figure 6.—**Typical pattern of soils in association 3.**

IIB32t—51 to 61 inches, mottled grayish-brown (2.5Y 5/2) and yellowish-brown (10YR 5/8) clay loam; weak, medium, subangular blocky structure; very firm; thin patchy clay films; few roots; common black concretions; many pebbles; neutral; gradual, smooth boundary.

IIIB33t—61 to 80 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; moderate, coarse, angular blocky structure; common black stains on vertical faces of peds; few roots; calcareous.

The A11 horizon ranges from black to very dark gray in color and from 3 to 6 inches in thickness. Armster soils that have been cultivated or that are moderately eroded have a lighter colored A horizon than that described. The number of pebbles and stones on the surface, and in the solum, ranges from few to many.

Armster soils have a thinner dark-colored A1 horizon than the associated Lamoni and Adair soils. They have a coarser textured A horizon than the associated Lineville and Ladoga soils.

Armster loam, 2 to 5 percent slopes (AmB).—Some areas of this soil are on the ends of ridges, generally at lower elevations than Lagonda and Lineville soils, which occupy the higher parts of the ridges. Other areas are on narrow, low ridges, above areas of more sloping Armster soils. Most of the tracts are small.

Included with this soil in mapping were small tracts of sloping Armster soils. Also included were a few eroded areas in which the surface layer is thinner than the one in the profile described as representative of the series.

Among the characteristics that make this soil well suited to cultivated crops and to grasses, trees, and use for wildlife habitat, are the gentle slopes and thick surface layer. The hazard of erosion is high, however, and erosion control is needed. This soil has been used mainly for pasture and as woodland. Capability unit IIe-5.

Armster loam, 5 to 9 percent slopes (AmC).—This soil is on ridges and hillsides. In some places it is above areas of strongly sloping Armster, Sampsel, Greenton, and Snead soils. In others it is above areas of nearly level soils of bottom lands. The tracts generally are small.

Included with this soil in mapping were small tracts occupied by gently sloping or strongly sloping Armster

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Figure 7.—An area of Rock land where bedrock is at a depth of only 1 to 18 inches. This area is used for pasture. In many other places, this land type is in timber and is used for wildlife habitat.

soils. Also included were small areas of Armster soil that has lost much of its original surface layer through erosion.

This soil has been used mainly for pasture or as woodland, and it has been protected from erosion by a cover of grass and trees. Where the tracts are large enough to cultivate, and where erosion control practices are used, this soil is well suited to most of the crops commonly grown in the county. Most of the areas are too small for cultivation to be feasible, however, and they are used for pasture or as woodland along with the surrounding steeper Armster soils. This soil is well suited to use for pasture, as woodland, and for wildlife habitat, but erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Armster loam, 5 to 9 percent slopes, eroded (AmC2).—In some places this soil is on ridges and hillsides, above areas of Rock land, or above areas of strongly sloping Armster, Sampsel, Snead, and Greenton soils. In others it is adjacent to areas of nearly level soils of bottom lands. Size of most of the areas is more than 20 acres. The profile is similar to the one described as representative of the series. Erosion has removed most of the upper part of the original dark-colored surface layer, however, and plowing has mixed the lower part of the original surface layer with material from the upper part of the subsoil. As a result, the present surface layer is dark brown to dark yellowish brown.

Included with this soil in mapping were small tracts of severely eroded Armster soils.

Most areas of this soil have been cultivated or are still used for cultivated crops. The moderate erosion, strong slopes, and rapid runoff make management difficult, but this soil is moderately well suited to cultivated crops. It is well suited to pasture and to use as woodland and for wildlife habitat. Further erosion is a major hazard. Practices that control erosion are needed. Capability unit IIIe-5.

Armster loam, 9 to 14 percent slopes (AmD).—This soil occupies hillsides below areas of sloping Armster soils and above areas of Rock land and Sampsel, Snead, and Greenton soils. In places it is above areas of nearly level soils of bottom lands. The profile is the one described as representative of the series. Size of the areas is normally more than 20 acres.

Included with this soil in mapping were small tracts of sloping and of moderately steep Armster soils.

This soil is somewhat poorly suited to cultivated crops because strong slopes and rapid runoff make it difficult to manage. It is well suited to pasture, to use as woodland, and for wildlife habitat. Erosion is a major hazard. Practices that help to control erosion are needed. Capability unit IVe-5.

Armster loam, 9 to 14 percent slopes, eroded (AmD2).—This soil occupies hillsides below areas of sloping Armster soils and above areas of Rock land and of Sampsel, Snead, and Greenton soils. In places it lies above areas of nearly level bottomland soils. The profile is similar to the one described as representative of the series, except that much of the original surface layer has been removed by erosion. In many places the remaining surface layer and the upper part of the subsoil have been mixed by plowing.

Included with this soil in mapping were small tracts of sloping and moderately steep Armster soils.

This soil is somewhat poorly suited to cultivated crops because its strong slopes, rapid runoff, and eroded condition make it difficult to manage. It is well suited to pasture, to use as woodland, and for wildlife habitat. Further erosion is a major hazard. Management is needed that includes erosion control and maintenance of plant cover much of the time. Capability unit VIe-5.

Armster loam, 14 to 20 percent slopes, eroded (AmE2).—This soil occupies hillsides below areas of strongly sloping Armster soils and above areas of Snead soils. In places it is above areas of Rock land or above areas of bottomland soils. The profile is similar to the one described as representative of the series, except that the surface layer is thinner.

Included with this soil in mapping were small tracts of uneroded and of severely eroded Armster soils.

This soil is not suited to cultivated crops, but it is well suited to pasture and to use as woodland and for wildlife habitat. Runoff is rapid, and further erosion is a major hazard. Management is needed that will keep a permanent cover of plants on this soil. Capability unit VIe-5.

Armster clay loam, 5 to 9 percent slopes, severely eroded (ArC3). This soil occupies ridgetops and hillsides above strongly sloping Armster soils. This soil is in irregularly shaped areas. Its profile is similar to the one described as representative of the series, except that erosion has removed nearly all, or all, of the original surface

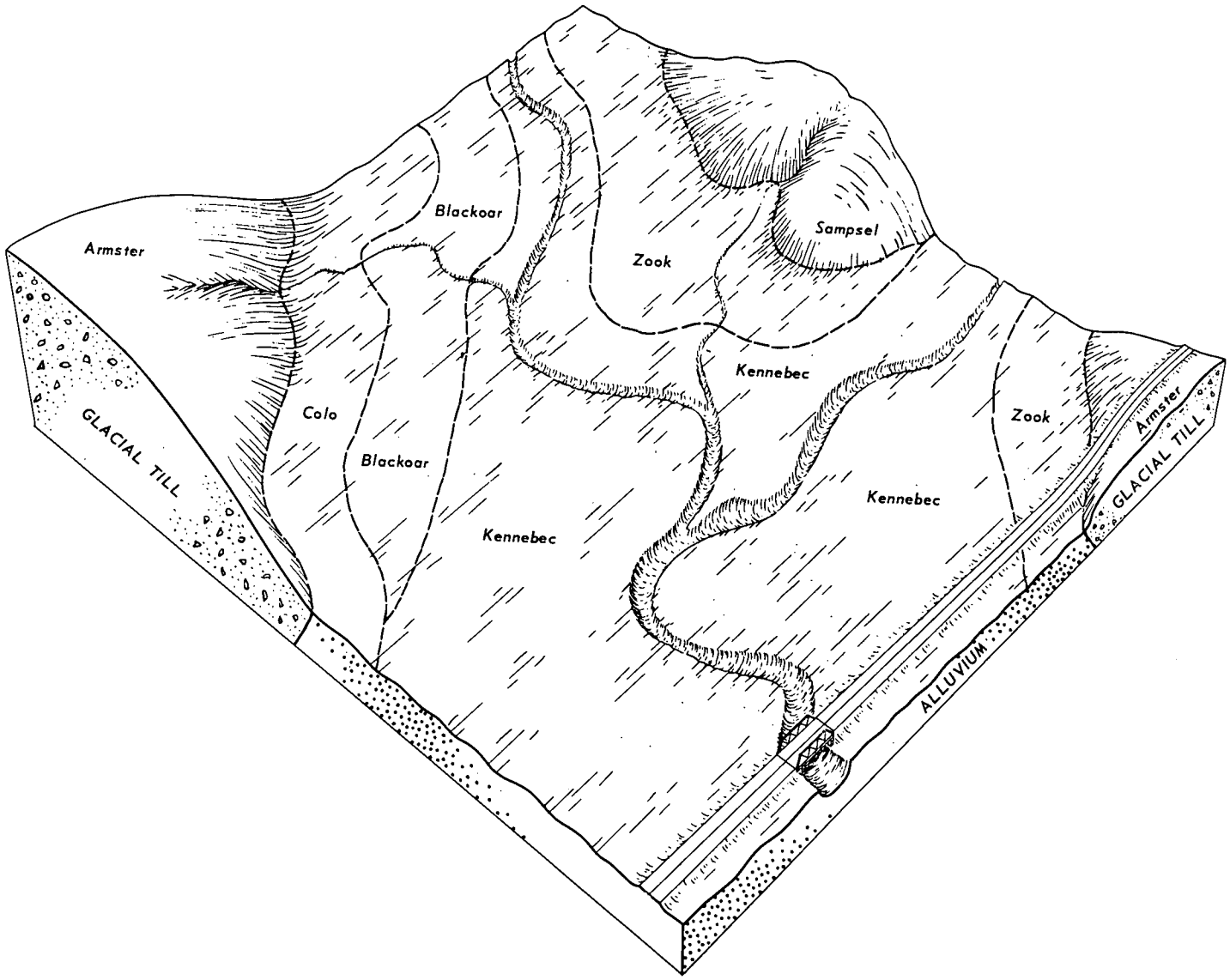

Figure 8.—**Typical pattern of soils in association 4.**

layer and left the dark yellowish-brown heavy clay loam subsoil at the surface.

Included with this soil in mapping were small tracts of less eroded Armster soils.

This soil is difficult to work and manage because it is sloping and severely eroded and its surface layer is moderately fine textured (fig. 9). It is poorly suited to the production of cultivated crops. It is moderately well suited to pasture, to use as woodland, and for wildlife habitat. Runoff is excessive, and further erosion is a major hazard. Management is needed that includes erosion control and the maintenance of ground cover much of the time. Capability unit IVe-8.

Armster clay loam, 9 to 14 percent slopes, severely eroded (ArD3).—This soil occupies hillsides below areas of sloping Armster soils and above areas of Sampsel, Snead, and Greenton soils, and Rock land. In places it is above areas of nearly level bottomland soils. The profile is similar to the one described as representative of the series, except that erosion has removed all of the original surface layer. The present surface layer consists of material from the subsoil and is dark yellowish-brown clay loam.

Included with this soil in mapping were small tracts of less eroded Armster soils.

Because of severe erosion, this soil is not suited to cultivated crops. It is moderately well suited to pasture and is well suited to use as woodland and for wildlife habitat. Management of this soil is difficult because of the rapid runoff, low fertility, and the hazard of further erosion. A cover of plants should be kept on this soil at all times. Capability unit VIe-8.

Blackoar Series

The Blackoar series consists of deep, poorly drained, nearly level soils on flood plains of streams. These bottom-land soils are subject to overflow. Once wet, they are

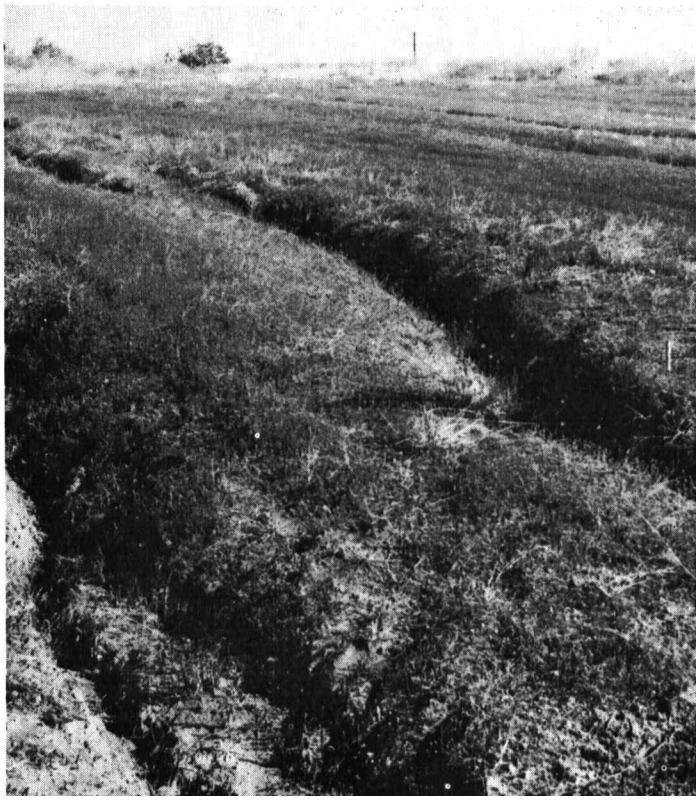

Figure 9.—**Only a sparse cover of plants grows on Armster clay loam, 5 to 9 percent slopes, severely eroded. As a result, this soil is not adequately protected from further sheet and gully erosion.**

slow to dry, and if surface drainage is not good, they remain wet for long periods. These soils formed in old alluvium derived from loess, from glacial till, and from material on the uplands that weathered from rock.

In a representative profile the surface layer is very dark gray silt loam about 18 inches thick. The subsoil is motted gray and dark-gray silt loam about 22 inches thick. The underlying material is mottled gray and dark-gray silt loam that extends to a depth of 60 inches.

Blackoar soils have high content of organic matter, moderate permeability, and high available water capacity. Wetness, closely related to poor surface drainage, is a hazard where crops are grown.

Blackoar soils are used mostly for cultivated crops, but pasture plants are grown to a limited extent on steep streambanks and in narrow areas extending along the sides of streams.

Representative profile of Blackoar silt loam in soybean field (6 miles north and 1½ miles east of Braymer, NW¼ NW¼ NW¼ sec. 13, T. 56 N., R. 26 W.):

Ap—0 to 6 inches, very dark gray (10YR 3/1) silt loam; weak, very fine, granular structure; very friable; many roots; neutral; clear, smooth boundary.

A1—6 to 18 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; very friable; common roots; many fine pores; slightly acid; clear, smooth boundary.

B2g—18 to 40 inches, gray (10YR 5/1) and dark-gray (10YR 4/1) silt loam; common, fine, distinct, dark-brown (10YR 3/3) mottles; weak, fine, subangular blocky structure; friable; few roots; many fine pores; few concretions; slightly acid; gradual, smooth boundary.

Cg—40 to 60 inches, gray (10YR 5/1) and dark-gray (10YR 4/1) silt loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; friable; few roots; few fine pores; few concretions; slightly acid.

The A horizon ranges from 16 to 20 inches in thickness. Texture of the B horizon ranges from silt loam to silty clay loam. The number of dark-colored concretions ranges from few to many, and size of the concretions ranges from small to large.

The Blackoar soils have a grayer A horizon and are lighter colored throughout than the associated Kennebec soils. They are coarser textured than the associated Zook soils.

Blackoar silt loam (Bk).—This is the only Blackoar soil mapped in the county. It is on flood plains of streams. Surface drainage generally is poor. Size of the area ranges from less than 5 to more than 100 acres.

Included with this soil in mapping were small tracts of Kennebec, Colo, and Zook soils.

This Blackoar soil is well suited to cultivated crops and to use for pasture, woodland, and wildlife habitat. It is used mainly for cultivated crops, but it is also used for pasture to some extent. Wetness is a major hazard, and this soil is subject to overwash and flooding. Floods of long duration occur at infrequent intervals, but flash floods can occur at frequent intervals. Management is needed that includes the improvement and maintenance of surface drainage and control of floods. Capability unit IIw-1.

Colo Series

The Colo series consists of deep, poorly drained, nearly level to very slightly depressional soils on flood plains of streams. These bottomland soils are subject to frequent flash floods and infrequent floods of long duration. They formed in old fine-textured alluvial sediment that is covered by 14 inches or more of recent silt loam alluvium. Both old and recent material has been eroded from loess, from glacial till, and from soils on uplands that formed through weathering of rock in place.

In a representative profile the surface layer is about 57 inches thick. The uppermost 14 inches of the surface layer is very dark gray silt loam, the next 26 inches is black silty clay loam, and the lower 17 inches is very dark gray and dark-gray light silty clay. The underlying material is mottled, dark-gray, light silty clay that extends to a depth of 80 inches.

Colo soils have high content of organic matter, moderately slow permeability, and high available water capacity. These soils are well suited to cultivated crops, pasture, timber, or wildlife habitat.

Representative profile of Colo silt loam in a field (6 miles south of Nettleton, center of SW¼SW¼ sec. 11, T 56 N., R. 27 W.):

Ap—0 to 7 inches, very dark gray (10YR 3/1) silt loam; weak, very fine, granular structure; very friable; many roots; slightly acid; clear, smooth boundary.

A11—7 to 14 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; very friable; common roots; slightly acid; gradual, smooth boundary.

A12—14 to 40 inches, black (10YR 2/1) silty clay loam; weak, very fine, subangular blocky structure; firm; common roots; thin patchy clay films; medium acid; gradual, smooth boundary.

A13—40 to 57 inches, very dark gray (10YR 3/1) and dark-gray (10YR 4/1) light silty clay, very dark gray

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Armster loam, 2 to 5 percent slopes	1,600	0.6	Lamoni and Adair soils, 5 to 9 percent slopes, severely eroded	3,800	1.4
Armster loam, 5 to 9 percent slopes	1,900	.7	Lamoni and Adair soils, 9 to 14 percent slopes	550	.2
Armster loam, 5 to 9 percent slopes, eroded	14,400	5.2	Lamoni and Adair soils, 9 to 14 percent slopes, eroded	5,400	2.0
Armster loam, 9 to 14 percent slopes	1,300	.5	Lamoni and Adair soils, 9 to 14 percent slopes, severely eroded	2,150	.8
Armster loam, 9 to 14 percent slopes, eroded	7,400	2.7	Lineville silt loam, 2 to 5 percent slopes	1,650	.6
Armster loam, 14 to 20 percent slopes, eroded	1,650	.6	Lineville silt loam, 2 to 5 percent slopes, eroded	284	.1
Armster clay loam, 5 to 9 percent slopes, severely eroded	1,600	.6	Lineville silt loam, 5 to 9 percent slopes	690	.2
Armster clay loam, 9 to 14 percent slopes, severely eroded	1,800	.7	Lineville silt loam, 5 to 9 percent slopes, eroded	2,100	.8
Blackoar silt loam	4,700	1.7	Lineville silty clay loam, 5 to 9 percent slopes, severely eroded	209	.1
Colo silt loam	7,500	2.7	Moniteau silt loam, 0 to 3 percent slopes	1,250	.4
Greenton silt loam, 2 to 5 percent slopes	464	.2	Nevin silt loam, 0 to 3 percent slopes	1,000	.4
Greenton silty clay loam, 5 to 9 percent slopes, eroded	3,400	1.2	Polo silt loam, 2 to 5 percent slopes	3,350	1.2
Greenton silty clay loam, 9 to 14 percent slopes, eroded	1,600	.6	Polo silt loam, 5 to 9 percent slopes	1,500	.5
Greenton silty clay loam, 9 to 14 percent slopes, severely eroded	291	.1	Polo silt loam, 5 to 9 percent slopes, eroded	3,950	1.4
Grundy silt loam, 0 to 2 percent slopes	456	.2	Polo silt loam, 9 to 14 percent slopes, eroded	600	.2
Grundy silt loam, 2 to 5 percent slopes	20,700	7.5	Rock land	11,700	4.3
Grundy silty clay loam, 2 to 5 percent slopes, eroded	880	.3	Sampsel silty clay loam, 2 to 5 percent slopes	650	.2
Grundy silty clay loam, 5 to 9 percent slopes, eroded	640	.2	Sampsel silty clay loam, 2 to 5 percent slopes, eroded	230	.1
Kennebec silt loam	25,000	9.1	Sampsel silty clay loam, 5 to 9 percent slopes	2,250	.8
Ladoga silt loam, 2 to 5 percent slopes	870	.3	Sampsel silty clay loam, 5 to 9 percent slopes, eroded	6,000	2.2
Ladoga silt loam, 5 to 9 percent slopes, eroded	1,850	.7	Sampsel silty clay loam, 5 to 9 percent slopes, severely eroded	520	.2
Ladoga silt loam, 9 to 14 percent slopes, eroded	900	.3	Sampsel silty clay loam, 9 to 14 percent slopes, eroded	1,850	.7
Ladoga silt loam, 14 to 20 percent slopes	155	.1	Snead silty clay loam, 5 to 9 percent slopes	2,200	.8
Lagonda silt loam, 2 to 5 percent slopes	21,000	7.6	Snead silty clay loam, 9 to 14 percent slopes	3,700	1.3
Lagonda silt loam, 2 to 5 percent slopes, eroded	5,900	2.1	Snead silty clay loam, 9 to 14 percent slopes, eroded	2,000	.7
Lagonda silt loam, 5 to 9 percent slopes	5,300	1.9	Snead silty clay loam, 14 to 20 percent slopes	610	.2
Lagonda silty clay loam, 5 to 9 percent slopes, eroded	40,000	14.5	Zook silty clay loam	5,700	2.1
Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded	4,250	1.6	Zook silty clay	1,400	.5
Lamoni and Adair soils, 2 to 5 percent slopes	2,200	.8	Water	214	.1
Lamoni and Adair soils, 2 to 5 percent slopes, eroded	700	.3	Quarries	87	(1)
Lamoni and Adair soils, 5 to 9 percent slopes	4,500	1.6	Total	275,200	100.0
Lamoni and Adair soils, 5 to 9 percent slopes, eroded	22,700	8.3			

[1] Less than 0.05 percent.

(10YR 3/1) kneaded; very firm; few roots; shiny ped faces; few small concretions; medium acid; gradual, smooth boundary.

C—57 to 80 inches, dark-gray (5Y 4/1) light silty clay; common, fine, faint, gray (5Y 5/1) mottles and few, fine, faint, dark-grayish brown (10YR 4/2) mottles; dark gray (10YR 4/1) kneaded; firm; massive.

The Ap and A11 horizons combined range from very dark gray to very dark brown silt loam 14 to 18 inches thick. The A12 and A13 horizons combined range from silty clay loam to silty clay in texture and from a few feet to many feet in thickness.

Colo soils are more poorly drained than the associated Kennebec soils and better drained than the associated Zook soils.

Colo silt loam (Co).—This is the only Colo soil mapped in the county. It is a nearly level to very slightly depressional soil on flood plains of streams.

Included with this soil in mapping were small tracts of Zook, Blackoar, and Kennebec soils.

This Colo soil is used mostly for cultivated crops, but a limited acreage is in pasture or is used as woodland. Trees grow on narrow areas of this soil that are on sides of stream channels or on steep banks along streams.

This soil is suited to cultivated crops, pasture, timber, and wildlife habitat. Flooding is the major hazard (fig. 10). Management that includes flood control is needed. Capability unit IIw-1.

Greenton Series

The Greenton series consists of deep, moderately well drained, gently sloping to strongly sloping soils on hillsides and the ends of ridges on uplands. Greenton soils formed in material weathered from various interbedded limestones and shales.

In a representative profile the surface layer is about 12 inches thick. The upper 7 inches is black silt loam, and the lower 5 inches is very dark gray and dark yellowish-brown, heavy silt loam. The subsoil, about 18 inches thick, is yellowish-brown and brown silty clay. The underlying material is mottled olive clay in the upper 9 inches and

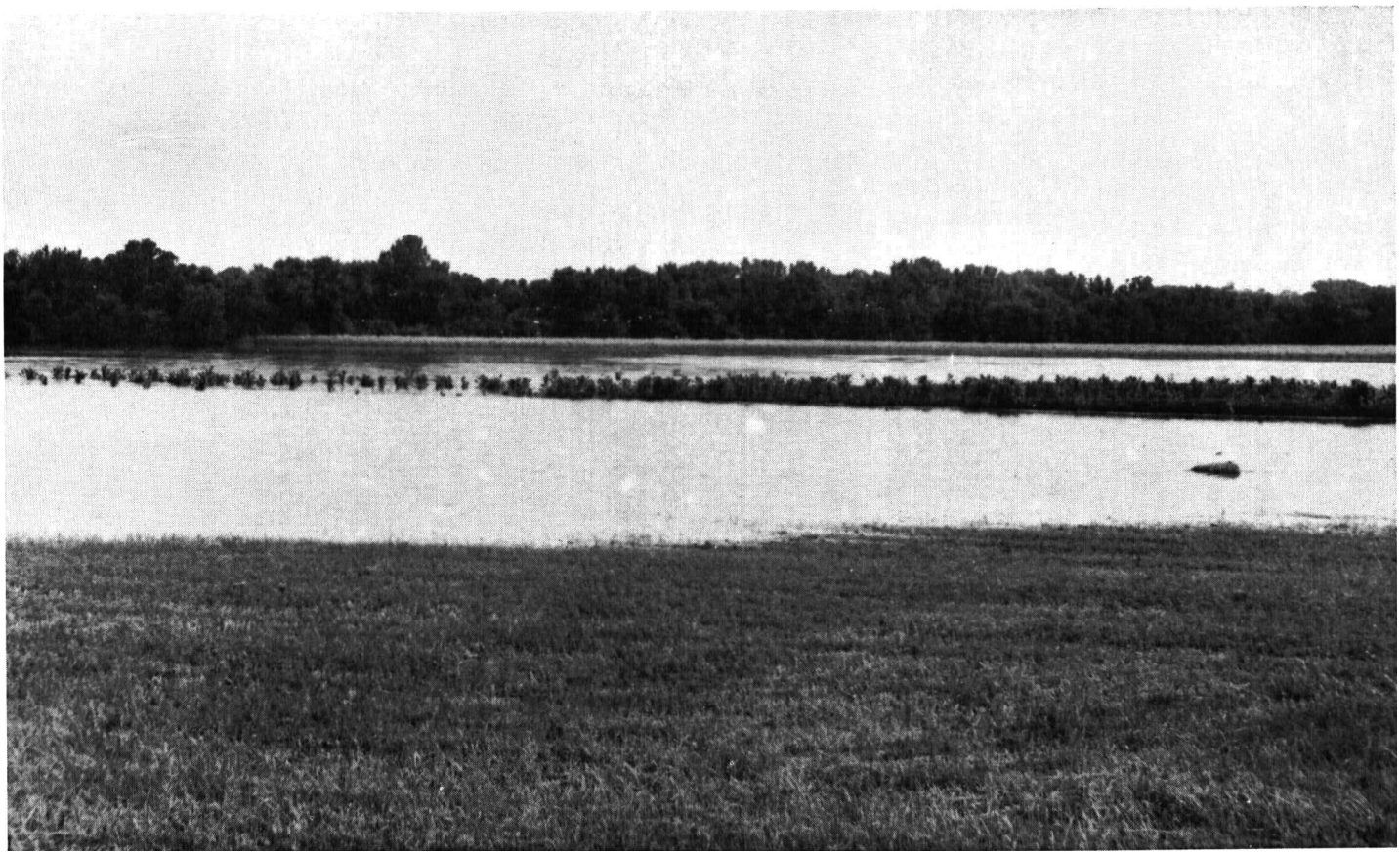

Figure 10.—An area of Colo silt loam covered by floodwaters. Flooding occurs occasionally on nearly all bottom land soils in Caldwell County.

is pale-olive and yellowish-brown silty clay in the lower 21 inches. The profile extends to a depth of 60 inches.

Greenton soils have moderate content of organic matter, moderate permeability, and moderate available water capacity.

Representative profile of a Greenton silt loam, 2 to 5 percent slopes, in a lespedeza pasture (3 miles north of Cowgill, NW¼SE¼SW¼ sec. 34, T. 56 N., R. 27 W.):

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

A1—7 to 12 inches, very dark gray (10YR 3/1) and dark yellowish-brown (10YR 4/4) heavy silt loam; weak, very fine, subangular blocky structure; friable; common roots; slightly acid; clear, smooth boundary.

B2t—12 to 28 inches, yellowish-brown (10YR 5/4) and brown (10YR 4/3) light silty clay; shows a few streaks of dark gray (10YR 4/1); weak, fine, angular blocky structure; firm; common roots; thin continuous clay films; common soft dark-brown concretions; slightly acid; clear, smooth boundary.

IIB3t—28 to 30 inches, dark-brown (7.5YR 4/4) silty clay; common, medium, distinct, light brownish-gray (10YR 6/2) and few, fine, distinct, black (10YR 2/1) mottles; weak, coarse, subangular blocky structure; firm; few roots; thin patchy clay films; few dark-brown concretions; neutral; abrupt, smooth boundary.

IIC1—30 to 39 inches, olive (5Y 5/3) clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; massive; very firm; few roots; few fragments of limestone; mildly alkaline.

IIC2—39 to 60 inches, pale-olive (5Y 6/4) and yellowish-brown (10YR 5/4) silty clay; massive; very firm; many limestone fragments; mildly alkaline.

The A horizon of moderately eroded Greenton soils is more brownish than the one in the profile described as representative of the series. The thickness of the B horizon ranges generally from about 18 to 24 inches, but it is more than 24 inches thick in some places.

Greenton soils are more permeable than Grundy, Lagonda, and Sampsel soils, which are associated in most areas at higher levels. Greenton soils lack the glacial materials that are in the B horizon of the associated Lamoni and Adair soils, Armster soils, and Lineville soils.

Greenton silt loam, 2 to 5 percent slopes (GnB).—This soil occupies ridge ends and benchlike hillsides. It is normally upslope from sloping Greenton soils. In some low areas, it is downslope from soils on uplands. The areas have an irregular shape. The profile is the one described as representative of the series.

Included with this soil in mapping were small tracts of eroded Greenton soils.

Among the characteristics that make this soil well suited to cultivated crops and to use for pasture, as woodland, and for wildlife habitat are the gentle slopes and the thick surface layer. This soil is used mainly for cultivated crops and pasture crops, grown on acreages of about equal size. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-5.

Greenton silty clay loam, 5 to 9 percent slopes, eroded (GrC2).—This soil occupies long narrow tracts or horizontal areas on hillsides and ridge ends. It is lower in elevation than Grundy or Lagonda soils but in places it is upslope or downslope from any of the other upland soils of the county. This soil has a profile similar to the one described as representative of the series, except it has a thinner surface layer of dark yellowish-brown silty clay loam.

Included with this soil in mapping were small tracts of uneroded and severely eroded Greenton soils. Also included are small tracts of Sampsel and Snead soils.

This soil is used mostly for cultivated crops and pasture grown on acreages of about equal size. The slopes, erosion, and moderately fine texture of the surface layer make this soil somewhat difficult to work and manage. It is moderately well suited to the production of cultivated crops and is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard, and management that includes erosion control is needed. Capability unit IIIe-5.

Greenton silty clay loam, 9 to 14 percent slopes, eroded (GrD2).—This soil is mainly in long, narrow, horizontal tracts on hillsides; but it also is in small, irregularly shaped tracts. It is downslope from the Polo soils or sloping Greenton soils and it is upslope from Armster, Sampsel, and Lamoni and Adair soils, or Rock land. In places it is adjacent to areas of soils on bottom lands. The profile is similar to the one described as representative of the series, except that the surface layer is thinner and is dark yellowish-brown silty clay loam.

Included with this soil in mapping were small tracts of Polo, Sampsel, and Snead soils and more sloping Greenton soils.

About one-third of the acreage of this Greenton soil is in pasture, one-third in hay, and one-third in cultivated crops other than hay. The steep slopes, the eroded condition, and the moderately fine textured surface layer make this soil difficult to work and manage. It is somewhat poorly suited to cultivated crops but is well suited to pasture, woodland, and wildlife habitat. Runoff is rapid, and further erosion is a major hazard. Management is needed that includes erosion control and the maintenance of a ground cover much of the time. Capability unit VIe-5.

Greenton silty clay loam, 9 to 14 percent slopes, severely eroded (GrD3).—This soil is in small, irregular areas on hillsides. It is downslope from less eroded Greenton soils and upslope from Rock land or Sampsel and Snead soils. In places it is adjacent to bottom-land soils. This soil has a profile similar to the one described as representative of the series, but erosion has removed the original surface layers leaving yellowish-brown silty clay loam subsoil on the surface.

Included with this soil in mapping were small tracts of less eroded Greenton soils.

This Greenton soil is used mostly for pasture but small areas are used for growing hay, for woodland, and for wildlife habitat. The strong slopes, severe erosion, and rapid runoff make this Greenton soil unsuitable for cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard on this soil, and management is needed that maintains continuous ground cover. Capability unit VIe-8.

Grundy Series

The Grundy series consists of deep, somewhat poorly drained, nearly level to sloping soils on uplands. These soils occupy the higher parts of high, rounded ridges. They also occupy low benchlike areas in the southeastern part of the county adjacent to the flood plain of Mud Creek. These soils formed in wind-deposited silt and clay.

In a representative profile the surface layer is black heavy silt loam about 7 inches thick. The subsurface layer is black silty clay loam about 3 inches thick. The subsoil is about 41 inches thick. The uppermost 3 inches of it is mottled dark-brown and very dark gray silty clay loam. Next, in sequence downward, is 5 inches of mottled very dark gray, dark yellowish-brown, and dark-gray silty clay; 10 inches of mottled grayish-brown, dark-brown, and dark-gray silty clay; and 11 inches of grayish-brown silty clay loam. The lowermost 12 inches is light-gray, grayish-brown, and yellowish-brown silty clay loam. The underlying material is mottled grayish-brown heavy silt loam that extends to a depth of 64 inches.

Grundy soils have moderate to high content of organic matter, slow permeability, and high available water capacity. Erosion is a major hazard.

Grundy soils are used mostly for cultivated crops, and only a small acreage is in pasture and woodland.

Representative profile of Grundy silt loam, 2 to 5 percent slopes, in a cornfield (3 miles west of Hamilton, SE corner of NE¼NW¼SW¼ sec. 16, T. 57 N., R. 28 W.):

Ap—0 to 7 inches, black (10YR 2/1) heavy silt loam; weak, fine, granular structure; friable; common roots; neutral; abrupt, smooth boundary.

A3—7 to 10 inches, black (10YR 2/1) silty clay loam; moderate, fine, granular structure; friable; common roots; slightly acid; clear, smooth boundary.

B1—10 to 13 inches, mottled dark-brown (10YR 3/3) and very dark gray (10YR 3/1) silty clay loam; strong, fine, subangular blocky structure; firm, common roots; discontinuous clay films on ped surfaces; medium acid; clear, smooth boundary.

B21t—13 to 18 inches, mottled very dark gray (10YR 3/1), dark yellowish-brown (10YR 4/4), and dark-gray (10YR 4/1) silty clay; few, fine, prominent, yellowish-red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; firm; few roots; continuous clay skins; medium acid; clear, smooth boundary.

B22t—18 to 28 inches, mottled grayish-brown (2.5Y 5/2), dark-brown (10YR 4/3), and dark-gray (10YR 4/1) silty clay; weak, fine, subangular blocky structure; very firm; few roots; discontinuous clay films; few black concretions; neutral; clear, smooth boundary.

B31t—28 to 39 inches, grayish-brown (2.5Y 5/2) silty clay loam mottled in a fine, distinct pattern with yellowish brown (10YR 5/6); weak, fine, subangular blocky structure; firm; few roots; few, small, black concretions; neutral; clear, smooth boundary.

B32—39 to 51 inches, light-gray (10YR 6/1) grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) silty clay loam; weak, medium, subangular blocky structure; firm, few roots; few, large, soft, black concretions; neutral.

C—51 to 64 inches, grayish-brown (10YR 5/2) heavy silt loam; many, coarse, prominent, dark yellowish-brown (10YR 4/4) mottles; massive; firm; sticky; many, large, black concretions; neutral.

The A horizon is uniform in color and thickness. A minor acreage of Grundy soils has been moderately eroded in the county.

Grundy soils have a finer textured A horizon than the associated Armster soils and a finer textured B horizon than the associated Lagonda, Lineville, and Armster soils.

Grundy silt loam, 0 to 2 percent slopes (GsA).—This soil is on ridges upslope from gently sloping Grundy and Lagonda soils. The areas are long and narrow.

Included with this soil in mapping were small tracts of gently sloping Grundy soils.

Characteristics that help to make this soil well suited to cultivated crops and to use for pasture, woodlands, and wildlife habitat are the thick surface layer and the nearly level relief. This soil is used mainly for cultivated crops. Capability unit IIw-1.

Grundy silt loam, 2 to 5 percent slopes (GsB).—This soil is on ridges upslope from gently sloping Lagonda soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of Lagonda soils and of moderately eroded Grundy soils.

This soil is used mostly for cultivated crops. Among the characteristics that make it well suited to cultivated crops and to use for pasture, woodland, and wildlife habitat are its gentle slopes and thick surface layer. Erosion is a major hazard and management that includes practices that control erosion is needed. Capability unit IIe-5.

Grundy silty clay loam, 2 to 5 percent slopes, eroded (GuB2).—This soil is on ridges upslope from Lagonda soils. It has a profile similar to the one described as representative of the series, except that erosion has removed much of the surface layer and left the silty clay loam subsurface layer exposed.

Included with this soil in mapping were small tracts of Lagonda soils too small to be mapped separately.

This Grundy soil is somewhat difficult to work because of the moderately fine texture and moderate erosion of the surface layer. About half the acreage is in cultivated crops, and about half is in pasture. The soil is moderately well suited to cultivated crops and is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard, and management that includes erosion control is needed. Capability unit IIIe-5.

Grundy silty clay loam, 5 to 9 percent slopes, eroded (GuC2).—This soil is on hillsides downslope from gently sloping Grundy soils and upslope from sloping Lagonda soils. It is mainly on the low-lying benchlike areas in the southeastern part of the county. This soil has a profile similar to the one described as representative of the series, except it has a silty clay loam surface layer.

Included with this soil in mapping were small tracts of Lagonda soils.

This Grundy soil is somewhat difficult to work and manage, because of the slope, the erosion, and the moderately fine textured surface layer. About half the acreage is in cultivated crops, and about half is in pasture. This soil is moderately well suited to cultivated crops and is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard, and management that includes erosion control is needed. Capability unit IIIe-5.

Kennebec Series

The Kennebec series consists of deep, well-drained, nearly level soils on bottoms along streams. These soils formed in recent, stratified deposits of silt loam texture. They are subject to occasional floods that last for a short time and cause moderate damage.

In a representative profile the surface layer is about 36 inches thick. It is very dark brown silt loam in the upper 10 inches and black silt loam in the lower 26 inches. The underlying material is black silt loam that reaches to a depth of 62 inches.

Kennebec soils have high content of organic matter, moderate permeability, and high available water capacity.

Kennebec soils are used mostly for cultivated crops but to some extent for pasture. Narrow areas adjacent to stream channels are used for timber and wildlife habitat (fig. 11).

Representative profile of Kennebec silt loam in meadow (2 miles north and 2 miles west of Catawba, NW¼SW¼-SW¼ sec. 7, T. 56 N., R. 26 W.):

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

A11—10 to 14 inches, black (10YR 2/1) silt loam; weak, very fine, granular structure; very friable; many roots; neutral; clear, smooth boundary.

A12—14 to 36 inches, black (10YR 2/1) silt loam; weak, medium, subangular blocky structure; friable; common roots; slightly acid; gradual, smooth boundary.

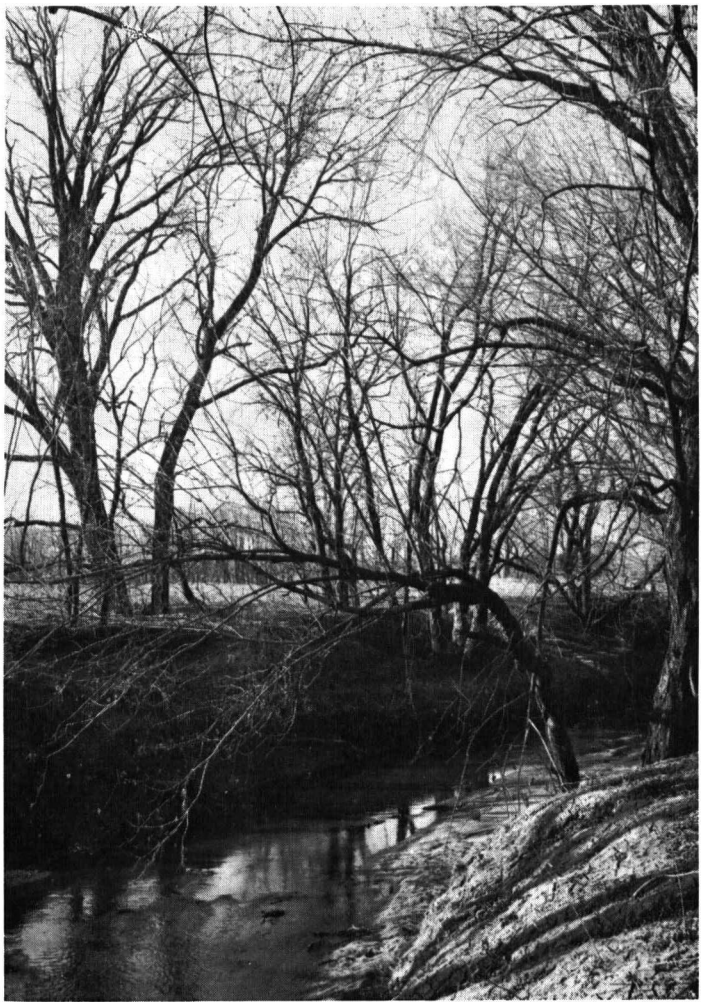

Figure 11.—Trees on steep soils on streambanks and on the adjacent nearly level Kennebec soils.

C—36 to 62 inches, black (10YR 2/1) silt loam; many dark-brown (10YR 3/3) splotches; massive; firm; common roots; slightly acid.

The A horizon is silt loam in most places, but it is loam in a few small areas. In places thin sandy layers occur throughout the profile.

Kennebec soils are better drained and more rapidly permeable than the associated Colo and Zook soils.

Kennebec silt loam (Ke).—This is the only Kennebec soil mapped in the county. It is in small to large areas on bottoms along streams.

Included with this soil in mapping were small tracts of Zook, Blackoar, and Colo soils.

Kennebec silt loam is well suited to cultivated crops, pasture, timber, and wildlife habitat. It is subject to infrequent overwash and flooding in places, but there are no major hazards to use of this soil. Capability unit I-1.

Ladoga Series

The Ladoga series consists of deep, moderately well drained, gently sloping to steep soils on ridges, hillsides, and benchlike low-lying ridge ends on uplands. These soils formed in silty material deposited by wind action, and in places small amounts of glacial sand and gravel are present.

In a representative profile the surface layer is very dark grayish-brown silt loam about 6 inches thick. The subsurface layer is dark-brown and very dark grayish-brown silt loam about 4 inches thick. The subsoil is about 35 inches thick. The uppermost 6 inches is dark-brown light silty clay loam. The next 20 inches is yellowish-brown silty clay loam. The lowermost 9 inches is yellowish-brown and dark yellowish-brown silty clay loam. The underlying material is mottled grayish-brown silt loam that extends to a depth of 60 inches.

Ladoga soils have moderately low content of organic matter, moderately slow permeability, and moderate available water capacity. Erosion is a major hazard.

Ladoga soils are used mostly for cultivated crops and pasture in acreages of about equal size. Small acreages are used for woodland and wildlife habitat.

Representative profile of Ladoga silt loam, 2 to 5 percent slopes, in pasture (2 miles west and 1 mile north of Catawba, center of SE¼SE¼ sec. 13, T. 56 N., R. 27 W.):

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; very friable; medium acid; clear, smooth boundary.

A2—6 to 10 inches, dark-brown (10YR 4/3) and very dark grayish-brown (10YR 3/2) silt loam; dark brown (10YR 4/3) predominates in the lower part; moderate, fine, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

B1—10 to 16 inches, dark-brown (10YR 4/3) light silty clay loam; strong, fine, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.

B2t—16 to 26 inches, yellowish-brown (10YR 5/4) silty clay loam; strong, fine, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.

B22t—26 to 36 inches, yellowish-brown (10YR 5/6 and 10YR 5/4) silty clay loam; strong, fine, subangular blocky structure; firm; very strongly acid; clear, smooth boundary.

B3—36 to 45 inches, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) silty clay loam; weak, very fine, subangular blocky structure; firm; strongly acid; clear, smooth boundary.

C—45 to 60 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; firm; medium acid.

The A1 horizon ranges from very dark grayish brown to dark grayish brown in color and from 6 to 10 inches in thickness.

Ladoga soils are lighter in color than Grundy, Lagonda, Lamoni, Adair, Greenton, and Sampsel soils, all of which formed in similar materials. Ladoga soils do not have the large amounts of glacial sand and gravel in the solum that is common in the associated Armster and Lineville soils. Ladoga soils have a grayer A horizon and a yellower subsoil than the associated Polo soils.

Ladoga silt loam, 2 to 5 percent slopes (LaB).—This soil is on ridges and benchlike low-lying ridge ends. It generally is lower in elevation than Grundy and Lagonda soils and generally is above sloping and strongly sloping Ladoga soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of eroded and sloping Ladoga soils. Also included were small tracts of Lagonda and Armster soils.

About equal acreages of this Ladoga soil are in cultivated crops and pasture. Among the characteristics that help to make this soil suited to cultivated crops and to use for pasture, woodland, and wildlife habitat are the gentle slopes and the thick surface layer. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-4.

Ladoga silt loam, 5 to 9 percent slopes, eroded (LaC2).—This soil is on ridges and hillsides. It generally is downslope from gently sloping Ladoga soils and upslope from strongly sloping Ladoga soils. In places it is upslope from Armster, Greenton, Snead, or Sampsel soils or Rock land. This soil has a profile similar to the one described as representative of the series, except that erosion has removed some of the original surface layer and plowing has turned up some of the upper part of the subsoil to produce a dark-brown heavy silt loam surface layer.

Included with his soil in mapping were small tracts of uneroded and severely eroded Ladoga soils. Also included were small tracts of Armster, Greenton, Snead, and Sampsel soils.

This soil is suited to cultivated crops, and to use for pasture, woodland, and wildlife habitat. It is difficult to work and manage, however, because of its slopes, past erosion, and the somewhat fine texture of the surface layer. About equal acreages of this soil are used for cultivated crops and pasture. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-4.

Ladoga silt loam, 9 to 14 percent slopes, eroded (LaD2).—This soil is on hillsides downslope from sloping Ladoga soils and upslope from Greenton, Snead, and Sampsel soils. This soil has a profile similar to that described as representative of the series, except that its surface layer is dark-brown heavy silt loam.

Included with this soil in mapping were small tracts of uneroded and severely eroded Ladoga soils.

This Ladoga soil is used mostly for growing hay and pasture plants. It is difficult to work and manage because of strong slopes, erosion, and a somewhat fine-textured surface layer. It is somewhat poorly suited to the production of most cultivated crops but is well suited to pasture,

woodland, and wildlife habitat. Rapid runoff and further erosion are major hazards on this soil. Management is needed that includes erosion control and maintenance of ground cover much of the time. Capability unit IVe–4.

Ladoga silt loam, 14 to 20 percent slopes (LaE).—This soil is on hillsides downslope from strongly sloping Ladoga soils and upslope from Greenton and Sampsel soils, and Rock land. This soil normally occurs in tracts of less than 20 acres in size.

Included with this soil in mapping were small tracts of eroded Ladoga soils.

This soil is unsuited to cultivated crops and is used mostly for pasture and woodland. It is well suited to pasture, woodland, and wildlife habitat. Erosion is the major hazard on this soil, and management that includes the maintenance of continuous ground cover is needed. Capability unit VIe–5.

Lagonda Series

The Lagonda series consists of deep, somewhat poorly drained, gently sloping and sloping soils on ridges, on the upper parts of hillsides, and around the heads of small drainageways. The Lagonda soils are the most extensive soils on uplands in the county. The upper layers of these soils contain practically no sand or gravel and contrast markedly with the sandy, gravelly lower layers. The upper layers formed in silty material that was transported and deposited by wind, in contrast with the lower layers that formed in silt, sand, clay, and gravel that was transported and deposited by glacial action.

In a representative profile the black surface layer is about 10 inches thick. The upper part is silt loam, and the lower part is mottled light silty clay loam. The subsoil is about 35 inches thick. The upper 6 inches is mottled very dark grayish-brown and very dark gray medium silty clay loam. Then, in sequence, is 8 inches of mottled very dark gray and dark yellowish-brown light silty clay; 10 inches of dark grayish-brown heavy silty clay loam; and 5 inches of mottled dark-gray heavy silty clay loam. The lower 6 inches is mottled dark grayish-brown clay loam. The underlying material is mottled dark grayish-brown clay loam that extends to a depth of 63 inches.

Lagonda soils have moderate to high content of organic matter, slow permeability, and high available water capacity.

About three-fourths of the acreage of Lagonda soils in this county is used for the production of cultivated crops, and the remaining one-fourth is mostly used for pasture. A small acreage is used for woodland.

Representative profile of Lagonda silt loam, 2 to 5 percent slopes, in a cultivated field (1 mile east and one-half mile south of Mirabile, near center of SW¼SE¼NE¼ sec. 3, T. 55 N., R. 29 W.):

Ap—0 to 6 inches, black (10YR 2/1) silt loam; moderate, fine and very fine, granular structure; friable; medium acid; abrupt, smooth boundary.

A3—6 to 10 inches, black (10YR 2/1) light silty clay loam; common, fine, faint, yellowish-red mottles in the lower 2 inches of the horizon; weak, medium and fine, granular structure; friable; strongly acid; clear, smooth boundary.

B1—10 to 16 inches, mottled very dark grayish-brown (10YR 3/2) and very dark gray (10YR 3/1) medium silty clay loam; strong, fine and very fine, subangular blocky structure; friable; few very fine sand grains on ped surfaces; strongly acid; abrupt, smooth boundary.

B21t—16 to 24 inches, mottled very dark gray (10YR 3/1) and dark yellowish-brown (10YR 4/4) light silty clay; fine, subangular blocky structure; very firm; nearly continuous clay films on ped surfaces; very dark gray ped surfaces and dark yellowish-brown ped interiors in fine distinct pattern; few, fine, dark reddish-brown concretions; few sand grains; medium acid; gradual, smooth boundary.

B22t—24 to 34 inches, dark grayish-brown (2.5Y 4/2) heavy silty clay loam; common, fine, faint, yellowish-brown mottles and few, fine, distinct, yellowish-red mottles; compound, weak, medium, prismatic structure and medium blocky structure; firm; discontinuous clay films on ped surfaces and in tubular pores; few, fine, yellowish-red and black oxide accumulations; occasional sand grains; neutral; clear, smooth boundary.

IIB23t—34 to 39 inches, dark-gray (10YR 4/1) heavy silty clay loam; fine, faint, dark yellowish-brown mottles; weak, coarse, blocky structure; firm; discontinuous clay films on ped surfaces and in tubular pores; common very dark gray ped coatings and pore fillings within peds; common, soft, dark oxide accumulations about 1 millimeter in diameter; occasional coarse sand grains and small rock fragments; neutral; clear, smooth boundary.

IIB3t—39 to 45 inches, dark grayish-brown (2.5Y 4/2) clay loam; common, fine, distinct, yellowish-brown to strong-brown mottles; very weak, coarse, blocky structure; firm; few patchy clay films; few, soft, dark oxide accumulations 0.07 to 1 millimeter in diameter; some coarse sand and fine gravel fragments; mildly alkaline; gradual, smooth boundary.

IIC—45 to 63 inches, dark grayish-brown (2.5Y 4/2) clay loam; common, fine, distinct, yellowish-brown mottles; massive with occasional cleavage planes; firm; few, soft, dark oxide accumulations 2 to 3 millimeters in diameter; few tubular pores 0.07 to 1 millimeter in diameter; few coarse sand grains and pebbles, some of granitic composition; moderately alkaline.

The A horizon ranges from black to dark gray in color and from silt loam to silty clay loam in texture. The depth to a marked increase in sand and gravel content ranges from 18 inches to 34 inches, but a depth of 24 inches is most common.

Lagonda soils have a finer textured A horizon than Adair and Armster soils which are on the same landscape. Lagonda soils have coarser textured B horizons than the associated Lamoni and Grundy soils.

Lagonda silt loam, 2 to 5 percent slopes (LdB).—This soil is on ridges above sloping Lagonda, Lamoni, Adair, or Armster soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of Grundy soils or moderately eroded or sloping Lagonda soils.

This Lagonda soil is used mostly for cultivated crops. Among the characteristics that make this soil well suited to cultivated crops, pasture, timber, and wildlife habitat are the gentle slopes and the thick surface layer. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-5.

Lagonda silt loam, 2 to 5 percent slopes, eroded (LdB2).—This soil is on ridges above sloping Lagonda, Lamoni, and Adair soils, or Armster soils. This soil has a profile similar to the one described as representative of the series, except it has thinner, browner surface layers and is somewhat finer textured because erosion has removed much of the surface layer. Plowing has mixed the

subsurface layer and the upper part of the subsoil to produce a very dark brown silt loam surface layer.

Included with this soil in mapping were small tracts of Lagonda soils that are uneroded, severely eroded, or more sloping than this soil.

This Lagonda soil is used mainly for cultivated crops. This soil is difficult to work because it is moderately eroded. It is moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Lagonda silt loam, 5 to 9 percent slopes (ldC).—This soil is on ridges and hillsides. It generally is downslope from gently sloping Lagonda soils and upslope from Lamoni and Adair soils or Armster soils. This soil is in moderately large sized tracts.

Included with this soil in mapping were small tracts of moderately eroded Lagonda soils.

This Lagonda soil has been used mainly for pasture. Among the characteristics that make this soil well suited to cultivated crops, pasture, timber, and wildlife habitat is a thick, medium-textured surface layer. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Lagonda silty clay loam, 5 to 9 percent slopes, eroded (lgC2).—This soil is on ridges and hillsides. Generally it is downslope from gently sloping Lagonda soils and upslope from Lamoni and Adair soils or Armster soils. This soil is in large tracts. It has a profile similar to the one described as representative of the series, except that it has a silty clay loam surface layer. Much of the original surface layer and some of the subsurface layer has been removed through erosion. Plowing has mixed the remaining part of the surface and subsurface layers with the top part of the subsoil.

Included with this soil in mapping were small tracts of Lagonda soils that are uneroded, severely eroded Lagonda soils, Lamoni and Adair soils, and Armster soils.

This soil is difficult to work and manage because of slope, erosion, and a moderately fine textured surface layer. It is moderately well suited to, and is used mainly for, the production of cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded (lgC3).—This soil is on ridges and hillsides downslope from Lagonda soils that are gently sloping, and upslope from Lamoni and Adair soils or Armster soils. This soil is in irregular shaped tracts that are cut by many small gullies.

This soil has a profile similar to the one described as representative of the series, but nearly all of the original surface layer has been removed by erosion. This has left the very dark grayish-brown silty clay loam subsoil at the surface.

Included with this soil in mapping were small tracts of Lagonda soils that are uneroded. Also included were small areas of Lagonda soils on gentle slopes.

This soil is difficult to work and manage because of the slope, severe erosion, and moderately fine texture of the surface layer. The soil is somewhat poorly suited to cultivated crops. It is moderately well suited to pasture, woodland, and wildlife habitat. Runoff is excessive, and further erosion is a major hazard. Management that includes erosion control and maintenance of a ground cover much of the time is needed. Capability unit IVe-8.

Lamoni Series

The Lamoni series consists of deep, somewhat poorly drained, sloping to strongly sloping soils on the sides of valleys. They formed in glacial sediment.

In a representative profile the surface layer is clay loam about 10 inches thick. The upper part is black, and the lower part is very dark grayish-brown. The subsoil is about 27 inches thick. The uppermost 4 inches is dark grayish-brown and dark-brown clay. Next, in sequence, is 6 inches of mottled dark grayish-brown and grayish-brown clay, 5 inches of mottled grayish-brown and yellowish-brown clay, and 9 inches of mottled light brownish-gray and yellowish-brown clay. The lowermost 3 inches is yellowish-brown, light brownish-gray, and grayish-brown clay loam. The underlying material is grayish-brown and yellowish-brown clay loam that reaches to a depth of 61 inches.

Lamoni soils have moderate to high organic-matter content, slow permeability, and high available water capacity.

Representative profile of Lamoni clay loam, 5 to 9 percent slopes, in meadow (3 miles south of Kidder, NE corner of SE¼SE¼NE¼ sec 24, T. 57 N., R. 29 W.) :

A1—0 to 7 inches, black (10YR 2/1) and very dark brown (10YR 2/2) clay loam; moderate, very fine, subangular blocky structure; friable; many roots; neutral; clear, smooth boundary.

A3—7 to 10 inches, very dark grayish-brown (10YR 3/2) clay loam, some ped surfaces very dark gray (10YR 3/1); moderate, very fine, subangular blocky structure; friable; common roots; medium acid; clear, smooth boundary.

B1—10 to 14 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 4/3) clay; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, very fine, subangular blocky structure; friable; common roots; very strongly acid; gradual, smooth boundary.

B21t—14 to 20 inches, dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) clay; many yellowish-brown (10YR 5/6) mottles and few strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few roots; thin continuous clay films; medium acid; gradual, smooth boundary.

B22t—20 to 25 inches, mottled grayish-brown (2.5Y 5/2) and yellowish-brown (10YR 5/6) clay; few, medium, prominent, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few roots; thick continuous clay films; many very small glacial pebbles; neutral; gradual, smooth boundary.

B31t—25 to 34 inches, mottled light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/6) clay; moderate, fine, subangular blocky structure; firm; few roots; thin discontinuous clay films; few pebbles; neutral; clear, smooth boundary.

B32t—34 to 37 inches, yellowish-brown (10YR 5/6), light brownish-gray (2.5Y 6/2), and grayish-brown (2.5Y 5/2) clay loam; weak, fine, subangular blocky structure; firm; few roots; thin discontinuous clay films; neutral; clear, smooth boundary.

C—37 to 61 inches, grayish-brown (2.5Y 5/2) and yellowish-brown (10YR 5/6) clay loam; massive; firm; few roots; few large white concretions; few black concretions; few pebbles; neutral.

The A1 horizon ranges from black to very dark grayish-brown in color and from 5 to 9 inches in thickness. The texture of the A1 and A3 horizons ranges from silt loam in the more gently rolling uneroded areas to clay loam where slopes are greater and erosion has taken place.

Lamoni soils have grayer colors in the B horizons than the associated Adair soils. They have finer textured B horizons than the associated Lagonda soils.

Lamoni soils are mapped only in undifferentiated units with the Adair soils. The Lamoni soils generally are at elevations slightly below the Adair soils.

Lamoni soils have a more grayish subsoil than Adair soils and lack the red colors of those soils.

Lamoni and Adair soils, 2 to 5 percent slopes (LmB).—These soils are on short ridges and generally are downslope from Grundy and Lagonda soils. They generally are upslope from sloping or strongly sloping Lamoni and Adair soils. From 60 to 70 percent of this mapping unit is Adair soils, and the rest is Lamoni soils.

Included with these soils in mapping were small tracts of Grundy and Lagonda soils and of uneroded Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for cultivated crops. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-5.

Lamoni and Adair soils, 2 to 5 percent slopes, eroded (LmB2).—These soils are on ridges; generally they are downslope from Grundy and Lagonda soils and upslope from sloping or strongly sloping Lamoni and Adair soils. These soils have profiles similar to the ones described as representative of these series, but they have a thinner surface layer.

Included with these soils in mapping were small tracts of Grundy soils, of Lagonda soils, and of slightly eroded Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for cultivated crops. Moderate erosion and a moderately fine textured surface layer make these soils difficult to work. They are moderately well suited to cultivated crops and pasture. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Lamoni and Adair soils, 5 to 9 percent slopes (LmC).—These soils are on hillsides and ridges and generally are downslope from gently sloping Lamoni and Adair soils or Armster soils. They are in small, odd-shaped tracts that generally are inaccessible for the production of cultivated crops. They have the profiles described as representative of these series.

Included with these soils in mapping were small tracts of strongly sloping Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for pasture and woodland. Where accessible, these soils are well suited to cultivated crops. They are well suited to pasture, woodland, and wildlife habitat. Capability unit IIIe-5.

Lamoni and Adair soils, 5 to 9 percent slopes, eroded (LmC2).—These soils are on ridges and hillsides. They generally are downslope from Grundy soils, Lagonda soils, Armster soils, and gently sloping Lamoni and Adair soils. These soils have profiles similar to the ones described as representative of these series, except that they have a thinner surface layer and more pebbles on the surface.

Included with these soils in mapping were small tracts of Lagonda soils and of severely eroded Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for cultivated crops and pasture in acreages of about equal size. Only small tracts are used for woodland. Slope, erosion, and moderately fine texture of the surface layer make these soils difficult to manage. They are moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Lamoni and Adair soils, 5 to 9 percent slopes, severely eroded (LmC3).—These soils are in odd-shaped tracts around the upper ends of small waterways and gullies, and also in small tracts on hillsides and at the ends of ridges. These soils have profiles similar to the ones described as representative of these series, except that the original surface layer has been removed by erosion and the present surface layer has formed from the original subsoil. Pebbles and rocks are common on the surface, and the areas are cut by many small gullies.

Included with these soils in mapping were small tracts of eroded Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for pasture and wildlife habitat. They are difficult to manage because they are sloping and have been severely eroded. They are poorly suited to cultivated crops but well suited to pasture, woodland, and wildlife habitat. Excessive runoff and further erosion are major hazards. Management that provides erosion control and ground cover much of the time is needed. Capability unit IVe–8.

Lamoni and Adair soils, 9 to 14 percent slopes (LmD).—These soils are on hillsides, generally downslope from more sloping Lamoni and Adair soils and upslope from Rock land and Armster, Sampsel, Snead, and Greenton soils.

Included with these soils in mapping were small tracts that are eroded.

These soils are in small irregular tracts, nearly all of which are used for pasture or woodland. The small size and poor accessibility of the tracts make these soils difficult to use for cultivated crops; but they are well suited to pasture, woodland, and wildlife habitat. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IVe-5.

Lamoni and Adair soils, 9 to 14 percent slopes, eroded (LmD2).—These soils are on hillsides downslope from gently sloping and sloping Lamoni and Adair soils and upslope from Rock land and Armster, Sampsel, Greenton, and Snead soils. These soils have profiles similar to the ones described as representative of these series, except that they have a finer textured surface layer.

Included with these soils in mapping were small tracts of moderately steep Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for pasture. Strong slopes, eroded condition, and a somewhat fine-textured surface layer make these soils difficult to work and manage. They are not suited to cultivated crops. They are well suited to pasture, woodland, and wildlife habitat. Runoff is rapid, and further erosion is a major hazard. Management that includes erosion control and maintenance of ground cover much of the time is needed. Capability unit VIe-5.

Lamoni and Adair soils, 9 to 14 percent slopes, severely eroded (LmD3).—These soils are in irregularly

shaped tracts around the upper ends of small waterways and gullies and on hillsides. They are downslope from sloping Lamoni and Adair soils and upslope from Rock land and Armster, Sampsel, Greenton, and Snead soils. These soils have profiles similar to the ones described as representative of these series, except that erosion has removed the original surface layer. The present surface layer was once the upper part of the subsoil.

Included with these soils in mapping were small tracts of eroded Lamoni and Adair soils.

These Lamoni and Adair soils are used mostly for pasture. Strong slopes and severely eroded condition make these soils unsuited to cultivated crops. They are moderately well suited to pasture and well suited to woodland and wildlife habitat. Rapid runoff and further erosion are major hazards. Management that includes the maintenance of a ground cover is needed. Capability unit VIe-8.

Lineville Series

The Lineville series consists of deep, moderately well drained, gently sloping, and sloping soils on ridges and upper hillsides in the uplands. The surface layer and upper part of the subsoil formed in silty materials deposited by wind. The lower part of the subsoil formed in silt, sand, clay, and gravel deposited by glacial action.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is about 53 inches thick. The uppermost 9 inches is mottled dark-brown light silty clay loam. It is underlain, in sequence, by 5 inches of mottled brown clay loam, 9 inches of mottled grayish-brown and brown clay loam, and 17 inches of mottled reddish-brown heavy clay loam. The lowermost 13 inches is mottled light brownish-gray and strong-brown clay loam.

Lineville soils have moderately low content of organic matter, moderately slow permeability, and high available water capacity. Erosion is a major hazard; it has been slight on most of the gently sloping areas and moderate on most of the sloping areas.

Lineville soils are used mostly for cultivated crops and pasture, but a small part of the acreage is used for woodland and wildlife habitat.

Representative profile of Lineville silt loam, 2 to 5 percent slopes, in a plowed field (1 mile north and 5½ miles east of Kingston, approximately 15 yards east and 28 yards south of NW. corner, NE¼NE¼NW¼ sec. 21, T. 56 N., R. 27 W.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

A2—8 to 14 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular and subangular blocky structure; friable; few roots; very dark grayish-brown (10YR 3/2) stains on some peds; slightly acid; clear, smooth boundary.

B1—14 to 23 inches, dark-brown (10YR 4/3) light silty clay loam; few, fine, faint, brown (10YR 5/3) mottles; weak, fine, subangular blocky structure; friable; few roots; strongly acid; clear, smooth boundary.

IIB21t—23 to 28 inches, brown (10YR 5/3) clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles, and few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; firm; few roots; thin continuous clay films; few, small, rounded pebbles; strongly acid; clear, smooth boundary.

IIB22t—28 to 37 inches, mottled grayish-brown (10YR 5/2) and brown (10YR 5/3) clay loam; few, fine, prominent, yellowish-red (5YR 5/6) mottles; weak, fine, prismatic structure and weak, medium, subangular blocky structure; firm; thick continuous clay films; many iron and manganese concretions; some rounded pebbles; very strongly acid; abrupt, smooth boundary.

IIIB23t—37 to 54 inches, reddish-brown (5YR 4/4) heavy clay loam; common, fine, distinct, grayish-brown (2.5Y 5/2) mottles and few, fine, distinct, gray (5Y 5/1 and 6/1) mottles; weak, fine, angular blocky structure; very firm; thin continuous clay films; common iron and manganese concretions; many pebbles; neutral; clear, smooth boundary.

IIIB3—54 to 67 inches mottled light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/6) clay loam; fine, distinct, light yellowish-brown (2.5Y 6/4) mottles; weak, medium, subangular blocky structure; very firm; patchy clay films; common iron and manganese concretions; moderately alkaline.

The A horizon ranges from very dark gray to dark yellowish brown in color and from 7 to 14 inches in thickness. The texture is silt loam, except where the soils have been severely eroded, and in those areas it is silty clay loam. The thickness of the loess over the glacial material ranges from 15 to 30 inches, but a thickness of about 18 inches is most common. The amount of pebbles and sand in the B horizon ranges from small to large.

Lineville soils have browner B horizons than Lagonda soils, which formed in similar materials. They have lighter colored A horizons than the associated Lamoni and Adair soils. Lineville soils have more sand in their B horizons than Ladoga soils, which are on nearby ridgetops.

Lineville silt loam, 2 to 5 percent slopes (LnB).—This soil is on ridges generally downslope from Grundy or Lagonda soils and upslope from either sloping Lineville or Armster soils. This soil is in long narrow tracts. It has the profile described as representative of the series.

Included with this soil in mapping were small tracts of moderately eroded or sloping Lineville soils. Also included were small tracts of Lagonda, Grundy, or Armster soils.

About half of this Lineville soil is in cultivated crops, and about half is in pasture. It is well suited to cultivated crops if tracts are large enough; but in many places cultivation is impractical because tracts are small and are surrounded by steeper, severely eroded, or less productive soils. Among the characteristics that make this soil well suited to cultivated crops, pasture, woodland, and wildlife habitat are gentle slopes and a thick surface layer. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-2.

Lineville silt loam, 2 to 5 percent slopes, eroded (LnB2).—This soil is on ridges downslope from Grundy and Lagonda soils and upslope from either sloping Lineville or Armster soils. This soil has a profile similar to the one described as representative of the series but has a thinner, medium-textured surface layer that has been moderately eroded.

Included with this soil in mapping were small tracts of uneroded Lineville soils.

This Lineville soil is easy to work and is used mostly for cultivated crops. It is moderately well suited to cultivated crops and well suited to pasture, woodland, and

wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-2.

Lineville silt loam, 5 to 9 percent slopes (LnC).—This soil is on ridges and hillsides. It generally is downslope from gently sloping Lineville, Lagonda, or Grundy soils and upslope from Armster soils.

Included with this soil in mapping were small tracts of Armster soils or eroded Lineville soils.

This Lineville soil is used mostly for pasture. The soil is moderately well suited to cultivated crops but in most places it is surrounded by steeper soils. This soil is well suited to pasture, woodland, and wildlife habitat. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-2.

Lineville silt loam, 5 to 9 percent slopes, eroded (LnC2).—This soil is on ridges and hillsides. It generally is downslope from Grundy, Lagonda, or gently sloping Lineville soils and upslope from Armster soils. This soil has a profile similar to the one described as representative of the series, but has a thinner surface layer. In places plowing has mixed the upper part of the subsoil with the surface layer to produce a light silty clay loam that is a little lighter colored than the original silt loam.

Included with this soil in mapping were small tracts of Armster soils.

This Lineville soil is used mostly for cultivated crops and pastures in acreages of about equal size. Slopes, erosion, and medium texture are among the characteristics that make this soil only moderately well suited to cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-2.

Lineville silty clay loam, 5 to 9 percent slopes, severely eroded (LvC3).—This soil is on ridges and hillsides downslope from moderately eroded Lineville soils and upslope from Armster soils. This soil is in small tracts. This soil has a profile similar to the one described as representative of the series, but erosion has removed the original surface layer and exposed the dark-brown silty clay loam subsoil.

Included with this soil in mapping were small tracts of moderately eroded Lineville soils.

This Lineville soil is used mostly for pasture. It is somewhat poorly suited to cultivated crops but moderately well suited to pasture, woodland, and wildlife habitat. Excessive runoff and further erosion are major hazards. Management that includes control of erosion and maintenance of ground cover is needed. Capability unit IVe-5.

Moniteau Series

The Moniteau series consists of deep, poorly drained, nearly level to gently sloping soils in benchlike positions above and adjacent to the flood plains of streams. These soils of the stream terraces are subject to flooding only during larger floods. They formed in water-deposited materials of local origin.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsurface layer is gray, light brownish-gray, and brown silt loam about 6 inches thick. The subsoil is about 32 inches thick. The uppermost 6 inches is mottled dark-gray heavy silt loam. Next, in sequence, is 18 inches of mottled dark-gray silty clay loam, and 8 inches of mottled gray light silty clay loam. The underlying material is mottled gray light silty clay loam that reaches to a depth of 62 inches.

Moniteau soils have moderately low content of organic matter, slow permeability, and high available water capacity.

Moniteau soils are used mostly for cultivated crops and pasture. A minor acreage is used for woodland and wildlife habitat.

Representative profile of Moniteau silt loam, 0 to 3 percent slopes, in cultivated cornfield (3½ miles west and 4 miles north of Kingston, NE¼NW¼ sec. 1, T. 56 N., R. 29 W.):

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; very friable; many fine roots; many pores and root channels; very strongly acid; abrupt, smooth boundary.

A21—8 to 10 inches, gray (10YR 5/1) silt loam; weak, fine, granular structure; very friable; many fine roots; many pores and root channels; very strongly acid; clear, smooth boundary.

A22—10 to 14 inches, light brownish-gray (10YR 6/2) and brown (10YR 4/3) silt loam; weak, very fine, granular structure; very friable; common fine roots; many pores and root channels; very strongly acid; clear, smooth boundary.

B1t—14 to 20 inches, dark-gray (10YR 4/1) heavy silt loam; fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, granular structure; friable; common fine roots; many pores and root channels; thin discontinuous clay films; few light-gray silty ped coatings; medium acid; gradual, smooth boundary.

B2tg—20 to 38 inches, dark-gray (10YR 4/1) silty clay loam; common, distinct, dark yellowish-brown (10YR 4/4) mottles; few black (10YR 2/1) streaks; strong, fine, subangular blocky structure; firm; few roots; many pores and root channels; thin discontinuous clay films; light ashy silt coating on peds in upper 2 inches; medium acid; gradual, smooth boundary.

B3g—38 to 46 inches, gray (10YR 5/1) light silty clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; black (10YR 2/1) streaks along cracks and old root channels; massive; very firm; few roots; few pores and root channels; thin discontinuous clay films; medium acid.

Cg—46 to 62 inches, gray (10YR 5/1) light silty clay loam; many, coarse, dark-brown (10YR 4/3) and yellowish-brown (10YR 5/6) mottles; massive; firm; many small concretions; medium acid.

The A horizon ranges from 14 to 20 inches in thickness. The B horizon ranges from heavy silt loam to silty clay loam in texture and from 22 inches to several feet in thickness.

Moniteau soils have lighter colored A horizons than the associated Nevin soils. Moniteau soils occupy topographic positions that are higher than bottom land soils.

Moniteau silt loam, 0 to 3 percent slopes (MoA).—This is the only Moniteau soil mapped in the county. It is in benchlike areas that rise above the adjacent flood plains of streams.

This soil is well suited to cultivated crops, pasture, woodland, and wildlife habitat. Nearly all of the acreage is in cultivated crops. Wetness and erosion are major hazards. Management that includes both erosion control and drainage is needed. Capability unit IIIw-2.

Nevin Series

The Nevin series consists of deep, somewhat poorly drained, nearly level to gently sloping soils on benchlike

terraces above and adjacent to the flood plains of streams. These soils are subject to flooding only during larger floods. They formed in water-deposited materials of local origin.

In a representative profile the surface layer is about 21 inches thick. It is very dark grayish-brown silt loam in the upper 7 inches and very dark gray silt loam in the lower 14 inches. The subsoil is about 35 inches thick. The uppermost 15 inches is mottled very dark gray and brown light silty clay loam. The next 10 inches is light-gray and dark yellowish-brown light silty clay loam. The lower 10 inches is gray and dark yellowish-brown light silty clay loam. The underlying material is mottled dark yellowish-brown silt loam that reaches to a depth of 64 inches.

Nevin soils have moderate to high content of organic matter, moderately slow permeability, and high available water capacity.

Nevin soils are used mostly for cultivated crops and pasture. A minor acreage is used for woodland and wildlife habitat.

Representative profile of Nevin silt loam, 0 to 3 percent slopes, in cultivated cornfield (one-half mile south and 3 miles west of Kidder, NW¼NE¼ sec. 9, T. 57 N., R. 29 W.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, granular structure; very friable; many fine roots; many small pores and wormholes; strongly acid; abrupt, smooth boundary.

A12—7 to 21 inches, very dark gray (10YR 3/1) silt loam; weak, very fine, granular structure; very friable; many fine roots; many small pores and wormholes; few light-gray (N 7/0) silt coatings on ped surfaces; very strongly acid; clear, smooth boundary.

B21t—21 to 36 inches, very dark gray (10YR 3/1) and brown (10YR 5/3) light silty clay loam; grayish-brown (10YR 5/2) mottles; few black (10YR 2/1) streaks in old root channels or cracks; weak, fine, subangular blocky structure; firm; few roots; few small pores and wormholes; thin discontinuous clay films; very strongly acid; clear, smooth boundary.

B22t—36 to 46 inches, light-gray (10YR 6/1) and dark yellowish-brown (10YR 4/4) light silty clay loam; few, very dark gray (10YR 3/1) streaks in old root channels or cracks; weak, fine, subangular blocky structure; firm; few roots; few small pores and wormholes; thin discontinuous clay films; very strongly acid.

B3t—46 to 56 inches, gray (10YR 6/1) and dark yellowish-brown (10YR 4/4) light silty clay loam; weak, medium, subangular blocky structure; firm; strongly acid.

C—56 to 64 inches, dark yellowish-brown (10YR 4/4) silt loam; prominent gray (10YR 6/1) and grayish-brown (10YR 5/2) mottles; massive; firm; strongly acid.

The A horizon ranges in color from very dark gray to very dark grayish brown in color and from 15 to 22 inches in thickness. The B horizon ranges from light silty clay loam to clay loam in texture.

Nevin soils have a darker colored A horizon than the associated Moniteau soils. Nevin soils occupy topographic positions that are higher than the bottomland soils.

Nevin silt loam, 0 to 3 percent slopes (NeA).—This is the only Nevin soil mapped in the county. It is in benchlike areas that rise above the adjacent stream flood plains.

This Nevin soil is used mostly for cultivated crops and pasture. It is well suited to cultivated crops, pasture, woodland, and wildlife habitat. Erosion is a hazard in some places and surface drainage is needed other places. Wetness is a major hazard. Management that includes both erosion control and drainage is needed. Capability unit IIw-1.

Polo Series

The Polo series consists of deep, well-drained, gently sloping and sloping soils on hillsides and on benchlike ridges on uplands. The upper 30 inches or more of the Polo soils formed in wind-deposited materials, and the underlying parts formed in materials weathered from limestone and shale.

In a representative profile the surface layer is about 12 inches thick. The upper 7 inches is very dark brown heavy silt loam, and the lower 5 inches is very dark brown light silty clay loam. The subsoil is about 66 inches thick. In sequence is 6 inches of very dark gray medium silty clay loam, 9 inches of mottled dark-brown and very dark grayish-brown light silty clay, 20 inches of mottled dark-brown light silty clay, 12 inches of reddish-brown heavy silty clay loam, and 19 inches of yellowish-red silty clay. The underlying material is yellowish silty clay that reaches to a depth of 84 inches.

Polo soils have moderate to high content of organic matter, moderate permeability, and high available water capacity.

Polo soils are used mostly for cultivated crops. They are used less extensively for pasture. Only a few areas are used as woodland.

Representative profile of Polo silt loam, 2 to 5 percent slopes, in pasture (4 miles south of Nettleton, 60 feet west of east pasture fence, and 140 feet south of road center, NE. corner of NW¼NE¼ sec. 3, T. 56 N., R. 27 W.):

Ap—0 to 7 inches, very dark brown (10YR 2/2) heavy silt loam, grayish brown (10YR 5/2) when dry; moderate, thin, platy structure in upper part that grades to weak, thin, platy and very fine, granular structure in lower part; friable; many roots; slightly acid; clear, smooth boundary.

A12—7 to 12 inches, very dark brown (10YR 2/2) light silty clay loam, grayish brown (10YR 5/2) when dry; weak, fine, granular structure; friable; many roots; medium acid; clear, smooth boundary.

B1t—12 to 18 inches, very dark gray (10YR 3/1) medium silty clay loam, very dark grayish brown (10YR 3/2) when crushed; weak, fine and very fine, subangular blocky structure; friable; common roots; strongly acid; gradual, smooth boundary.

B21t—18 to 27 inches, mottled, fine, faint, dark-brown (10YR 3/3) and very dark grayish-brown (10YR 3/2) light silty clay, dark brown (10YR 3/3) when crushed; moderate, fine, subangular blocky structure; friable; discontinuous clay films on ped surfaces; common roots; few dark iron and manganese-oxide concretions 1 millimeter in diameter; strongly acid; gradual, smooth boundary.

B22t—27 to 35 inches, dark-brown (10YR 3/3) light silty clay; common, fine, faint, dark-brown (7.5YR 4/4) mottles; dark yellowish-brown (10YR 4/4) when crushed; moderate, fine, subangular blocky structure; friable; nearly continuous clay films on ped surfaces; common fine roots; few concretions; few fine pores in and between peds; strongly acid; gradual, smooth boundary.

B23t—35 to 47 inches, dark-brown (7.5YR 4/4) light silty clay; few, fine, faint, dark grayish-brown (10YR 4/2) mottles; moderate, medium, angular blocky structure; distinct, nearly continuous dark-brown to

dark reddish-brown and very dark gray clay films on peds; common, fine, dark iron and manganese-oxide accumulations; common, fine, tubular pores, 1 to 2 millimeters in diameter, that are lined with clay films; few fine roots; strongly acid; gradual, smooth boundary.

B31t—47 to 59 inches, reddish-brown (5YR 4/4) heavy silty clay loam, dark-brown (7.5YR 4/4) when kneaded; moderate, medium, subangular blocky peds arranged in weak, medium and coarse prisms; friable; nearly continuous, thin, dark reddish-brown (5YR 3/3) clay films on peds; tubular pores lined with very dark gray (10YR 3/1) clay films; few, fine, fibrous roots; few, very fine, dark iron and manganese concretions; medium acid; gradual, smooth boundary.

IIB32t—59 to 78 inches, yellowish-red (5YR 4/8) silty clay; weak, coarse, subangular blocky structure; firm; thin, patchy, dark reddish-brown (5YR 3/2) and very dark gray (10YR 3/1) clay films on peds and in few, large, tubular pores 2 to 5 millimeters in diameter; few, fine, fibrous roots; medium acid; gradual, smooth boundary.

IIC—78 to 84 inches, yellowish silty clay.

R—84 inches, limestone bedrock.

The A horizon ranges in color from very dark brown to dark brown and in thickness from 10 to 14 inches. The depth to residual material ranges from 30 to 60 inches, but about 35 inches is most common. The depth to bedrock ranges from 6 to 8 feet.

Polo soils are in close association with Grundy, Lagonda, Lamoni, Adair, Ladoga, Greenton, and Sampsel soils. The Polo soils are browner throughout the solum and are more permeable than any of these soils.

Polo silt loam, 2 to 5 percent slopes (PoB).—This soil is on benchlike ridges and hillsides. It generally is upslope from most of the upland soils of the county, but in places it is either upslope or downslope from Grundy or Lagonda soils. The soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of Grundy soils, Lagonda soils, and eroded Polo soils.

This soil is used mostly for cultivated crops. Among the characteristics that make it well suited to cultivated crops are gentle slopes and a thick surface layer. This soil is also used for pasture, woodland, and wildlife habitat. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-4.

Polo silt loam, 5 to 9 percent slopes (PoC).—This soil is on benchlike ridges and hillsides. It generally is downslope from gently sloping Polo soils, Grundy soils, or Lagonda soils and is upslope from, or adjacent to, any of the other upland soils of the county.

Included with this soil in mapping were small tracts of eroded Polo soils.

This Polo soil is used mostly for pasture and hay, which protect the soil from sheet erosion. Among the characteristics that make this soil easy to work is a thick, medium-textured surface layer. This soil is also used for woodland and wildlife habitat. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-4.

Polo silt loam, 5 to 9 percent slopes, eroded (PoC2).—This soil is on benchlike ridges and hillsides. It generally is downslope from gently sloping Polo, Grundy, or Lagonda soils and is upslope from, and adjacent to, any of the other upland soils of the county.

This soil has a profile similar to the one described as representative of the series but has a thinner surface layer. Erosion has removed a part of the original surface layer, and plowing has mixed some of the upper part of the subsoil and the remaining surface layer to produce a layer of very dark gray heavy silt loam.

Included with this soil in mapping were small tracts of gently sloping Polo soils and small tracts of other upland soils of the county.

This Polo soil is used mostly for cultivated crops, and to some extent for pasture. It is moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-4.

Polo silt loam, 9 to 14 percent slopes, eroded (PoD2).—This soil is on hillsides downslope from sloping Polo soils. This soil has a profile similar to the one described as representative of the series but has a thinner surface layer. Erosion has removed part of the original surface layer, and plowing has mixed part of the subsoil and the remaining part of the original surface layer to produce a very dark gray layer of heavy silt loam.

Included with this soil in mapping were small tracts of uneroded and severely eroded Polo soils.

This Polo soil is used mostly for cultivated crops and pasture. It is somewhat poorly suited to cultivated crops, but it is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management is needed that includes erosion control and maintenance of ground cover of plants much of the time. Capability unit IVe-4.

Rock Land

Rock land (Ro) is about 80 to 98 percent rock and about 2 to 20 percent shallow soils. Slopes are mainly between 9 and 19 percent, but they range from 1 to 75 percent. In most places the soils are underlain by thin interbedded layers of limestone and shale. Chert and limestone rocks that range from 4 to 12 inches or more in diameter are common on the surface of these soils. In a few places the underlying rocks are interbedded sandstone and shale. Low cliffs or ledges of limestone, generally not more than 10 feet high, occur in some places. In these places the soils are very dark gray to dark reddish-brown silty clay loam, and they generally contain many small fragments of limestone. In most of these places, the soils range from 0 to 18 inches in thickness.

Included with this land type in mapping were small tracts of Snead soils.

Shallow rocky soil material and rapid runoff make Rock land somewhat poorly suited to pasture and only moderately well suited to woodland and wildlife habitat. The hazards of drought and erosion also limit use. Management is needed that provides protection from fire and overgrazing and that keeps a cover of vegetation on parts of this land type that will support plants. Capability unit VIIs-10.

Sampsel Series

The Sampsel series consists of deep, somewhat poorly drained, gently sloping to strongly sloping soils on uplands. They are on hillsides, mostly on the lower part.

These soils formed in material weathered from various shales. These shales are interbedded with limestone at various elevations in the county (fig. 12).

In a representative profile the surface layer is black silty clay loam about 12 inches thick. The subsoil is about 54 inches thick. The uppermost 4 inches is medium silty clay loam mottled with dark grayish brown. The next 21 inches is mottled olive-gray light silty clay. The lower 29 inches is mottled gray, olive, and light olive-brown light silty clay. The underlying material is olive-brown soft shale that has a texture of light silty clay and silty clay loam to a depth of 84 inches.

Sampsel soils have a high content of organic matter, slow permeability, and high available water capacity. These soils remain wet in places for short periods after a rain because ground water seeps along the surface of the underlying shale and limestone.

Except for a small acreage that is used for woodland and wildlife habitat, Sampsel soils are used in about equal acreages for cultivated crops or pasture.

Representative profile of Sampsel silty clay loam, 5 to 9 percent slopes, in permanent bluegrass pasture (3 miles north of Cowgill, 35 feet north and 255 feet east of the SW. corner of sec. 3, T. 55 N., R. 27 W.):

Ap—0 to 5 inches, black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) when dry, very dark brown (10YR 2/2) when kneaded; strong, very fine, granular structure; friable; slightly hard when dry; many roots; neutral; abrupt, smooth boundary.

A1—5 to 12 inches, black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) when dry, very dark brown (10YR 2/2) when kneaded; strong, fine, granular structure; friable; slightly hard when dry; many roots; medium acid; clear, smooth boundary.

B1t—12 to 16 inches, very dark grayish-brown (10YR 3/2) medium silty clay loam, grayish brown (2.5Y 5/2) when dry, very dark grayish brown (2.5Y 3/2) when kneaded; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; moderate, very fine, subangular blocky structure; friable; common roots; thin continuous clay films; few worm casts; medium acid; clear, smooth boundary.

B21t—16 to 35 inches, olive-gray (5Y 4/2) light silty clay, light olive brown (2.5Y 5/4) when kneaded; many, fine, prominent, yellowish-brown (10YR 5/8 and 5/6) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; thick continuous clay films; neutral; clear, smooth boundary.

B22t—35 to 37 inches, olive-gray (5Y 5/2) light silty clay, light olive brown (2.5Y 5/4) when kneaded; many, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; very slightly plastic when wet; few iron and manganese concretions 2 to 4 millimeters in diameter; mildly alkaline; abrupt, smooth boundary.

B3—37 to 66 inches, mottled gray (5Y 5/1), olive (5Y 5/3), and light olive-brown (2.5Y 5/4) light silty clay, light olive brown (2.5Y 5/4) when dry; weak, medium, subangular blocky structure and massive; firm; many, soft, light olive-brown (2.5Y 5/4) shale lenses; moderately alkaline; gradual, smooth boundary.

C1—66 to 84 inches, olive-brown (2.5Y 4/4) soft shale of light silty clay and silty clay loam texture; firm; soapy when wet; common very dark brown iron and manganese concretionary material; thin, soft, platy, light olive-brown (2.5Y 5/4) shale lenses; moderately alkaline; gradual, smooth boundary.

C2—84 to 118 inches, olive-brown (2.5Y 4/4) platy shale of silty clay loam texture; mottled with various shades of dark gray and brown; firm; soapy when wet; moderately alkaline.

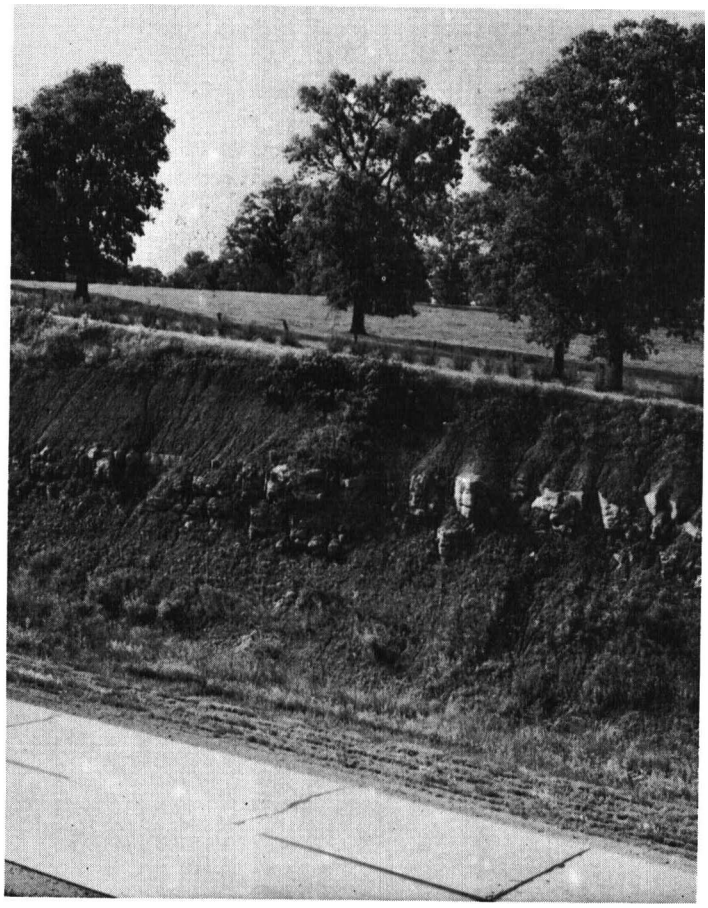

Figure 12.—Area of Sampsel soils underlain by interbedded shale and limestone that is exposed in a road cut. The shale and limestone are similar to the rocks that weathered to form the material in which the Sampsel soils developed.

The Ap horizon ranges from heavy silt loam to silty clay loam. The color of the moderately eroded surface soil is black, whereas that of the severely eroded surface soil is dark gray and yellowish brown.

Sampsel soils differ from the associated Grundy and Lagonda soils in having small fragments of limestone and white concretions throughout the B horizon. Sampsel soils are more slowly permeable than Greenton, Polo, Armster, and Lineville soils, which have similar textures. Sampsel soils have a thicker solum than the Snead soils, which formed in similar materials.

Sampsel silty clay loam, 2 to 5 percent slopes (SaB).—This soil is on hillsides downslope from Grundy, Lagonda, Lamoni, Adair, and Armster soils and upslope from other Sampsel soils.

Included with this soil in mapping were small tracts of Sampsel soils that are moderately eroded.

This Sampsel soil is used mostly for cultivated crops and pasture. Among the characteristics that make it well suited to cultivated crops, pasture, woodland, and wildlife habitat are gentle slopes and a thick surface layer. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIe-5.

Sampsel silty clay loam, 2 to 5 percent slopes, eroded (SaB2).—This soil is on hillsides, generally downslope from uneroded Sampsel soils and upslope from other Sampsel soils. This soil has a profile similar to the

one described as representative of the series but has a thinner and slightly finer textured surface layer.

Included with this soil in mapping were small tracts of uneroded Sampsel soils.

This Sampsel soil is used for cultivated crops. Moderate erosion and a moderately fine textured surface layer make this soil somewhat difficult to work. This soil is moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Sampsel silty clay loam, 5 to 9 percent slopes (SaC).—This soil is on hillsides, downslope or upslope from Lamoni and Adair soils, Armster soils, Greenton soils, and Rock land. This soil generally is in long, narrow areas lying horizontally along hillsides or in small irregularly shaped areas. Groundwater keeps this soil wet in places for short periods after rain. This soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of eroded Sampsel soils.

This Sampsel soil is used mostly for pasture. It is moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Sampsel silty clay loam, 5 to 9 percent slopes, eroded (SaC2).—This soil is on hillsides and is either downslope or upslope from Lamoni and Adair soils, Armster soils, Greenton soils, and Rock land. This soil generally is in long narrow areas lying horizontally along hillsides. Groundwater moving along the surface of the underlying bedrock keeps some areas of this soil wet for short periods after a rain. This soil has a profile similar to the one described as representative of the series, but it has a medium silty clay loam surface layer.

Included with this soil in mapping were small tracts of uneroded Sampsel soils, Greenton soils, and Rock land.

This Sampsel soil is used mostly for cultivated crops and pasture. It is moderately well suited to cultivated crops and well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management that includes erosion control is needed. Capability unit IIIe-5.

Sampsel silty clay loam, 5 to 9 percent slopes, severely eroded (SaC3).—This soil is on hillsides either downslope or upslope from Lamoni and Adair soils, Armster soils, Greenton soils, uneroded or eroded Sampsel soils, or Rock land. This soil is in small tracts of irregular shape and remains wet in places after rain. The profile of this soil is similar to the one described as representative of the series, but erosion has removed the original surface layer and exposed the very dark grayish-brown subsoil of medium silty clay loam.

Included with this soil in mapping were small tracts of Rock land.

This Sampsel soil is used for pasture, woodland, and wildlife habitat. It is somewhat poorly suited to cultivated crops but moderately well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management is needed that includes erosion control and maintenance of a ground cover much of the time. Capability unit IVe-8.

Sampsel silty clay loam, 9 to 14 percent slopes, eroded (SaD2).—This soil is on hillsides either downslope or upslope from Lamoni and Adair soils, Armster soils, Greenton soils, sloping Sampsel soils, or Rock land. This soil is in long narrow areas lying horizontally along hillsides and is most common near the foot of hills. Groundwater seepage keeps this soil wet in places after rain. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thinner and generally is medium silty clay loam.

Included with this soil in mapping were small tracts of either uneroded or severely eroded Sampsel soils.

This Sampsel soil is used mostly for pasture, but a small acreage is used for woodland and as wildlife habitat. It is not suited to cultivated crops and is moderately well suited to pasture, woodland, and wildlife habitat. Rapid runoff and further erosion are major hazards on this soil. Management is needed that includes erosion control and the maintenance of a ground cover much of the time. Capability unit VIe-5.

Snead Series

The Snead series consists of moderately deep, moderately well drained, sloping to moderately steep soils on hillsides. They range from 18 to 30 inches in thickness. Generally, the underlying material is slightly weathered shale and interbedded thin limestone. Ground water movement on top of the underlying shale beds keeps these soils wet in places for prolonged periods in rainy seasons. These soils formed in materials weathered from interbedded shales and limestones.

In a representative profile the surface layer is about 12 inches thick. The upper 6 inches is very dark gray silty clay loam, and the lower 6 inches is black silty clay loam. The subsoil is about 8 inches thick. In the upper 5 inches it is mixed very dark gray and grayish-brown silty clay; and in the lower 3 inches it is mixed very dark gray, olive-gray, and olive clay. The underlying material is partially weathered shale, small limestone rock fragments, and olive-gray silty clay that reaches to a depth of 66 inches.

Snead soils have moderate to high content of organic matter, slow permeability, and very low available water capacity.

About equal acreages of Snead soils are used for cultivated crops and pasture, and small acreages are used for woodland and wildlife habitat.

Representative profile of Snead silty clay loam, 5 to 9 percent slopes, in mixed meadow (3 miles south and 2 miles east of Kingston, NE corner of SW¼NW¼SW¼ sec. 1, T. 55 N., R. 28 W.):

Ap—0 to 6 inches, very dark gray (10YR 3/1) silty clay loam; strong, medium, granular structure; friable; many roots; slightly acid; clear, smooth boundary.

A12—6 to 12 inches, black (10YR 2/1) silty clay loam; strong, very fine, subangular blocky structure; friable; common roots; many fine pores; slightly acid; clear, smooth boundary.

B2—12 to 17 inches, mixed very dark gray (10YR 3/1) and grayish-brown (10YR 5/2) silty clay; strong, medium, subangular blocky structure; firm; few roots; many very small pores; neutral; gradual, wavy boundary.

B3—17 to 20 inches, mottled very dark gray (10YR 3/1), olive-gray (5Y 5/2), and olive (5Y 5/4) clay; weak, fine, subangular blocky structure; firm; few roots; many small limestone rock fragments or white concretions; strongly alkaline; clear, smooth boundary.

C—20 to 66 inches, olive-gray (5Y 5/2) silty clay and clay having a soapy feel; splotches of dark gray (5Y 4/1) and olive brown (2.5Y 4/4) few roots to a depth of 25 inches, partly weathered shale and small limestone rock fragments; moderately alkaline.

The A horizon ranges in color from black to very dark grayish brown and in texture from heavy silt loam to silty clay. Chert and limestone fragments on the surface and in the A horizon range from none in most places to few to common in some places.

Snead soils have a thinner solum than the associated Greenton and Sampsel soils.

Snead silty clay loam, 5 to 9 percent slopes (SnC).—This soil is on hillside positions downslope from Lagonda soils, Lamoni and Adair soils, Armster soils, and Polo soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were small tracts of eroded Snead soils.

This Snead soil is used mostly for cultivated crops and pasture. Erosion is a major hazard. Management is needed that controls erosion and maintains a ground cover much of the time. Capability unit IVe-11.

Snead silty clay loam, 9 to 14 percent slopes (SnD).—This soil is on hillsides downslope from Armster, Lamoni, Adair, Greenton, and Polo soils and upslope from Rock land and Sampsel and Greenton soils. It is adjacent to soils of the bottom lands in some places.

Included with this soil in mapping were small tracts of Rock land and eroded Snead and Sampsel soils.

This Snead soil is used mostly for pasture. Strong slopes and rapid runoff make this soil unsuitable for cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Erosion is a major hazard. Management is needed that includes erosion control and the maintenance of a ground cover much of the time. Capability unit VIe-11.

Snead silty clay loam, 9 to 14 percent slopes, eroded (SnD2).—This soil is on hillsides below Armster, Lamoni, Adair, Greenton, and Polo soils. It generally is upslope from Rock land, Sampsel and Greenton soils, or soils of the bottom lands. This soil generally is in narrow areas extending horizontally along hillsides, but larger areas are present. This soil has a profile similar to the one described as representative of the series, except that it has a thinner surface layer caused by erosion.

Included with this soil in mapping were small tracts of Sampsel soils and Rock land.

This Snead soil is used mostly for pasture. Strong slopes, a thin surface layer, and rapid runoff make it unsuited to cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Further erosion is a major hazard. Management is needed that includes erosion control and maintenance of a continuous ground cover. Capability unit VIe-11.

Snead silty clay loam, 14 to 20 percent slopes (SnE).—This soil is on hillsides downslope from strongly sloping Snead soils and upslope from Rock land.

Included with this soil in mapping were small tracts of eroded Snead soils.

This Snead soil is used mostly for pasture. Moderately steep slopes and rapid runoff make it unsuited to cultivated crops. It is well suited to pasture, woodland, and wildlife habitat. Management that provides a continuous cover of plants is needed. Capability unit VIIe-11.

Zook Series

The Zook series consists of deep, poorly drained, nearly level to slightly depressional soils. These soils are in sloughs, swales, old stream channels, and other depressional areas on bottom lands along streams. They are subject to flooding and dry slowly. Zook soils formed in the fine alluvial sediment eroded from loess, glacial till, and material weathered from rock in place on uplands.

In a representative profile the surface layer extends to a depth of about 62 inches. The upper 7 inches is very dark gray silty clay loam; the next 5 inches is black silty clay loam; the next 22 inches is black silty clay; and the lower 28 inches is dark-gray and very dark gray silty clay.

Zook soils have high content of organic matter, slow permeability, and moderate available water capacity.

Zook soils generally are used for cultivated crops and pasture, but narrow areas adjacent to streams and along the steep banks of streams and waterways are also used for timber and wildlife habitat. In places undrained areas form temporary ponds and sloughs that produce excellent wildlife habitat.

Representative profile of Zook silty clay loam, in harvested bean field (5½ miles south of Nettleton, NE¼ SW¼NW¼ sec. 11, T. 56 N., R. 27 W.):

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; weak, very fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

A11—7 to 12 inches, black (10YR 2/1) silty clay loam; weak, fine, granular structure; firm; common roots; slightly acid; gradual, smooth boundary.

A12—12 to 34 inches, black (10YR 2/1) silty clay; strong, medium, subangular blocky structure; very firm; common roots; slightly acid; gradual, smooth boundary.

A13—34 to 62 inches, dark-gray (10YR 4/1) and very dark gray (10YR 3/1) silty clay; moderate, medium, subangular blocky structure; very firm; few roots; neutral.

The Ap and A11 horizons combined range from very dark gray to black silty clay loam to silty clay 12 to 16 inches thick. The A12 and A13 horizons combined range from a few feet to many feet in thickness.

Zook soils are finer textured than the associated Kennebec, Blackoar, and Colo soils.

Zook silty clay loam (Zo).—This nearly level to depressional soil is along the flood plains of streams. It has the profile described as representative of the series.

Included with this soil in mapping were small tracts of Zook silty clay and Blackoar, Kennebec, and Colo soils.

This Zook soil is used mostly for cultivated crops and pasture. Limited amounts of timber are produced on steep streambanks and on narrow strips of bottom land along stream channels. The soil is well suited to cultivated crops, pasture, woodland, and wildlife habitat; but lack of drainage and flooding are major concerns. Management that provides drainage and controls flooding is needed. Capability unit IIIw-2.

Zook silty clay (Zs).—This nearly level to depressional soil is along the flood plains of major streams. It is finer textured and darker colored, but the profile otherwise is similar to the one described as representative of the series. This Zook soil is more common in depressions than Zook silty clay loam.

Included with this soil in mapping were small tracts of Zook silty clay loam and Kennebec, Blackoar, and Colo soils.

This soil is used mostly for cultivated crops and pasture. Some timber is produced along streambanks and around the edges of poorly drained or undrained areas. Areas that are undrained or temporarily ponded in wet seasons are used for wildlife habitat. This soil is moderately well suited to cultivated crops, woodland, and wildlife habitat, but lack of drainage and flooding are major concerns. In some places drainage is difficult to establish or maintain. Small flash floods of short duration frequently occur, and large floods of long duration sometimes occur. The soil dries slowly after flooding, and this can delay work in the fields. Management is needed that provides drainage and control of flooding. Capability unit IIIw-2.

Use and Management of the Soils

This part of the soil survey describes the use and management of the soils of Caldwell County for crops and pasture, discusses use of the soils as woodland, and gives facts about use of the soils for wildlife habitat. It also discusses uses of the soils for engineering purposes and for recreation.

Management for Crops and Pasture

In this part of the survey, capability grouping of the soils is defined and the soils are placed in capability units. Suggestions for the use and management of the soils for crops and pasture are given. A table shows predicted average acre yields of the principal crops at two levels of management. Corn, soybeans, and hay are the crops grown most extensively in this county. In 1968, about 60 percent of the acreage in the county was used to grow these or other field crops and 25 percent of the acreage was in pasture.[2]

In nearly 80 percent of the county, the soils are gently sloping to strongly sloping. For these soils, practices that control erosion are needed. In about 7 percent of the acreage, the major hazard to crops is wetness caused by restricted internal drainage of the soils, by the nearly level topography, or by overflow. In nearly 4 percent of the acreage, bedrock is near the surface or crops out at the surface, or stones are on or near the surface. In those areas droughtiness is a hazard to crops, or bedrock and stones interfere with tillage.

The principal practices used to control erosion on the sloping soils are selecting uses that are suitable for the soils; establishing grade-stabilization dams, terraces, and terrace outlets; choosing a suitable cropping system; selecting suitable varieties of crops for planting; cultivating on the contour; establishing improved pasture; renovating pastures as needed; properly managing grazing; and applying the proper kinds and amounts of fertilizer and other soil amendments.

Deciding on the proper land use, establishing farm drainage ditches, deepening stream channels, providing and maintaining dikes and levees, and choosing the right kind of crops for planting are practices commonly used to protect the soils from excess moisture.

On the stony or shallow soils, selection of a suitable use and practice of good grassland and woodland management are necessary.

On cultivated soils, fertilizer and lime should be applied according to the needs indicated by the results of soil tests and field trials, and according to the kind of crops to be grown.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils 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 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 engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed 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, range, woodland, or wildlife. (None in Caldwell County.)

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

[2] From unpublished Conservation Needs Inventory for 1968 on file at the Missouri State office of the Soil Conservation Service.

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

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in Caldwell 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 some parts of the United States but not in Caldwell County, 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, 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-4 or IIIe-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Caldwell County are described and suggestions for the use and management of the soils are given. The capability units are not numbered consecutively. They are numbered according to a statewide system, and not all of the capability units used in Missouri are represented in this county. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all of the soils of a given series appear in the unit. To find the names of all of the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–1

Only Kennebec silt loam, on bottom lands, is in this unit. This soil is deep, well drained, and nearly level. Its surface layer is silt loam, and it has a friable subsoil.

This soil is fertile and is easily cultivated. It has high available water capacity, moderate permeability, and a high content of organic matter. Providing protection from infrequent flooding is the major management requirement.

This soil is suited to all the crops commonly grown in the county. Corn, wheat, oats, soybeans, and alfalfa are the main crops. It is also suited to grasses and trees, and it can be used for the development of wildlife habitat. Adding manure and properly utilizing crop residue help to maintain the supply of organic matter and to keep this soil in good tilth.

CAPABILITY UNIT IIe–2

This unit consists of deep, moderately well drained soils of the Lineville series. These soils have a medium-textured surface layer. They are gently sloping, slightly eroded to moderately eroded soils on uplands.

Soils in this unit are relatively fertile and are easy to cultivate. They have high available water capacity, moderately slow permeability, and moderately low content of organic matter. Major management requirements are practices that help to control further erosion, that maintain fertility and the content of organic matter, and that keep the soils in good tilth.

These soils are suited to crops commonly grown in the county. Corn, oats, wheat, soybeans, and alfalfa are the main crops. These soils are also suited to grasses, trees, and wildlife habitat.

Growing winter cover crops and meadow crops and properly utilizing crop residue help to maintain organic matter and good tilth and help protect the soil against further erosion. Terraces, waterways, and contour farming help control runoff and further erosion. Continuous hay and pasture crops help protect the soil from further erosion without the use of mechanical measures.

CAPABILITY UNIT IIe–4

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

These soils are fertile and are easily cultivated. They have moderate to high available water capacity and moderately slow to moderate permeability. They are moderate to high in content of organic matter. Major management requirements are practices that help to control erosion, that maintain content of organic matter, and that keep the soils in good tilth.

These soils are suited to the crops commonly grown in the county. The main crops are corn, oats, wheat, soybeans, and alfalfa. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth and help protect the soil against erosion. Terraces, waterways, and contour farming help control runoff and erosion. Maximum use of close-growing crops and limited use of row crops help protect the soils from erosion without the use of mechanical measures.

CAPABILITY UNIT IIe–5

This unit consists of deep, somewhat poorly drained to well-drained, slightly eroded silt loams, silty clay loams, and loams that have a very firm to friable subsoil. These soils are gently sloping and are on uplands. They are in

the Armster, Greenton, Grundy, Lagonda, Sampsel, Lamoni, and Adair series.

Soils of this unit are relatively fertile and are easily cultivated. They have moderate to high available water capacity and very slow to moderate permeability. They are moderately low to high in content of organic matter. All soils of this unit are subject to further soil loss unless properly managed. The major management needs are maintenance of good tilth and control of further erosion.

These soils are suited to all the crops commonly grown in the county. Corn, oats, wheat, soybeans, and alfalfa are the main crops. They are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth and help protect the soils against further erosion. Terraces, waterways, and contour farming help control runoff and help protect against further erosion. Maximum use of close-growing crops and limited use of row crops help protect the soil from erosion without the use of mechanical measures. Intensive management, including the use of terraces, waterways, and farming on the contour, allows a crop rotation that includes more years of row crops and fewer years of meadow.

CAPABILITY UNIT IIw–1

This unit consists of deep, somewhat poorly drained and poorly drained, nearly level or gently sloping soils of the Blackoar, Colo, Grundy, and Nevin series on bottom lands, stream terraces, and uplands. These are silt loam, silty clay loam, and silty clay soils that have a friable to firm subsoil.

Soils in this unit are relatively fertile and are easily cultivated. They have moderate to high available water capacity and moderate, moderately slow, and slow permeability. They are moderate to high in content of organic matter. The major management needs are practices that help to maintain the content of organic matter and fertility, improve surface drainage, and protect the soils from flooding.

These soils are suited to all the crops commonly grown in the county. Corn, wheat, and soybeans are the main crops. The soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth.

CAPABILITY UNIT IIIe–2

This unit consists of deep, moderately well drained, medium-textured soils of the Lineville series on sloping uplands. These soils are slightly or moderately eroded.

These soils are relatively fertile and are easily cultivated. They have high available water capacity, moderately slow permeability, and moderately low content of organic matter. These soils are subject to further erosion unless properly managed. Major management needs are controlling further erosion and maintaining the content of organic matter and good tilth.

These soils are suited to most crops commonly grown in the county. The main crops are corn, oats, wheat, soybeans, and alfalfa. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops and meadow crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth and help protect the soils against further erosion. Terraces, waterways, and contour farming help control runoff and erosion. Continuous hay and meadow crops help protect the soil from further erosion without the use of mechanical measures.

CAPABILITY UNIT IIIe–4

This unit consists of deep, well-drained and moderately drained, sloping soils of the Ladoga and Polo series on uplands. They have a medium-textured surface layer over a moderately fine to fine-textured subsoil. These soils are slightly or moderately eroded.

These soils are fertile and easily cultivated. They have moderate to high available water capacity, moderately slow to moderate permeability, and moderately low to high content of organic matter. Major management needs are controlling further erosion and maintaining the content of organic matter and good tilth.

These soils are suited to all the crops commonly grown in the county. Corn, oats, wheat, soybeans, and alfalfa are the main crops. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops and meadow crops, adding manure, and properly utilizing crop residue help to control further erosion and to maintain the content of organic matter and good tilth. Terraces, waterways, and contour farming help control runoff and further erosion. Maximum use of close-growing crops and limited use of row crops help protect the soil from erosion without the use of mechanical measures.

CAPABILITY UNIT IIIe–5

This unit consists of deep, somewhat poorly drained to well-drained, silty clay loam, clay loam, silt loam, and loam soils of the Armster, Greenton, Grundy, Lagonda, Sampsel, Lamoni, and Adair series. These soils have a very firm to friable subsoil. They are gently sloping or sloping, are slightly to moderately eroded, and are on uplands.

Soils in this unit are relatively fertile and are easily cultivated. They have moderate to high available water capacity and slow to moderate permeability. They are moderately low to high in content of organic matter. All soils of this unit are subject to further erosion unless properly managed. The major management needs are maintaining fertility and the content of organic matter, keeping the soils in good tilth, and controlling further erosion.

These soils are suited to all the crops commonly grown in the county. Corn, oats, wheat, soybeans, and alfalfa are the main crops. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops and meadow crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth. Contour farming helps control runoff and further erosion. Continuous hay and meadow crops help protect the soils from further erosion without the use of mechanical measures.

CAPABILITY UNIT IIIw-2

This unit consists of deep, poorly drained silt loams of the Moniteau and Zook series. These soils have a firm or very firm subsoil. They are on nearly level to gently sloping stream terraces and bottom lands.

These soils are relatively fertile and are easily cultivated. They have moderate to high available water capacity, have slow permeability, and are moderately low to high in content of organic matter. The major management needs are maintaining fertility and the content of organic matter, improving surface drainage in places, and controlling erosion in gently sloping areas.

These soils are suited to all the crops commonly grown in the county. Corn, wheat, and soybeans are the main crops. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth.

CAPABILITY UNIT IVe-4

This unit consists of deep, well-drained and moderately well drained soils of the Ladoga and Polo series. These soils have a medium-textured surface layer over a moderately fine to fine-textured subsoil. They are slightly or moderately eroded and are on strongly sloping steep uplands.

These soils are fertile and are easily cultivated. They have moderate to high available water capacity and moderately slow to moderate permeability. Content of organic matter is moderately low to high. Major management needs are controlling erosion and maintaining the content of organic matter and good tilth.

These soils are somewhat poorly suited to crops commonly grown in the county. The main crops are corn, oats, wheat, soybeans, and alfalfa. These soils are suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops and meadow crops, adding manure, and properly utilizing crop residue help to control further erosion and to maintain the content of organic matter and good tilth. Terraces, waterways, and contour farming help to control further erosion and runoff on cultivated soils. Continuous meadow or hay crops help to protect the soils from erosion without the use of mechanical measures.

CAPABILITY UNIT IVe-5

This unit consists of deep, somewhat poorly drained to well-drained silt loams, loams, clay loams, and silty clay loams of the Adair, Armster, Lineville, and Lamoni series. These soils have a very firm to friable subsoil. They are sloping or strongly sloping and are on uplands. The sloping soils on uplands are severely eroded, and the strongly sloping soils are slightly eroded or moderately eroded.

Soils in this unit have high available water capacity, moderately slow permeability, and moderately low content of organic matter. The slightly eroded and moderately eroded soils are fairly fertile and easy to cultivate. The severely eroded soils are fairly low in fertility and difficult to cultivate. All soils in this unit are subject to further erosion unless properly managed. The major management needs are maintaining fertility and the content of organic matter, keeping the soils in good tilth, and controlling further erosion.

Soils in this unit are moderately well suited to all the crops commonly grown in the county. Corn, oats, wheat, soybeans, and alfalfa are the main crops. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to maintain the content of organic matter and good tilth and help protect the soils against further erosion. Terraces, waterways, and contour farming helps control runoff and further erosion. Continuous meadow and hay crops help protect the soils from excessive erosion losses without the use of mechanical measures.

CAPABILITY UNIT IVe-8

This unit consists of deep, moderately well drained and somewhat poorly drained soils of the Armster, Lagonda, Sampsel, Lamoni, and Adair series. These are sloping, severely eroded soils on uplands. They have a fine-textured subsoil.

These soils are relatively low in fertility and are difficult to cultivate. They have moderate to high available water capacity, moderately slow to very slow permeability, and moderately low to high content of organic matter. The major management needs are controlling erosion and maintaining the content of organic matter.

Soils of this unit are moderately well suited to all the crops commonly grown in the county. The main crops are corn, oats, wheat, soybeans, and alfalfa. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to control further erosion and to maintain the content of organic matter. Terraces, waterways, and contour farming help to control runoff and further erosion on cultivated soils. Continuous meadow or hay crops help protect the soils from excessive erosion losses without the use of mechanical measures.

CAPABILITY UNIT IVe-11

This unit consists of moderately deep, moderately well drained, moderately fine textured soils of the Snead series. These sloping soils are slightly to moderately eroded.

These soils are moderately fertile but are difficult to work when wet. They have very low available water capacity and are slowly permeable. Content of organic matter is moderate to high. The major management needs are controlling erosion and maintaining the content of organic matter.

Soils of this unit are moderately well suited to all the crops commonly grown in the county. The main crops are corn, oats, wheat, soybeans, and alfalfa. These soils are also suited to grasses, trees, and the development of wildlife habitat.

Growing winter cover crops, adding manure, and properly utilizing crop residue help to control further erosion and to maintain the content of organic matter. Terraces, waterways, and contour farming help to control runoff and further erosion on cultivated soils. Continuous meadow or hay crops help protect the soil from excessive erosion losses without the use of mechanical measures.

CAPABILITY UNIT VIe-5

This unit consists of deep, somewhat poorly drained to well-drained silt loam, loam, silty clay loam, and clay loam soils of the Armster, Greenton, Ladoga, Lamoni, Sampsel, and Adair series. These soils have a very firm to friable subsoil and are on strongly sloping and moderately steep uplands. They are slightly to severely eroded.

Runoff is rapid on all of the soils. They have moderate to high available water capacity, moderate to slow permeability, and moderately low to high content of organic matter. All soils in this unit are subject to further soil loss unless properly managed. The major management needs are maintaining a continuous cover of plants, controlling rapid runoff, and controlling further erosion.

Soils in this unit are suited to pasture, trees, and wildlife habitat.

Growing permanent pasture that is protected from overgrazing, or timber that is protected from fire, helps protect these soils from runoff and further erosion. Performing pasture renovation or logging operations on the contour also helps control further erosion.

CAPABILITY UNIT VIe-8

This unit consists of deep, well-drained to somewhat poorly drained soils of the Armster, Greenton, Lamoni, and Adair series. These soils have a fine-textured subsoil, are severely eroded, and are on strongly sloping uplands.

These soils are low in fertility and are difficult to cultivate. They have moderate to high available water capacity, moderately slow to very slow permeability, and moderately low to high content of organic matter. The major management needs are controlling further erosion and maintaining a cover of plants.

Soils of this unit are not suited to cultivated crops. They are suited to pasture, timber, and the development of wildlife habitat. Permanent pasture that is protected from overgrazing, or timber that is protected from fire, provides continuous vegetative cover that helps protect the soils from runoff and further erosion.

CAPABILITY UNIT VIe-11

This unit consists of moderately deep, moderately well drained silty clay loam soils of the Snead series. These soils have a firm subsoil, are on strongly sloping uplands, and are slightly to moderately eroded.

These soils are moderately fertile and are difficult to work when wet. They have a very low available water capacity and are slowly permeable. The content of organic matter is moderate to high. All soils in this unit are subject to further soil loss unless properly managed. The major management needs are maintaining the content of organic matter and fertility, improving and maintaining tilth, and controlling further erosion.

These soils are suited to grasses, trees, and the development of wildlife habitat.

Continuous meadow and hay crops help protect these soils from further erosion.

CAPABILITY UNIT VIIe-11

This unit consists of moderately deep, moderately well drained silty clay loam soils of the Snead series. These soils have a firm subsoil and are on moderately steep uplands. They are slightly to moderately eroded.

These soils are moderately fertile, are slowly permeable, and they have a very low available water capacity. Their content of organic matter is moderate to high. All soils in this unit are subject to further soil loss unless properly managed. The major management needs are maintaining a continuous cover of plants and controlling rapid runoff and further erosion.

These soils are suited to pasture, trees, and wildlife habitat.

Permanent pasture that is protected from overgrazing, or timber that is protected from fire, helps protect these soils from runoff and further erosion. Renovating pasture or logging on the contour helps control runoff and erosion.

CAPABILITY UNIT VIIs-10

This unit consists of shallow, droughty Rock land on sloping to steep uplands. This Rock land is infertile, has very low available water capacity, and is low in content of organic matter. The major management need is maintaining a ground cover of plants.

This land type is suited to pasture, trees, and wildlife habitat.

Pasture that is protected from overgrazing and trees that are protected from fire help protect this land type from erosion.

Predicted yields

Predicted average acre yields for some of the principal crops grown in Caldwell County are shown in table 2. Yields are estimated averages for a 5- to 10-year period at two levels of management.

The yields shown in columns A are those to be expected from the ordinary management most farmers in the county were using in 1965. Under this kind of management only about half the amount of lime and fertilizer shown to be needed by soil tests is applied. Crop residue is returned to the soil by leaving straw, stalks, and stubble in the field, by feeding livestock in the field, or by spreading barnyard manure.

The yields in columns B are those to be expected from improved management used by some farmers in Caldwell County in 1965. Under this system lime and fertilizer are applied in amounts indicated by soil tests; crop residue is returned to the soils; minimum tillage is practiced; fieldwork is timely; adapted varieties of crops and seeding mixtures are used; surface drainage is improved where needed; and grazing is properly managed and weeds are cut in pastures.

Use of the Soils as Woodland

The native woody vegetation of Caldwell County consists of dense stands of trees or of scattered trees that grew with the tall prairie grasses. Trees in the dense stands grew on bottom lands along streams and on hillsides rising from the bottom lands. Scattered trees that grew with the tall prairie grasses were on broad upland ridges.

At the present time, dense stands of trees are on steep soils of hillsides and in areas of shallow rocky soils. Trees also grow in narrow bands along the edges and on the steep banks of streams. Scattered trees grow on soils that are used for cultivated crops or pasture (fig. 13). The

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

[Yields in columns A are to be expected under ordinary management; those in columns B under improved management. Absence of yield indicates that the crop is not ordinarily grown on the soil]

Soil	Corn		Oats		Soybeans		Clover		Pasture	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*A.U.D.*[1]	*A.U.D.*[1]
Armster loam, 2 to 5 percent slopes	45	64	30	40	20	30	2.0	3.0	100	160
Armster loam, 5 to 9 percent slopes	45	64	30	40	20	30	2.0	3.0	100	160
Armster loam, 5 to 9 percent slopes, eroded	35	55	25	35	15	25	2.0	3.0	100	160
Armster loam, 9 to 14 percent slopes	35	55	30	35	15	25	1.5	3.0	100	160
Armster loam, 9 to 14 percent slopes, eroded							1.5	3.0	100	160
Armster loam, 14 to 20 percent slopes, eroded									100	160
Armster clay loam, 5 to 9 percent slopes, severely eroded	20	30	20	30	15	20	1.5	2.5	80	140
Armster clay loam, 9 to 14 percent slopes, severely eroded									80	110
Blackoar silt loam	55	75	40	50	30	40	2.5	4.0	100	170
Colo silt loam	60	85	40	50	30	40	2.5	4.0	123	220
Greenton silt loam, 2 to 5 percent slopes	50	75	35	40	25	35	2.0	3.5	100	160
Greenton silty clay loam, 5 to 9 percent slopes, eroded	40	60	30	35	20	30	2.0	3.5	100	160
Greenton silty clay loam, 9 to 14 percent slopes, eroded							2.0	3.5	100	160
Greenton silty clay loam, 9 to 14 percent slopes, severely eroded									80	100
Grundy silt loam, 0 to 2 percent slopes	45	65	35	40	25	35	1.5	2.5	120	180
Grundy silt loam, 2 to 5 percent slopes	45	65	30	40	20	30	1.5	2.5	120	180
Grundy silty clay loam, 2 to 5 percent slopes, eroded	40	60	25	35	15	25	1.5	2.5	120	180
Grundy silty clay loam, 5 to 9 percent slopes, eroded	35	55	30	40	20	30	1.5	2.5	120	180
Kennebec silt loam	68	100	50	60	33	40	3.0	4.0	130	220
Ladoga silt loam, 2 to 5 percent slopes	45	64	30	40	20	30	2.0	3.5	100	160
Ladoga silt loam, 5 to 9 percent slopes, eroded	40	55	25	35	15	25	2.0	3.5	100	160
Ladoga silt loam, 9 to 14 percent slopes, eroded	25	40	20	30	10	15	1.0	1.5	100	160
Ladoga silt loam, 14 to 20 percent slopes									100	160
Lagonda silt loam, 2 to 5 percent slopes	50	70	30	40	25	35	1.5	2.5	120	180
Lagonda silt loam, 2 to 5 percent slopes, eroded	45	65	25	35	20	30	1.5	2.5	120	180
Lagonda silt loam, 5 to 9 percent slopes	45	65	25	35	20	30	1.5	2.5	120	180
Lagonda silty clay loam, 5 to 9 percent slopes, eroded	40	60	25	35	15	25	1.5	2.5	120	180
Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded	20	30	15	25	10	20	1.0	2.0	80	110
Lamoni and Adair soils, 2 to 5 percent slopes	45	65	30	40	15	25	1.5	3.5	120	180
Lamoni and Adair soils, 2 to 5 percent slopes, eroded	40	60	25	35	15	25	1.5	3.5	120	180
Lamoni and Adair soils, 5 to 9 percent slopes	40	60	25	35	15	25	1.5	3.5	120	180
Lamoni and Adair soils, 5 to 9 percent slopes, eroded	35	55	20	30	10	20	1.5	3.5	120	180
Lamoni and Adair soils, 5 to 9 percent slopes, severely eroded	20	40	15	25	10	15	1.0	2.5	80	110
Lamoni and Adair soils, 9 to 14 percent slopes	35	55	20	30	10	20	1.5	3.5	120	180
Lamoni and Adair soils, 9 to 14 percent slopes, eroded							1.5	3.5	120	180
Lamoni and Adair soils, 9 to 14 percent slopes, severely eroded									70	100
Lineville silt loam, 2 to 5 percent slopes	45	65	30	40	20	30	1.5	2.5	110	160
Lineville silt loam, 2 to 5 percent slopes, eroded	40	60	25	35	15	25	1.5	2.5	110	160
Lineville silt loam, 5 to 9 percent slopes	40	60	25	35	15	25	1.5	2.5	110	160
Lineville silt loam, 5 to 9 percent slopes, eroded	35	55	20	30	15	25	1.5	2.5	110	160
Lineville silty clay loam, 5 to 9 percent slopes, severely eroded	20	30	15	25	10	20	1.0	2.0	80	110
Moniteau silt loam, 0 to 3 percent slopes	45	70	25	35	15	30	2.0	3.0	100	160
Nevin silt loam, 0 to 3 percent slopes	50	75	40	60	30	40	2.5	4.0	100	160
Polo silt loam, 2 to 5 percent slopes	45	65	35	40	25	35	2.0	3.5	120	180
Polo silt loam, 5 to 9 percent slopes	40	60	30	35	20	30	2.0	3.5	120	180
Polo silt loam, 5 to 9 percent slopes, eroded	35	55	25	30	15	25	2.0	3.5	120	180
Polo silt loam, 9 to 14 percent slopes, eroded	25	40	25	30	15	25	1.5	2.5	100	160
Rock land									60	100
Sampsel silty clay loam, 2 to 5 percent slopes	45	65	25	35	20	30	1.5	2.5	120	160
Sampsel silty clay loam, 2 to 5 percent slopes, eroded	35	55	20	30	15	25	1.5	2.5	120	160
Sampsel silty clay loam, 5 to 9 percent slopes	40	60	25	35	20	30	1.5	2.5	120	160
Sampsel silty clay loam, 5 to 9 percent slopes, eroded	35	55	20	30	15	25	1.5	2.5	120	160
Sampsel silty clay loam, 5 to 9 percent slopes, severely eroded	20	30	15	20	10	20	1.0	2.0	80	110
Sampsel silty clay loam, 9 to 14 percent slopes, eroded							1.5	2.5	120	160
Snead silty clay loam, 5 to 9 percent slopes	25	45	20	30	20	30	1.8	2.0	120	160
Snead silty clay loam, 9 to 14 percent slopes							1.8	2.0	80	110
Snead silty clay loam, 9 to 14 percent slopes, eroded									70	100
Snead silty clay loam, 14 to 20 percent slopes									60	100
Zook silty clay loam	55	80	40	50	30	40	2.5	4.0	125	180
Zook silty clay	50	75	25	35	25	35	1.5	2.5	125	180

[1] Animal-unit-days is the number of days that one cow can be grazed on 1 acre without damage to the pasture.

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Figure 13.—**Scattered trees growing in a field of cultivated Lagond a soils. Many of the trees marketed in Caldwell County grow on land used mainly for cultivated crops or pasture.**

total area of woodland in Caldwell County is about 35,000 acres, or 12.7 percent of the county (*10*).

The suitability of soils in Caldwell County for use as woodland is discussed by soil associations in the paragraphs that follow. These associations are described in detail in the section "General Soil Map."

Suitability for trees of soils of association 1.—This association consists mainly of the Lagonda and Grundy soils and occupies about 62 percent of the county. It is on high, rounded ridges on the major divides and in low areas resembling benches. Only a small part of this soil association is used as woodland. The woodland consists of scattered trees growing near farmsteads, in open fields, or in fence rows.

Soils of this association are well suited to the production of high-quality hardwood trees, although other farm crops tend to eliminate areas of woodland and make the growing of trees a minor use of the soils.

Suitability for trees of the soils of association 2.—This association consists mainly of Armster and Lineville soils and occupies about 13 percent of the county. These soils are on hillsides, low ridges, and narrow bottom lands along minor streams. Only a small part of this association is used as woodland. This woodland consists mainly of scattered trees growing near farmsteads, in open fields, and in fence rows. Dense stands of trees are on the steep soils of hillsides and on areas of shallow rocky soils.

Soils of this association are well suited or moderately well suited to the production of high-quality hardwood trees. Droughtiness is a hazard on the shallow, rocky soils. In some of those areas, timber of lower quality is produced.

Suitability for trees of the soils of association 3.—This association consists mainly of the Sampsel, Greenton, and Snead soils and occupies about 13 percent of the county. These soils are on ridges and hillsides and in small valleys. A moderately large part of this association is used as woodland. The wooded areas consist of scattered trees growing near farmsteads, in open fields, and in fence rows. Dense stands of trees are on the steep soils of hillsides and in areas of shallow, rocky soils.

Soils of this association are well suited or moderately well suited to the production of high-quality hardwood trees, and woodland is a major use of the soils. Droughtiness is a hazard in areas of shallow, rocky soils. In some of those places, timber of lower quality is produced.

Suitability for trees of the soils of association 4.—This association consists mainly of Kennebec and Zook soils and occupies about 12 percent of the county. These soils are on bottom lands along streams. A moderately large part of this association is used as woodland. Trees grow in narrow bands along the edges and on the steep banks of streams and creeks.

Soils of this association are well suited to the production of high-quality hardwood trees. They are generally used for other farm crops, however, except where they are close to streams.

Other uses of the soils for trees.—Soils of this county are used for ornamental plantings around homes, cemeteries, parks, and golf courses; production of Christmas trees; and planting of windbreaks for protection of farmsteads. Use of soils for trees is expected to increase as the need to improve the total environment becomes more critical. Where trees and shrubs are to be established, the suitability of the soils should be taken into account. Several soil series in Caldwell County are well suited to growing trees and shrubs, but technical assistance is generally needed in planning.

Much of the existing woodland in this county does not indicate the potential of the soils for use as woodland. Trees now grow only on soils that are not suited to the economical production of farm crops, or they are grown in conjunction with field crops or in pastures. Measures could be taken to improve these situations, and many of the wooded areas could be managed for the production of high-quality hardwood timber.

The names of native trees commonly growing throughout Caldwell County are shown in the following list:

Common name	*Scientific name*
Oaks:	
Black oak	*Quercus velutina*
Bur oak	*Q. macrocarpa*
Chinkapin oak	*Q. muehlenbergii*
Post oak	*Q. stellata*
Red oak	*Q. rubra*
Shingle oak	*Q. imbricaria*
Swamp white oak	*Q. bicolor*
White oak	*Q. alba*
Other species:	
Ash	*Fraxinus americana* and *F. pennsylvanica*
Basswood	*Tilia americana*
Boxelder	*Acer negundo*
Buckeye	*Aesculus glabra*
Cherry	*Prunus serotina*
Coffeetree	*Gymocladus dioicus*
Cottonwood	*Populus deltoides*
Elm	*Ulmus americana* and *U. rubra*
Hackberry	*Celtis occidentalis*
Hickory	*Carya ovata* and *C. cordiformis*
Honeylocust	*Gleditsia triacanthos*
Maple	*Acer saccharum*
Osage-orange	*Maclura pomifera*
Redcedar	*Juniperus virginiana*
Sycamore	*Platanus occidentalis*
Walnut	*Juglans nigra*
Willow	*Salix nigra*

Use of the Soils for Wildlife Habitat

This section deals with the suitability of the soils of Caldwell County for growing plants that furnish food and cover for wildlife. It consists of (1) an explanation of the relationship between wildlife management and soils; (2) a table that rates the soils for elements of wildlife habitat and for habitat for classes of wildlife; and (3) definitions of the ratings, of habitat elements, and of classes of wildlife.

Successful management of wildlife on any tract involves having food, cover, and water available in suitable combination. Lack of any of these necessities, an unfavorable balance between them, or inadequate distribution of them can seriously limit or make impossible the use of the tract as a habitat for desired species of wildlife.

Information on soils is useful in creating, improving, or maintaining an environment that is suitable for providing food, cover, and water for wildlife. Most wildlife habitats are managed by planting suitable vegetation, by manipulating existing vegetation, or by a combination of these measures. Information on soils can also be useful in broad-scale planning for parks, nature areas, or other recreational developments having wildlife aspects.

Table 3 rates the soils of Caldwell County according to potential for the creation, improvement, or maintenance of eight elements of wildlife habitat, and also for their relative value as habitats for openland wildlife, woodland wildlife, and wetland wildlife.

In rating the soils for wildlife potential, major emphasis was given to the following soil characteristics and qualities: available water capacity, effective soil depth, hazard of flooding, reaction, slope, texture of the surface layer, and natural drainage or wetness.

Habitat suitability ratings

The suitability ratings shown in table 3 are defined as follows:

Good means that the soil is above average for a wildlife habitat element or a habitat for a given class of wildlife. A satisfactory habitat generally is easily created, or the habitat can be improved or maintained. There are few or no soil limitations to habitat management, and satisfactory results can be expected.

Fair means that the soil is about average for a habitat element or for a habitat for a given class of wildlife. A satisfactory habitat usually can be created, or the habitat can be improved or maintained. There are moderate soil limitations to management. Fairly frequent attention and moderate intensity of management may be required to obtain satisfactory results.

Poor means that the soil is below average for an element or for a habitat for a given class of wildlife. Soil limitations are rather severe, but a satisfactory habitat usually can be created, or the habitat can be improved or maintained. Results are uncertain. Management may be difficult and may require intensive effort.

Very poor means that the soil has severe limitations and that the creation, improvement, or maintenance of a satisfactory habitat is impractical under prevailing soil conditions. Unsatisfactory results are probable.

Habitat elements

The seven habitat elements listed in table 3 are described in the following paragraphs:

Grain and seed crops are domestic grains or seed-producing annuals planted to produce food for wildlife. Examples are corn, sorghum, wheat, oats, soybeans, and millet.

TABLE 3.—*Potential of soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Adair: (Mapped only with Lamoni series).				
Armster:				
AmB	Good	Good	Good	Good
AmC, AmC2, AmD, AmD2	Fair: slope	Good	Good	Good
AmE2, ArC3, ArD3	Poor: slope	Fair: slope	Good	Good
Blackoar: Bk	Good	Fair: wetness	Good	Fair: wetness
Colo: Co	Good	Fair: wetness	Good	Fair: wetness
Greenton:				
GnB	Good	Good	Good	Good
GrC2, GrD2, GrD3	Fair: slope	Good	Good	Good
Grundy:				
GsA	Good	Good	Good	Good
GsB, GuB2	Good	Good	Good	Good
GuC2	Fair: slope	Good	Good	Good
Kennebec: Ke	Good	Good	Good	Good
Ladoga:				
LaB	Good	Good	Good	Good
LaC2, LaD2	Fair: slope	Good	Good	Good
LaE	Poor: slope	Fair: slope	Good	Good
Lagonda:				
LdB, LdB2	Good	Good	Good	Good
LdC, LgC2, LgC3	Fair: slope	Good	Good	Good
Lamoni and Adair soils:				
LmB, LmB2	Good	Good	Good	Good
LmC, LmC2, LmC3, LmD, LmD2, LmD3.	Fair: slope	Good	Good	Good
Lineville:				
LnB, LnB2	Good	Good	Good	Good
LnC, LnC2, LvC3	Fair: slope	Good	Good	Good
Moniteau: MoA	Fair: wetness	Fair: wetness	Fair: wetness	Fair: wetness
Nevin: NeA	Good	Good	Good	Good
Polo:				
PoB	Good	Good	Good	Good
PoC, PoC2, PoD2	Fair: slope	Good	Good	Good
Rock land: Ro	Very poor: rocky	Very poor: rocky	Very poor: rocky	Very poor: rocky
Sampsel:				
SaB, SaB2	Good	Good	Good	Good
SaC, SaC2, SaC3, SaD2	Fair: slope	Good	Good	Good
Snead:				
SnC, SnD, SnD2	Fair: slope	Good	Good	Fair: soil thickness
SnE	Poor: slope	Fair: slope	Good	Fair: soil thickness
Zook:				
Zo	Fair: flooding	Fair: wetness	Fair: wetness	Fair: wetness
Zs	Fair: flooding	Fair: wetness	Fair: wetness	Fair: wetness

of wildlife habitat and classes of wildlife

Elements of wildlife habitat—Continued			Classes of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Openland	Woodland	Wetland
Good	Poor: slope	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.
Fair: wetness	Good	Fair: moderate permeability.	Good	Fair	Fair.
Fair: wetness	Good	Fair: moderate permeability.	Good	Fair	Fair.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Fair: drainage	Fair: drainage	Good	Good	Fair.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: drainage	Very poor: drainage.	Good	Good	Very poor.
Good	Poor: slope	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	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	Good	Good	Very poor.
Good	Very 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	Good	Good	Very poor.
Fair: wetness	Fair: slope	Fair: slope	Fair	Fair	Fair.
Good	Fair: slope	Fair: slope	Good	Good	Fair.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Very poor: rocky	Very poor: slope	Very poor: slope	Very poor	Very poor	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Fair: soil thickness	Very poor: slope	Very poor: slope	Good	Fair	Very poor.
Fair: soil thickness	Very poor: slope	Very poor: slope	Fair	Fair	Very poor.
Fair: wetness	Good	Good	Fair	Fair	Good.
Fair: wetness	Poor: silty clay surface layer.	Good	Fair	Fair	Fair.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted to furnish wildlife food and cover. Examples are fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clovers, trefoils, alfalfa, and sericea lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses and forbs (weeds) that provide food and cover principally to upland forms of wildlife and are mainly established through natural processes. Examples are bluestem, Indiangrass, wheatgrass, wildrye, oatgrass, pokeweed, strawberries, lespedezas, wild beans, and dandelions.

Hardwood plants are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, twigs, or foliage used extensively as food by wildlife; and which commonly are established through natural processes but also may be planted. Examples are oak, beech, cherry, hawthorn, dogwood, viburnum, holly, honeysuckle, and roses.

Coniferous woody plants are cone-bearing trees and shrubs, primarily of importance to wildlife as cover, but which also may furnish food in the form of browse, seeds, or fruitlike cones; and which commonly are established through natural processes but also may be planted. Examples are pine, spruce, white-cedar, hemlock, balsam fir, redcedar, juniper, and yew.

Wetland food and cover plants are annual and perennial wild herbaceous plants of moist to wet sites, exclusive of submerged or floating aquatics, that produce food and cover mainly used by wetland forms of wildlife. Examples are smartweed, wild millet, bulrushes, sedges, reeds, and cattails.

Shallow water developments are impoundments or excavations where water generally does not exceed 5 feet in depth. Examples are low dikes and levees, shallow dugouts, level ditches, and devices for controlling the water level in marshy streams or channels.

Classes of wildlife

The three classes of wildlife listed in table 3 are defined as follows:

Openland wildlife consists of birds and mammals that normally make their homes in cultivated fields and pastures and meadows; on lawns; and in areas overgrown by grasses, herbs, and shrubby growth. Examples are quail, pheasant, meadowlark, field sparrow, redwinged blackbird, cottontail rabbit, red fox, and woodchuck.

Woodland wildlife consists of birds and mammals that normally make their homes in areas wooded with hardwood trees and shrubs, coniferous trees and shrubs, or mixtures of such plants. Examples are ruffed grouse, woodchuck, thrush, vireo, scarlet tanager, gray and red squirrels, gray fox, white-tailed deer, and raccoon.

Wetland wildlife consists of birds and mammals that normally make their homes in wet areas, such as ponds, streams or ditches, marshes, and swamps. Examples are black duck, wood duck, rail, heron, shore birds, mink, muskrat, and beaver.

Engineering Uses of the Soils [3]

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

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

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

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4 and 5, which show, respectively, several estimated soil properties significant to 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 4 and 5. It also can be used to make other useful maps.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Estimates generally are made to a depth of about 5 feet, and interpretations do not apply to greater depths. Also, engineers should not apply specific values to the estimates for bearing capacity and traffic-supporting capacity given in this survey. Investigation of each site is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil

[3] By CHARLES L. DICKERSON, agricultural engineer, Soil Conservation Service.

engineering. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some of the terms used in this soil survey have special meaning to soil scientists not known to all engineers. Many of the terms commonly used in soil science are defined in the Glossary at the back of this survey.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*12*) used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

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

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

Engineering properties of the soils

Table 4 gives, for each soil series and land type, some of the estimated soil characteristics significant to engineering and the engineering classification of the soil material in the principal horizons.

Permeability is estimated for uncompacted soil material. The estimates are based on the structure, texture, and consistence of the soil and on field observations and limited laboratory data.

Available water capacity is the capacity of the soil to hold water available for use by most plants. It is the difference between the amount of soil water at field capacity and the amount at wilting point. The estimates of available water capacity for most of the soils are based on laboratory data. For a few, the estimates are based on data for similar soils.

The shrink-swell potential indicates the change in volume to be expected when the moisture content changes. It is estimated primarily on the basis of the amount and kind of clay in a soil. In general, a soil classified as CH and A-7 has a high shrink-swell potential. Soils with a low shrink-swell potential are clean sands and gravel (single grain) and soils having a small amount of nonplastic to slightly plastic fine material.

Depth to bedrock is not given in table 4 because bedrock is 6 feet or more below the surface of most soils. Bedrock is less than 6 feet below the surface of Rock land and the Snead soils.

Engineering interpretations

Table 5 rates soils as a source of topsoil and roadfill material. It also shows the major soil features affecting highway location, foundations for low buildings, and several other farm and nonfarm engineering practices. Limitations of the soil for use as sewage lagoons and septic tank filter fields are stated.

In selecting soils for highway construction the engineer investigates the likelihood of flooding, seepage, and landslides. He considers the presence of poor quality material within or slightly below the subgrade. For example, a layer of highly plastic clay impedes internal drainage and affects the stability of the soil. Poor drainage, flooding, or a high water table affects the need for drainage or embankments.

Suitability of the soils of Caldwell County for the design and application of conservation practices, for building foundations, and for irrigation systems and sewage disposal are primarily affected by soil drainage, permeability, slope, overflow, wetness, and presence of rock. These properties are evaluated in table 5 for the soils of each series.

All of the soils located on flood plains in the county are subject to flooding. Even the soils on second bottoms or terraces are subject to some infrequent flooding. The extent of flooding varies with the rainfall pattern and extent to which local soil and water conservation practices are applied. Soils occurring in the uplands, particularly those having slopes of more than 7 to 8 percent, have an irregular dendritic slope pattern. Such a pattern requires considerable cutting and filling and restricts the suitability of the soil for parallel terrace construction. Only the small areas occupied by Rock land and the soils of the Snead series have rock or shale layers that interfere with normal use. Farm pond construction is generally well adapted to all soils except those containing stones in the solum and those subject to overflow.

Recreational Uses of the Soils

Recreation can be a primary use of certain areas, but it is more likely to be part of a multiple-use scheme for developing an area. Recreational enterprises are important segments of community development. Skillful management is needed if the soils, water, plants, and wildlife are to provide opportunities for outdoor enjoyment and at the same time provide monetary gain for the landowner.

Caldwell County has many natural resources that offer a range of opportunities for development of outdoor recreational areas. The county is favorably located with respect to the high-density population in and around

TABLE 4.—*Estimated soil properties*

[The land type Rock land (Ro) is omitted from this table because its properties are variable and generally require onsite investigation. reason the reader should carefully follow the instructions for

Soil series	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	In.			
Adair	0–15	Loam	ML	A–4
Mapped only with Lamoni series.	15–21	Clay loam	CL	A–7–6
	21–60	Clay loam	CL	A–7
Armster: AmB, AmC, AmC2, AmD, AmD2, AmE2, ArC3, ArD3.	0–7	Loam	ML	A–4
	7–60	Clay loam	CL	A–7
Blackoar: Bk	0–60	Silt loam	ML or CL	A–4
Colo: Co	0–14	Silt loam	ML or CL	A–7–6
	14–40	Silty clay loam	CL	A–7–6
	40–80	Light silty clay	CH	A–7–6
Greenton: GnB, GrC2, GrD2, GrD3	0–12	Silty loam	ML or CL	A–4
	12–30	Silty clay	CH	A–7
	30–39	Clay	CH	A–7
	39–60	Silty clay	CH	A–7
Grundy: GsA, GsB, GuB2, GuC2	0–7	Silt loam	ML	A–4
	7–13	Silty clay loam	CL	A–6 or A–7
	13–28	Silty clay	CH	A–7
	28–51	Silty clay loam	CL	A–7
	51–60	Silt loam	ML	A–4
Kennebec: Ke	0–60	Silt loam	ML	A–4
Ladoga: LaB, LaC2, LaD2, LaE	0–10	Silt loam	ML	A–4
	10–45	Silty clay loam	CL	A–6 or A–7
	45–60	Silt loam	ML or CL	A–4
Lagonda: LdB, LdB2, LdC, LgC2, LgC3	0–6	Silt loam	ML	A–4
	6–16	Silty clay loam	CL	A–6 or A–7
	16–24	Silty clay	CH	A–7
	24–39	Silty clay loam	CL	A–6 or A–7
	39–63	Clay loam	CL	A–7
*Lamoni: LmB, LmB2, LmC, LmC2, LmC3, LmD, LmD2, LmD3. For Adair part of these units, see Adair series.	0–10	Clay loam	CL	A–7
	10–34	Clay	CH	A–7
	34–60	Clay loam	CL	A–7
Lineville: LnB, LnB2, LnC, LnC2, LvC3	0–14	Silt loam	ML	A–4 or A–7–6
	14–23	Silty clay loam	CL	A–6 or A–7
	23–67	Clay loam	CL	A–7
Moniteau: MoA	0–20	Silt loam	ML–CL	A–4
	20–60	Silty clay loam	CL	A–6
Nevin: NeA	0–21	Silt loam	ML–CL	A–7–6
	21–56	Silty clay loam	CL	A–7–6
	56–60	Silt loam	ML–CL	A–7–6
Polo: PoB, PoC, PoC2, PoD2	0–7	Silt loam	ML–CL	A–4
	7–18	Silty clay loam	CL	A–6
	18–47	Silty clay	CH	A–7
	47–60	Silty clay loam	CL	A–6
Sampsel: SaB, SaB2, SaC, SaC2, SaC3, SaD2	0–16	Silty clay loam	CL	A–6 or A–7
	16–66	Silty clay	CH	A–7
	66	Shale.		
Snead: SnC, SnD, SnD2, SnE	0–12	Silty clay loam	CL	A–7
	12–17	Silty clay	CL	A–7
	17–20	Clay	CL	A–7
	20	Shale.		
Zook: Zo, Zs	0–12	Silty clay loam	CL	A–7–6
	12–60	Silty clay	CH	A–7

[1] For depth of 0 to 14 inches. The pH value for depth of 14 to 60 inches ranges from 6.1 to 6.5.

significant to engineering

An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. For this referring to another series in the first column of this table]

Percentage passing sieve			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			In./hr.	*In./in. of soil*	*pH value*	
----------	100	70–80	0. 63–2. 00	0. 13–0. 15	4. 5–5. 0	Low.
100	95–100	70–80	0. 06–0. 20	0. 13–0. 15	4. 5–5. 0	Moderate.
100	95–100	60–80	0. 20–0. 63	0. 13–0. 15	5. 6–6. 5	Moderate.
100	90–95	65–70	0. 63–2. 00	0. 14–0. 16	4. 5–5. 0	Low.
90–100	85–90	65–75	0. 20–0. 63	0. 16–0. 18	4. 5–5. 0	Moderate.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	6. 1–7. 3	Low.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	6. 1–6. 5	Low.
----------	100	90–95	0. 20–0. 63	0. 15–0. 18	5. 6–6. 0	Moderate.
----------	100	90–95	0. 20–0. 63	0. 13–0. 15	5. 6–6. 0	High.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	5. 6–6. 5	Low.
----------	100	90–95	0. 63–2. 00	0. 13–0. 15	6. 1–7. 3	High.
----------	100	90–95	0. 63–2. 00	0. 13–0. 15	7. 4–7. 8	High.
----------	100	90–95	0. 63–2. 00	0. 13–0. 15	7. 4–7. 8	High.
----------	100	95–100	0. 63–2. 00	0. 18–0. 21	6. 6–7. 3	Low.
----------	100	95–100	0. 20–0. 63	0. 15–0. 18	5. 6–6. 5	Moderate.
----------	100	95–100	0. 06–0. 20	0. 13–0. 15	5. 6–7. 3	High.
----------	100	95–100	0. 06–0. 20	0. 14–0. 16	6. 6–7. 3	Moderate.
----------	100	95–100	0. 63–2. 00	0. 18–0. 21	6. 6–7. 3	Low.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	[1] 6. 6–7. 3	Low.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	5. 6–6. 0	Low.
----------	100	75–90	0. 20–0. 63	0. 13–0. 15	4. 5–5. 5	Moderate.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	5. 6–6. 0	Low.
----------	100	85–95	0. 63–2. 00	0. 18–0. 21	5. 6–6. 0	Low.
----------	100	85–95	0. 63–2. 00	0. 18–0. 21	5. 1–5. 5	Moderate.
----------	100	75–90	0. 06–0. 20	0. 13–0. 15	5. 6–6. 0	High.
----------	100	75–90	0. 20–0. 63	0. 13–0. 15	6. 6–7. 3	High.
95–100	90–95	85–90	0. 20–0. 63	0. 13–0. 15	7. 4–8. 4	High.
100	90–95	70–80	0. 63–2. 00	0. 14–0. 16	5. 6–7. 3	Moderate.
90–100	85–90	70–80	0. 06–0. 20	0. 13–0. 15	4. 5–7. 3	High.
90–100	85–90	70–80	0. 63–2. 00	0. 14–0. 16	6. 6–7. 3	Moderate.
----------	100	85–95	0. 63–2. 00	0. 10–0. 21	6. 1–6. 5	Low.
----------	100	85–95	0. 63–2. 00	0. 18–0. 21	5. 1–5. 5	Moderate.
95–100	90–95	85–90	0. 20–0. 63	0. 13–0. 15	4. 5–8. 4	Moderate.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	4. 5–6. 0	Low.
----------	100	85–95	0. 06–0. 20	0. 13–0. 15	5. 6–6. 0	Moderate.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	4. 5–5. 5	Low.
----------	100	90–95	0. 20–0. 63	0. 15–0. 18	4. 5–5. 0	Moderate.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	----------	Low.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	6. 1–6. 5	Low.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	5. 6–6. 0	Moderate.
----------	100	85–95	0. 63–2. 00	0. 13–0. 15	5. 1–5. 5	High.
----------	100	85–95	0. 63–2. 00	0. 15–0. 18	5. 6–6. 0	Moderate.
----------	100	85–95	0. 63–2. 00	0. 18–0. 21	7. 3–5. 6	Moderate.
----------	100	85–95	0. 06–0. 20	0. 13–0. 16	6. 6–7. 3	High.
95–100	95–100	90–100	0. 06–0. 20	0. 15–0. 20	6. 1–6. 5	Moderate.
100	95–100	90–100	0. 06–0. 20	0. 13–0. 15	6. 6–7. 8	Moderate.
100	95–100	95–100	0. 06–0. 20	0. 13–0. 15	8. 5–9. 0	Moderate.
----------	100	85–95	0. 20–0. 63	0. 15–0. 18	7. 3–6. 1	Moderate.
----------	100	85–95	0. 06–0. 20	0. 13–0. 15	6. 1–7. 3	High.

TABLE 5.—*Interpretations of*

[The land type Rock land (Ro) is omitted from this table because its properties are variable. An asterisk in the first column indicates that at tions for referring to another series

Soil series	Suitability as a source of—		Soil features affecting—		
	Topsoil	Road fill	Highway location	Foundations for low buildings	Farm ponds: Reservoir area
Adair Mapped only with Lamoni series.	Good to a depth of about 15 inches. Fair to poor below 15 inches.	Fair	Gently sloping to moderately steep slopes; unstable on cut slopes.	Moderate shrink-swell potential; slow permeability.	No limiting soil features.
Armster: AmB, AmC, AmC2, AmD, AmD2, AmE2, ArC3, ArD3.	Good to a depth of about 7 inches. Fair below 7 inches.	Fair	Gently sloping to moderately steep slopes; unstable on cut slopes.	Moderate shrink-swell potential.	No limiting soil features.
Blackoar: Bk	Good	Good	Subject to overflow; poorly drained.	Poorly drained; subject to overflow.	Subject to overflow.
Colo: Co	Good	Good	Subject to overflow.	High shrink-swell potential below a depth of 40 inches.	Subject to overflow.
Greenton: GnB, GrC2, GrD2, GrD3.	Good to a depth of of about 12 inches. Poor below 12 inches.	Poor to fair	No limiting soil features.	High shrink-swell potential.	No limiting soil features.
Grundy: GsA, GsB, GuB2, GuC2.	Good to a depth of about 13 inches. Poor below 13 inches.	Fair to poor	Slow permeability	High shrink-swell potential; slow permeability.	No limiting soil features.
Kennebec: Ke	Good	Good	Subject to overflow.	Subject to overflow.	Subject to overflow.
Ladoga: LaB, LaC2, LaD2, LaE.	Good to a depth of about 10 inches. Poor below 10 inches.	Fair to good	No limiting soil features.	Moderate shrink-swell potential.	No limiting soil features.
Lagonda: LdB, LdB2, LdC, LgC2, LgC3.	Good to a depth of about 13 inches. Poor below 13 inches.	Fair to poor	No limiting soil features.	High shrink-swell potential; slow permeability.	No limiting soil features.

engineering properties

least one mapping unit in this series is made up of two or more kinds of soil. For this reason the reader should carefully follow the instruc- in the first column of this table]

Soil features affecting—Continued					Soil limitations for sewage disposal	
Farm ponds—Con. Embankments	Drainage	Irrigation	Diversions	Waterways	Septic tank disposal fields	Sewage lagoons
Moderate shrink-swell potential.	Not needed	Gently sloping to strongly sloping.	Gently sloping to strongly sloping.	Moderately well drained or somewhat poorly drained.	Severe where slopes are 9 to 14 percent; slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 14 percent.
Moderate shrink-swell potential.	Not needed	Gently sloping to moderately steep.	Gently sloping to moderately steep.	Gently sloping to moderately steep.	Severe where slopes are 9 to 20 percent; moderately slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 20 percent.
Subject to overflow.	No limiting soil features.	Poorly drained	Not needed	Not needed	Severe: subject to flooding more than once in 5 years.	Severe: subject to flooding.
Subject to overflow; high shrink-swell potential below a depth of 40 inches.	No limiting soil features.	Poorly drained	Not needed	Not needed	Severe: subject to flooding more than once in 5 years.	Severe: subject to flooding.
High shrink-swell potential.	Not needed	Gently sloping to strongly sloping.	No limiting soil features.	No limiting soil features.	Moderate: moderate permeability. Severe where slopes are 9 to 14 percent.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 14 percent.
High shrink-swell potential.	Not needed	Slow permeability; nearly level to sloping.	No limiting soil features.	Somewhat poorly drained.	Severe: slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 9 percent.
Subject to overflow.	No limiting soil features.	No limiting soil features.	Not needed	Not needed	Severe: subject to flooding more than once in 5 years.	Severe: subject to flooding.
Moderate shrink-swell potential below depth of 10 inches.	Not needed	Gently sloping to moderately steep.	No limiting soil features.	Gently sloping to moderately steep.	Severe where slopes are 9 to 20 percent; moderately slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 20 percent.
High shrink-swell potential.	Not needed	Slow permeability; gently sloping to sloping.	No limiting soil features.	Somewhat poorly drained.	Severe where slopes are 5 to 9 percent; slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 9 percent.

TABLE 5.—*Interpretations of*

Soil series	Suitability as a source of—		Soil features affecting—		
	Topsoil	Road fill	Highway location	Foundations for low buildings	Farm ponds: Reservoir area
*Lamoni: LmB, LmB2, LmC, LmC2, LmC3, LmD, LmD2, LmD3. For Adair soils in these units, see Adair series.	Good to a depth of about 7 inches. Fair below 7 inches.	Fair	Gently sloping to moderately steep slopes; unstable cut slopes.	High shrink-swell potential.	No limiting soil features.
Lineville: LnB, LnB2, LnC, LnC2, LvC3.	Good to a depth of about 13 inches. Poor below 13 inches.	Fair to poor	No limiting soil features.	Moderately slow permeability.	No limiting soil features.
Moniteau: MoA	Good	Good	Poorly drained; subject to overflow.	Poorly drained; subject to overflow.	No limiting soil features.
Nevin: NeA	Good	Good	Subject to overflow.	Subject to overflow.	No limiting soil features.
Polo: PoB, PoC, PoC2, PoD2	Good to a depth of about 12 inches. Poor below 12 inches.	Fair to good	No limiting soil features.	No limiting soil features.	No limiting soil features.
Sampsel: SaB, SaB2, SaC, SaC2, SaC3, SaD2.	Good to a depth of about 13 inches. Poor below 13 inches.	Fair to poor	No limiting soil features.	High shrink-swell potential; slow permeability.	No limiting soil features.
Snead: SnC, SnD, SnD2, SnE	Fair	Fair to poor	Shale below a depth of 18 to 30 inches; bedrock outcrops; hillside seeps.	Shale below a depth of 18 to 30 inches; subject to slippage.	Shale below a depth of 18 to 30 inches.
Zook: Zo, Zs	Fair to poor	Fair to good	Subject to overflow.	Subject to overflow.	No limiting soil features.

engineering properties—Continued

Soil features affecting—Continued					Soil limitations for sewage disposal	
Farm ponds—Con. Embankments	Drainage	Irrigation	Diversions	Waterways	Septic tank disposal fields	Sewage lagoons
High shrink-swell potential between a depth of 10 and 34 inches.	Not needed	Gently sloping to strongly sloping.	Gently sloping to strongly sloping.	Somewhat poorly drained.	Severe where slopes are 9 to 14 percent; slow to very slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 14 percent.
High shrink-swell potential.	Not needed	Moderately slow permeability; gently sloping and sloping.	Gently sloping and sloping.	No limiting soil features.	Severe where slopes are 5 to 9 percent; moderately slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 9 percent.
No limiting soil features.	No limiting soil features.	Poorly drained	No limiting soil features.	Not needed	Severe: slow permeability.	Severe: subject to flooding.
No limiting soil features.	No limiting soil features.	No limiting soil features.	No limiting soil features.	Not needed	Severe: moderately slow permeability.	Severe: subject to flooding.
No limiting soil features.	Not needed	Gently sloping to strongly sloping.	No limiting soil features	No limiting soil features.	Slight where slopes are 2 to 5 percent. Moderate where slopes are 5 to 9 percent. Severe where slopes are 9 to 14 percent.	Severe where slopes are 5 to 14 percent; moderately rapid permeability.
High shrink-swell potential.	Not needed	Gently sloping to strongly sloping.	Gently sloping to strongly sloping.	Somewhat poorly drained.	Severe where slopes are 9 to 14 percent; slow permeability.	Moderate where slopes are 2 to 5 percent. Severe where slopes are 5 to 14 percent.
Shale below a depth of 18 to 30 inches.	Not needed	Slow permeability; sloping to moderately steep.	Shale below a depth of 18 to 30 inches; sloping to moderately steep.	Shale below a depth of 18 to 30 inches; sloping to moderately steep.	Severe; slow permeability; shale below a depth of 18 to 30 inches.	Severe; 18 to 30 inches to shale.
High shrink-swell potential.	Depressional	Poorly drained	Not needed	Not needed	Severe; slow permeability; subject to flooding more than once in 5 years.	Severe; subject to flooding.

Kansas City. The center of the county is only about an hour's drive from the Kansas City metropolitan area. U.S. Highways No. 36 and No. 69, State Highway No. 13, and many secondary, improved, all-weather roads provide easy access to the county.

Topography and the nature of most of the soils favor the development of ponds and lakes and the development of land areas that would be suitable for many forms of outdoor recreation. Steep, rocky sloping areas, narrow stream valleys, cleared areas, and wooded areas are intermingled throughout the county. These provide the basis for a variety of scenery and recreational developments. Small lakes, camping areas, picnic areas, riding trails, nature trails, golf courses, and hunting preserves are examples of recreational facilities that can be built and developed throughout the county.

Soils are an important factor in the planning of most nonfarm and recreational uses of land. Information in this section points out soil-related limitations and problems that may be encountered in such uses. The most severe limitations listed can be overcome if the cost involved can be justified. The information is not intended to eliminate the need for onsite investigation for specific uses but rather to serve as a guide for screening sites for planning and more detailed investigation.

Table 6 shows the estimated degree of limitation of each of the survey mapping units for stated recreational uses of the soils of Caldwell County. For *moderate* and *severe* limitations, the table lists the cause of such limitations. Following are the three degrees of limitations used in the table and their meanings:

Slight.—Limitations, if any, are of minor importance and are easy to overcome.

Moderate.—Limitations are of a magnitude to require careful planning, design, and management. The cost of measures to correct or overcome the limitations is an important consideration.

Severe.—Limitations are serious enough that the cost of corrective measures may be too high to justify the intended use. The soil or site is not suited to the intended recreational use.

TABLE 6.—*Limitations of soils for stated recreational developments*

Soil series and map symbols	Picnic areas	Playgrounds	Camp areas	Paths and trails	Golf fairways
Armster:					
AmB	Slight	Moderate: moderately slow permeability; slopes.	Moderate: moderately slow permeability.	Slight	Slight.
AmC, AmC2	Slight	Severe: slopes	Moderate: moderately slow permeability.	Slight	Slight.
AmD, AmD2	Moderate: slopes	Severe: slopes	Moderate: moderately slow permeability; slopes.	Slight	Moderate: slopes.
AmE2	Severe: slopes	Severe: slopes	Severe: slopes	Moderate: slopes	Moderate: slopes.
ArC3	Moderate: clay loam surface soil.	Severe: slopes	Moderate: clay loam surface soil; moderately slow permeability.	Moderate: clay loam surface soil.	Slight.
ArD3	Moderate: clay loam surface soil; slopes.	Severe: slopes	Moderate: clay loam surface soil; slopes; moderately slow permeability.	Moderate: clay loam surface soil.	Moderate: slopes.
Blackoar: Bk	Severe: wetness	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness	Severe: wetness.
Colo: Co	Severe: wetness	Severe: flooding	Severe: flooding	Moderate: wetness; flooding.	Moderate: flooding.
Greenton:					
GnB	Slight	Moderate: slopes	Slight	Slight	Slight.
GrC2	Moderate: silty clay loam surface soil.	Severe: slopes	Moderate: loam	Moderate: silty clay loam surface soil.	Slight.
GrD2, GrD3	Moderate: silty clay loam surface soil; slopes.	Severe: slopes	Moderate: loam; slopes.	Moderate: silty clay loam surface soil.	Moderate: slopes.

TABLE 6.—*Limitations of soils for stated recreational developments*—Continued

Soil series and map symbols	Picnic areas	Playgrounds	Camp areas	Paths and trails	Golf fairways
Grundy:					
GsA, GsB	Moderate: wetness	Moderate: wetness; slow permeability.	Moderate: wetness; slow permeability.	Moderate: wetness.	Slight.
GuB2	Moderate: silty clay loam surface soil; wetness.	Moderate: silty clay loam surface soil; wetness; slow permeability; slopes.	Moderate: silty clay loam surface soil; wetness; slow permeability; slopes.	Moderate: silty clay loam surface soil; wetness.	Slight.
GuC2	Moderate: silty clay loam surface soil; wetness.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability.	Moderate: silty clay loam surface soil; wetness.	Slight.
Kennebec: Ke	Moderate: flooding	Severe: flooding	Severe: flooding	Moderate: flooding	Moderate: flooding.
Ladoga:					
LaB	Moderate: wetness	Moderate: moderately slow permeability; slopes.	Moderate: moderately slow permeability.	Slight	Slight.
LaC2	Moderate: wetness	Severe: slopes	Moderate: moderately slow permeability.	Slight	Slight.
LaD2	Moderate: wetness; slopes.	Severe: slopes	Moderate: moderately slow permeability; slopes.	Slight	Moderate: slopes.
LaE	Severe: slopes	Severe: slopes	Severe: slopes	Moderate: slopes	Moderate: slopes.
Lagonda:					
LdB, LdB2	Moderate: wetness.	Moderate: wetness; slow permeability; slopes.	Moderate: wetness; slow permeability.	Moderate: wetness.	Slight.
LdC	Moderate: wetness.	Severe: slopes	Moderate: wetness; slow permeability.	Moderate: wetness.	Slight.
LgC2, LgC3	Moderate: silty clay loam surface soil; wetness.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability.	Moderate: silty clay loam surface soil; wetness.	Slight.
Lamoni and Adair soils:					
LmB, LmB2	Moderate: clay loam surface soil; wetness.	Moderate: clay loam surface soil; wetness; slow permeability; slopes.	Severe: slow permeability.	Moderate: clay loam surface soil; wetness.	Slight.
LmC, LmC2, LmC3.	Moderate: clay loam surface soil; wetness.	Severe: slopes	Severe: slow permeability.	Moderate: clay loam surface soil; wetness	Slight.
LmD, LmD2, LmD3.	Moderate: clay loam surface soil; wetness; slopes.	Severe: slopes	Severe: slow permeability.	Moderate: clay loam surface soil; wetness.	Moderate: slopes.
Lineville:					
LnB, LnB2	Moderate: wetness	Moderate: moderately slow permeability; slopes.	Moderate: moderately slow permeability.	Slight	Slight.
LnC, LnC2	Moderate: wetness	Severe: slopes	Moderate: moderately slow permeability.	Slight	Slight.
LvC3	Moderate: silty clay loam surface soil; wetness.	Severe: slopes	Moderate: silty clay loam surface soil; slow permeability.	Moderate: silty clay loam surface soil.	Slight.

TABLE 6.—*Limitations of soils for stated recreational developments*—Continued

Soil series and map symbols	Picnic areas	Playgrounds	Camp areas	Paths and trails	Golf fairways
Moniteau: MoA	Severe: wetness	Severe: wetness	Severe: wetness; flooding.	Severe: wetness	Severe: wetness.
Nevin: NeA	Moderate: wetness; flooding.	Moderate: wetness; flooding; moderately slow permeability.	Severe: flooding	Moderate: wetness	Moderate: flooding.
Polo:					
PoB	Slight	Moderate: slopes	Slight	Slight	Slight.
PoC, PoC2	Slight	Severe: slopes	Slight	Slight	Slight.
PoD2	Moderate: slopes	Severe: slopes	Moderate: slopes	Slight	Moderate: slopes.
Rock land: Ro	Severe: slopes; rockiness.	Severe: slopes; rockiness.	Severe: slopes; rockiness; stones and boulders.	Severe: rockiness	Severe: slopes; rockiness.
Sampsel:					
SaB, SaB2	Moderate: silty clay loam surface soil; wetness.	Moderate: silty clay loam surface soil; wetness; slow permeability; slopes.	Moderate: silty clay loam surface soil; wetness; slow permeability.	Moderate: silty clay loam surface soil; wetness.	Slight.
SaC, SaC2, SaC3	Moderate: silty clay loam surface soil; wetness.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability.	Moderate: silty clay loam surface soil; wetness.	Slight.
SaD2	Moderate: silty clay loam surface soil; wetness; slopes.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability; slopes.	Moderate: silty clay loam surface soil; wetness.	Moderate: slopes.
Snead:					
SnC	Moderate: silty clay loam surface soil; wetness.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability.	Moderate: silty clay loam surface soil; wetness.	Slight.
SnD, SnD2	Moderate: silty clay loam surface soil; wetness; slopes.	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slow permeability; slopes.	Moderate: silty clay loam surface soil; wetness.	Moderate: slopes.
SnE	Severe: slopes	Severe: slopes	Severe: slopes	Moderate: silty clay loam surface soil; wetness; slopes.	Moderate: slopes.
Zook:					
Zo	Severe: wetness	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness	Severe: wetness.
Zs	Severe: silty clay surface soil; wetness.	Severe: silty clay surface soil; wetness; flooding.	Severe: silty clay surface soil; wetness; flooding.	Severe: silty clay surface soil; wetness.	Severe: wetness.

The kinds of limitations are expressed in terms of soil characteristics or properties. As a rule, the properties that affect agricultural uses of soils are also the ones that affect recreational uses. For example, soils subject to flooding have limitations both for use for crops and for use for recreation. Flooding presents a serious limitation to use of soils intended for camping sites and for most recreational buildings. Where flooding is infrequent, the use of soils for hiking trails, nature study areas, or greenbelt open space may be only partly limited. Soils that are wet a significant part of the use season, even if not subject to flooding, are not well suited to use for campsites, recreational roads and trails, playgrounds, golf fairways, and picnic areas. Some droughty soils also have limitations, and stones in some soils are hazardous for certain uses. Some silty soils are excessively dusty, and some clayey soils remain sticky and slippery.

Slope affects the recreational uses of soils also. Steep slopes normally present severe hazards. Nearly level, well-drained, stone-free soils that are above the level ordinarily reached by overflow normally have little or no limitation for recreational use. Hard rock near the surface is a hazard to the use of soils that require leveling, the establishment of vegetation, or the construction of roads and other facilities.

In table 6 the following soil properties have been considered in rating the soils for use for picnic areas, playgrounds, camp areas, paths and trails, and golf fairways: (1) wetness, as indicated by soil drainage, tendency to ponding, or the presence of a high water table; (2) permeability, as indicated by soil texture, structure, and color; (3) estimated frequency of flooding; (4) depth to rock; (5) texture of the surface layer and proportion of coarse fragments; and (6) slope. Soil properties that affect other soil uses, some of which are applicable to recreational development, are given in table 5 in the section "Engineering Uses of the Soils."

These properties were evaluated and the degree of soil limitation is shown in table 6 for the following recreational uses:

Picnic areas.—Ratings apply to community or individual type picnic areas for seasonal use. Such soil properties as presence of stones, susceptibility to flooding, and texture of the surface layer are most significant. The sustained growth of vegetation able to withstand heavy traffic is important.

Playgrounds.—Ratings apply to playgrounds and to areas to be developed for organized games, such as baseball, football, and badminton. Areas selected for this use are subject to intensive foot traffic and the ability to support vegetation is important. Nearly level areas of well-drained soils that have a surface layer of texture and consistence that provide a firm surface are generally most suitable. Sites where the soil properties are less desirable require more expenditure for preparation and maintenance.

Camp areas.—The ratings apply to sites for tents and small camp trailers and the accompanying activities of outdoor living. Suitability of the soil to support vegetation that can withstand traffic is an important consideration.

Paths and trails.—Ratings apply to trails that are to be used for cross-country hiking, bridle paths, and nonintensive uses allowing random movement of people. It is assumed that such areas will require a minimum of excavation and of preparation of the site. Swamps, very stony areas, and sand dunes are generally considered as presenting severe hazards to use for paths and trails.

Golf fairways.—Ratings apply to golf fairways between greens. It is assumed that on fairways a suitable kind of vegetation will be established. Rocks on the soil surface, steep slopes, flooding, shallowness to rock, and wetness are features that determine feasilibity for establishing and maintaining fairways.

Formation and Classification of the Soils

This section discusses factors that have affected the formation of soils in Caldwell County. It also classifies the soils into higher categories.

Factors of Soil Formation

Soil is produced when soil-forming processes act on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineral composition of the parent materials; (2) the plant and animal life on and in the soil; (3) the climate under which the soil material has accumulated and existed since accumulation; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are active factors of soil genesis. They act on the parent material and slowly change it into a soil with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent materials also affect the kind of soil that is formed and, in extreme cases, determine it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. Usually a long time is required for the development of distinct horizons.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. It determines the limits of chemical and mineralogical composition of the soil. In Caldwell County, four kinds of parent material, alone or in combinations of two or more, have contributed to the formation of the soils. These four kinds are residual material derived from bedrock, glacial or ice-deposited material, loess or wind-deposited material, and alluvial or water-deposited material.

Residual material has weathered from limestone, sandstone, and shale to form the parent material of such soils as the Snead, Greenton, and Sampsel. These rock formations also are exposed as Rock land, which is not classified as soil.

Glacial parent material, composed of sand, silt, clay, gravel, and large boulders, was transported into Caldwell County by ice action. In these kinds of material

were formed such soils as the Armster (fig. 14), Lamoni, and Adair soils.

Loess parent material, made up principally of silts and clays, was transported into this county by wind. The Grundy soils were formed from this material.

Alluvial parent material in Caldwell County is of local origin. It is made up of silt, sand, clay, and gravel transported by water from ridges and hillsides to adjacent flood plains of streams. No large streams that could bring in outside materials flow through the county. Soils such as the Blackoar, Colo, and Zook were formed from this kind of parent material.

Some soils in this county have formed from more than one kind of parent material. For example, Lagonda soils were formed in a thin layer of loess over glacial material.

Plant and animal life

Plants, animals, insects, bacteria and fungi are important in the formation of soils. Increase of organic matter and nitrogen in the soil, gains or losses in plant nutrients, and alteration of structure and porosity are among the changes caused by living organisms.

Vegetation, particularly tall prairie grasses and deciduous forests, has affected the formation of soils in this county more than other living organisms. Most of the soils developed under tall prairie grasses, but some developed under deciduous forests.

Tall prairie grasses and the accompanying associated plant and animal life form soils that have thick, dark-colored surface layers and comparatively high organic-matter content. A large proportion of the soils of Caldwell County are "prairie soils." Examples of such soils are those of the Lagonda and Grundy series.

Deciduous forests, with the accompanying associated plant and animal life, form soils that have light-colored surface layers and comparatively low organic-matter content. Only a very small part of the soils in Caldwell County developed under forest vegetation alone. A large part of the soils developed under prairie vegetation and then under forest vegetation. Such soils have lighter colored surface layers than "prairie soils" but somewhat darker surface layers than "forest soils."

Examples of soils in Caldwell County that were influenced by deciduous forest vegetation are the Lineville, Armster, and Ladoga soils. The Ladoga soils are somewhat lighter colored than the Grundy soils, which developed under a cover of prairie grasses. The surface layer of the Ladoga soils is very dark gray and dark grayish brown, and the upper part of their subsoil is brown and dark yellowish brown. In contrast, Grundy soils have a black to very dark brown surface layer and are very dark gray and dark grayish brown in the upper part of the subsoil.

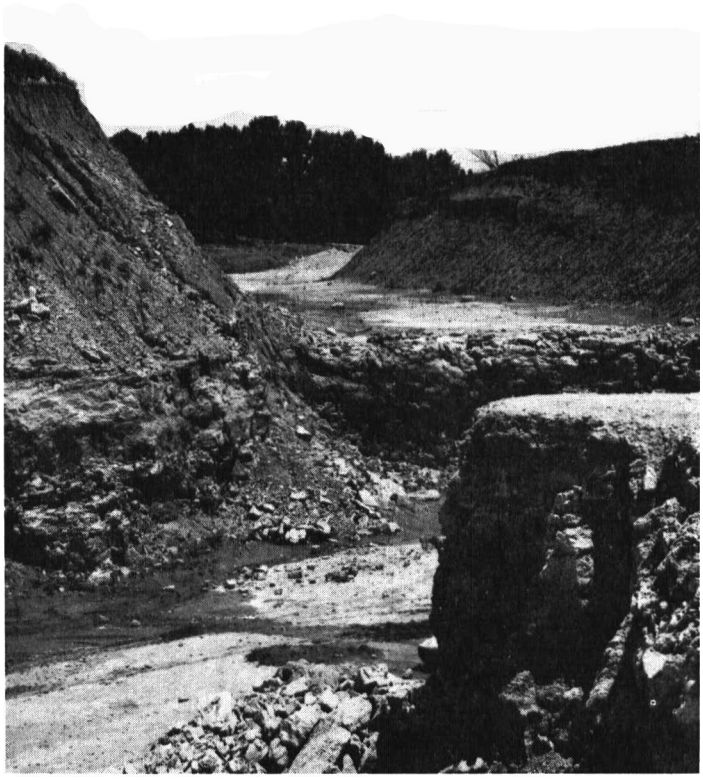

***Figure 14.*—Limestone quarry in which a channel has been cut through the glacial material to expose the limestone ledge. The limestone is about 10 feet thick, and the glacial material is about 15 feet thick. Armster soils have developed in the upper part of the glacial material.**

Climate

Climate, both long ago and recently, has been an important factor in the formation of the soils in Caldwell County. As a result of the climate of long ago, soil-forming materials were deposited in the county by ice and wind. More recent climate affected, either directly or indirectly, the development of the soils that formed from these and other materials. Geologic erosion, plant and animal life, and, in more recent time, accelerated erosion have varied with the climate and have influenced soil development.

Rainfall, combined with land use and farming operations, has a marked effect on the soils of the county. Two-thirds of the annual rainfall of 35.5 inches per year falls in the six months of April to September. This is the same period when most of the seedbed preparation and most of the tillage are performed. Erosion of Armster, Greenton, Lagonda, Lineville, Polo, Sampsel, and Snead series and Lamoni and Adair soils, for example, is related to climate and time of tillage.

Climate affects vegetation and in this way affects soils in the county. Pollen studies in Iowa (*3*) indicate that the climate during the Sangamon period (20,000 to 150,000 years ago) was cool and moist. This climate favored growth of coniferous vegetation. The pollen studies indicate that two periods have occurred in which the climate has been decidedly semiarid. During these periods, grass, which is able to withstand greater climatic extremes than trees, grew on these soils. The first such period occurred about 6,500 to 8,100 years ago, whereas the last, which was even drier, occurred during the last 6,500 years. This suggests that the recent climatic period favored grass vegetation. The great majority of

the soils have dark-colored upper soil layers, which indicates they developed under a prairie vegetation. Examples are the Adair, Greenton, Lagonda, Lamoni, Polo, Sampsel, and Snead soils. Observations during mapping indicate that deciduous tree cover is increasing in the county. This suggests that the climate may again be becoming more humid.

Topography

Togography, or relief, affects soil formation through its influence on drainage, runoff, infiltration, and other related factors, including accelerated erosion. In areas that have about the same plant cover and rainfall, runoff is rapid on steep slopes and is slower or lacking in level areas. In areas where most of the water runs off, little water enters the soil and soils form slowly. For example, in the Snead soils the soil horizons are indistinct, and the solum is thin. In areas where little water runs off, or where it runs off slowly, more water enters and soils form more rapidly. For example, in the Grundy soils, the soil horizons are distinct and the solum is thick.

In Caldwell County, runoff in most places has been somewhat slow and soil horizons are distinct. This is the case with the Greenton, Lagonda, Sampsel, Moniteau, and Grundy soils.

Time

Time is necessary for soils to form from parent materials. In Caldwell County soils that have formed in residual, glacial, and loessal materials have had a long period of time in which soil development could take place. These soils have well-defined horizons and are referred to as "old soils."

Soils that have formed from alluvial materials range from "old soils" to "young soils," depending primarily on how long the period of time has been in which soil development could take place. The "old soils" are on stream terraces in materials that have been in place for a long period of time. Examples are the Moniteau soils, which have a silt loam surface layer and a silty clay loam subsoil and substratum. The "young soils" are adjacent to streams in recently deposited materials that in some places are still in the process of being deposited from year to year by flooding and overwashing. Kennebec soils are an example, as they have silt loam texture throughout and evidence of recent stratifications. In some places in Caldwell County, steep rocky materials have been exposed by geologic erosion. These materials, although very old, have not had time to develop into soil. The Rock land miscellaneous land type is an example.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*7*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties and was adopted in 1965 (*9*). It is under continual study (*5*).

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 7 shows the classification of each soil series of Caldwell County by family, subgroup, and order, according to the current system.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different kinds of climate. Table 7 shows that the two soil orders in Caldwell County are Mollisols and Alfisols.

Mollisols have formed under grass and have a thick, friable, dark-colored surface layer. Base saturation is more than 50 percent. The soil material in these soils has not been mixed by shrinking and swelling.

Alfisols are mineral soils that have a clay-enriched B horizon that has medium or high base saturation.

SUBORDER.—Each order has been subdivided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS.—Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with the growth of roots or the movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 7 because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group,

TABLE 7.—*Soils classified according to the current system*

[Classifications were made during correlation of the series in April 1967]

Soil series	Family	Subgroup	Order
Adair [1]	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Armster [1]	Fine, montmorillonitic, mesic	Mollic Hapludalfs	Alfisols.
Blackoar	Fine-silty, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Colo	Fine-silty, mixed, noncalcareous, mesic	Cumulic Haplaquolls	Mollisols.
Greenton [1]	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Grundy	Fine, montomrillonitic, 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	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Lineville	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Moniteau	Fine-silty, mixed, mesic	Typic Ochraqualfs	Alfisols.
Nevin	Fine-silty, mixed, mesic	Aquic Argiudolls	Mollisols.
Polo	Fine, montmorillonitic, mesic	Typic Argiudolls	Mollisols.
Sampsel [1]	Fine, montmorillonitic, noncalcareous, mesic	Typic Argiaquolls	Mollisols.
Snead	Fine, mixed, mesic	Aquic Hapludolls	Mollisols.
Zook	Fine, montmorillonitic, noncalcareous, mesic	Cumulic Haplaquolls	Mollisols.

[1] The severely eroded phases of these series are taxadjuncts because the A horizons are thinner and lighter colored than is defined as the range for the respective series.

suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, minerals, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Nature of the County

This section provides general information about Caldwell County. It briefly discusses the history, farming, natural resources, highways, relief and drainage, and climate. Agricultural statistics used are from records of the U.S. Bureau of the Census.

Settlement of what is now Caldwell County was started in 1831, and the county was organized in 1836. The new county was settled mainly by people of the Mormon faith, who established a county seat at Far West. The population of Caldwell County increased rapidly and by 1839 had reached a total of about 5,000. Far West had become a city of more than 3,000.

In the winter of 1839, the Mormon people left Caldwell County and their abandoned farms were soon occupied by new settlers. The county seat was moved to Kingston, and the city of Far West became farmland.

According to records of the U.S. Bureau of the Census, Caldwell County had a population of 8,830 in 1960. Hamilton, the largest town, had a population of 1,701 in 1960, and Kingston, the county seat, a population of 311. Farming has always been the primary source of income in this county. General livestock farming is the most common type of enterprise. More than 94 percent of the county was in farms in 1964. In that year there were 1,114 farms in the county, and the average size of the farms was 232.8 acres.

The principal kinds and numbers of livestock in the county in 1964 were as follows:

	Numbers
Cattle and calves	43, 003
Milk cows	2, 721
Hogs and pigs	54, 662
Sheep and lambs	7, 826
Chickens (4 months and over)	42, 557

Acreages of the principal crops harvested in 1964 were as follows:

	Acres
Corn for all purposes	28, 945
Oats for grain	3, 242
Soybeans harvested for beans	23, 236
Wheat	10, 480

Soil is the most valuable natural resource in Caldwell County and also the most used resource. Limestone is quarried to a limited extent for use on farms and for road surfacing and construction purposes. Coal was mined to a very limited extent in the past, and natural gas in limited amounts is produced and used in some parts of the county.

Highways and small roads, for local use, are good in nearly all parts of the county. Markets for farm products are readily available in both Kansas City and St. Joseph, and transportation, both by rail and highway, to these markets is good. Industry is of limited extent within the county. Some county residents, however, are employed by industrial developments outside the county.

Relief and Drainage

Physiographically, Caldwell County consists of a well-dissected plain having many ridges and valleys. A number of points in the western and northwestern part of the county reach 1,020 to 1,040 feet above sea level. The lowest point, where Shoal Creek leaves the east edge of the county, is about 720 feet above sea level (*4*).

The ridges are rounded. They have slopes of 2 to 4 percent along the center and 5 to 8 percent along the sides. In some places the ridgetops are almost flat, but these areas are small both in size and number.

The valleys are numerous and range from small to moderately large. The valley slopes, or hillsides, commonly have slopes of 9 to 14 percent, but steeper slopes do occur, generally adjacent to a valley floor or stream bottom. Some of these steeper slopes are rocky, and in most places they are in timber.

The valley floors or stream bottoms, even in the small valleys, are generally large enough for farming and in most places are used for cultivated crops. Flooding and overwashing may occur in nearly all of these areas.

Shoal Creek, the largest stream in Caldwell County, is comparatively small and drains only about 45 square miles before entering the western part of the county. This stream and its many tributaries drain about 370 square miles of the total 432 square miles in the county. All of this area and the area along the north edge of the county drained by Marrowbone Creek and Lick Fork, is part of the Grand River watershed.

The only part of Caldwell County that is not part of the Grand River watershed is the area west of Cowgill and south of Missouri Highway No. 116. This area is drained by the Crooked River system. The part of Crooked River in Caldwell County is only a small stream.

Climate of Caldwell County [4]

Weather records for Chillicothe, Mo., go back to the year 1878. There is a break in the record, but continuous daily observations have been recorded at or near Chillicothe since 1917. Thirty years of this record, 1931 through 1960, have been used in preparation of the tables, graphs, and text in this section. The weather station was located 11 blocks north of the Chillicothe Post Office from February 1922 to September 1946.

The Civil Aviation Authority took over the weather observations through 1950, during which time the station was located 2.3 miles southeast of the Chillicothe Post Office at the airport facility. From 1950 to the end of the period of record used, the weather observations were recorded at Radio Station KCHI, 1.8 miles south southwest of the Chillicothe Post Office. This radio station was continuing as observer at the time this summary was written. The latter 20 years of record are believed to be representative of weather conditions in the rural area around the weather station. The first 10 years of record are from a location in the town of Chillicothe, but there are no reasons to believe that this has introduced any serious bias to the data. Most of the information on climate is in tables 8 to 14.

The average time interval between the last spring freeze and the first freeze in the fall is 179 days. The average annual precipitation is near 35 inches. During the 30 years of record used in this summary, annual precipitation ranged from near 20 inches to as much as 48 inches. Table 8 shows additional facts about the monthly precipitation at Chillicothe. On the average, the period April through September is the time when rainfall is most abundant. These are also the months when thunderstorms are most frequent, although they have been known to occur in each of the other months of the year.

Each of the 30 winters included in this summary had some snow. The first measurable snowfall usually occurs in November, and the last usually comes in March or April. About one year in four will have less than 15 inches of snow, and about one in six will have snowfall in excess of 30 inches. It is unusual for snow cover to remain on the ground for more than a week or two at a time. If there is to be a heavy fall of snow in a single storm, March is the most likely month for this to occur.

Table 10 shows the probability of occurrence of intense, short-duration rainstorms in Caldwell County.

Caldwell County is subject to large changes of temperature from season to season, as shown in table 11. The fall and winter months have the largest day-to-day changes. Temperature changes more slowly in summer than in other seasons. The temperature records taken at Chilli-

[4] By JAMES D. MCQUIGG, climatologist for Missouri, National Weather Service, U.S. Department of Commerce.

TABLE 8.—*Precipitation at Chillicothe, Mo.*

Month	Average monthly total	One year in 10 will have—		Extreme values in monthly precipitation		Greatest daily rainfall [1]	Number of days when precipitation is—			Snowfall	
		Less than [1]	More than [1]	Least [1]	Most [1]		0.10 inch or more	0.20 inch or more	1.00 inch or more	Monthly average [1]	Extreme value
	In.	*In.*	*In.*	*In.*	*In.*	*In.*				*In.*	*In.*
January	1.42	0.34	3.52	0.13	4.58	1.98	3.5	2.3	0.1	5.3	20.8
February	1.26	.42	1.86	.11	4.46	1.38	3.4	2.2	.1	4.9	17.6
March	2.36	.41	3.97	.39	4.19	2.60	5.1	3.8	.4	5.1	30.7
April	3.11	1.37	4.67	1.20	6.93	2.06	6.4	4.7	.6	.5	4.0
May	4.37	2.47	7.80	.96	13.30	3.70	7.8	6.2	1.0	0	0
June	5.48	1.92	10.41	.36	15.46	5.66	7.7	6.3	1.5	0	0
July	3.83	.98	8.22	.76	15.98	7.16	5.4	4.3	1.1	0	0
August	3.75	1.05	7.56	.13	9.55	4.85	5.6	4.4	1.1	0	0
September	3.65	.40	9.02	.14	10.08	3.93	5.1	4.0	1.3	0	0
October	2.52	.28	5.24	.11	8.62	3.50	4.2	3.2	.7	0	0
November	1.99	.15	4.66	.07	9.10	2.36	3.8	2.7	.4	1.7	10.0
December	1.63	.42	3.20	.32	3.31	1.87	3.6	2.5	.3	4.8	15.0
Year	35.37					7.16				22.3	

[1] Period of record is 1931–60.

TABLE 9.—*Probability of precipitation in stated quantities by 2-week intervals at Chillicothe, Mo.*

[Period of record 1931–60]

Biweekly intervals	Probability that precipitation will be at least—			
	0.40 inch	1.00 inch	2.00 inches	4.00 inches
	Pct.	*Pct.*	*Pct.*	*Pct.*
March 1–14	72	40	12	0
March 15–28	78	48	18	2
March 29–April 11	83	56	25	4
April 12–25	87	65	38	11
April 26–May 9	84	58	30	7
May 10–23	93	69	32	5
May 24–June 6	90	75	51	22
June 7–20	93	77	53	21
June 21–July 4	87	69	44	18
July 5–18	76	55	33	12
July 19–August 1	80	47	17	1
August 2–15	95	76	44	11
August 16–29	79	54	28	7
August 30–September 12	83	65	42	16
September 13–26	80	58	34	12
September 27–October 11	76	52	25	5

TABLE 10.—*Precipitation intensity by duration and frequency for Caldwell County, Mo.*

[Source: U.S. Weather Bureau Technical Paper No. 40*(11)*]

Length of period	1 year in 2 years	1 year in 10 years	1 year in 100 years
	In.	*In.*	*In.*
30 minutes	1. 32	1. 92	2. 75
60 minutes	1. 65	2. 41	3. 45
24 hours	3. 40	5. 20	7. 30

cothe, Mo., are believed to be representative of most of Caldwell County, with the exception of some small areas of bottom land along the rivers. In these latter locations, on calm clear nights, the minimum temperature tends to be a few degrees lower than in areas of the surrounding upland.

January is the coldest month, on the average. During the 30 years of record used in this summary, the coldest temperature was 21° below zero in February 1934. During the period prior to 1931, a low temperature of 29° below zero was recorded in January. Prolonged periods of very cold weather are rare. About half of the Januarys during the period of 1931–60 had at least 4 days having temperatures of 50 degrees or more. Only about 1 year in 5 will have as many as 5 days in January having temperatures below zero. Below-zero temperatures are rare in December and March.

Table 12 shows, in some detail, the probabilities of occurrence of the last freeze in the spring and the first freeze in the fall.

On the average, July is the hottest month and is also the month having the highest extreme temperatures, 116° recorded in July 1936. In one out of two Julys, temperatures of 100° F. or more can be expected at least once. Table 13 provides additional details concerning temperatures.

The term "heating degree day" has been used by engineers, architects, and the fuel industry for many years. The number of heating degree days for a given day is equal to a base temperature of 65° F., less the mean temperature for that day. When the heating degree day value increases, the amount of fuel required to heat a given building also increases. Table 14 shows the average heating degree days for each month (base 65° F.) and for the season, and the number of degree days that would be exceeded one year in ten.

Since much of the crop season precipitation occurs in connection with thunderstorms, there is risk of hail and an occasional tornado. The years when the risk of these

TABLE 11.—*Temperature at Chillicothe, Missouri*

[For the period 1931–60]

Month	Average daily			Standard deviation of daily mean	2 years in 10 will have at least 4 days with—		Extreme values	
	Maximum	Minimum	Mean		Maximum equal to or higher than—	Minimum equal to or lower than—	Maximum	Minimum
	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*
January	37. 3	17. 0	27. 1	12. 0	57	−4	72	−21
February	41. 8	20. 2	31. 0	11. 9	62	1	76	−23
March	51. 4	28. 9	40. 1	11. 8	74	12	88	−17
April	65. 6	41. 1	53. 3	10. 0	83	27	91	0
May	75. 7	51. 9	63. 8	8. 4	90	39	101	31
June	85. 1	61. 9	73. 5	7. 2	98	51	110	40
July	90. 9	65. 9	78. 4	6. 2	103	56	116	47
August	88. 6	64. 2	76. 4	6. 7	101	53	114	42
September	81. 7	54. 8	68. 3	9. 1	97	40	105	24
October	70. 7	43. 9	57. 3	9. 3	87	29	99	16
November	53. 1	30. 2	41. 6	10. 9	72	14	84	−2
December	41. 4	21. 5	31. 5	11. 1	62	1	71	−20

unwelcome weather elements is very low are the drought years. There is no evidence that Caldwell County is any more or any less subject to hail or occasional tornadoes than any other Missouri county.

In the preceding sections dealing with the climate of Caldwell County, most of the statements made were based on actual measurements of temperatures and precipitation at the official cooperative Weather Bureau station at Chillicothe. Some small areas in the county have differences in terrain and elevation which affect their climate, and thereby have different weather from that measured at the Chillicothe weather station. As a rule, however, the climatic patterns at Chillicothe represent reasonably well those for a large part of Caldwell County.

In the discussion that follows, precipitation patterns were derived from weather records at Chillicothe, Mo. Runoff patterns are based on 15 years of observations of stage readings on the Thompson River near Trenton, Mo. Potential evapotranspiration patterns are estimates computed from average monthly temperatures by use of Thornthwaite's method (*6*).

Several things can happen to the water that falls as rain or snow on Caldwell County. Some of it evaporates into the air and is carried away by wind. When vegetation is in the growing stage, large amounts of water will be transpired through the leaves of plants. These two phenomena are sometimes lumped together under the term "evapotranspiration." Evapotranspiration is difficult to measure, but there are methods, including Thornthwaite's (*6*), that permit reasonably accurate estimates, based on weather measurements. The evapotranspiration estimates presented in this section are in terms of potential evapotranspiration, or the maximum amount of water that would be lost from the soil surface and from actively growing plants if the soil moisture levels remained at or above field capacity. Actually, there are

TABLE 12.—*Probability of freezing temperatures later than specified dates in spring and earlier than specified dates in fall at Chillicothe, Mo.*

[Based on records for 1931–60]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	March 26	April 7	April 14	April 21	May 2
2 years in 10 later than	March 21	April 1	April 7	April 16	April 27
5 years in 10 later than	March 12	March 21	March 27	April 7	April 19
Fall:					
1 year in 10 earlier than	November 3	October 28	October 16	October 9	September 29
2 years in 10 earlier than	November 10	November 3	October 22	October 14	October 5
5 years in 10 earlier than	November 23	November 13	November 2	October 24	October 15

TABLE 13.—*Maximum and minimum temperature by days per month at Chillicothe, Mo.*

[Based on records for 1931–60]

Month	Average number of days per month that have—					
	Maximum temperature of—			Minimum temperature of—		
	32° F. or more	50° F. or more	90° F. or more	0° F. or less	32° F. or less	50° F. or less
January	11	6	0	3	29	31
February	7	8	0	2	25	28
March	3	16	0	0	21	30
April	0	27	0	0	6	24
May	0	31	2	0	0	13
June	0	30	9	0	0	2
July	0	31	17	0	0	0
August	0	31	15	0	0	1
September	0	30	7	0	0	11
October	0	30	1	0	4	23
November	2	18	0	0	18	29
December	7	8	0	1	27	31

TABLE 14.—*Heating degree-days*

[Based on records at Chillicothe, Mo., for 1931–60]

Month	Heating degree-days	1 year in 10, heating degree-days are expected to be—	
		More than—	Less than—
July	0		
August	4		
September	68	115	21
October	268	378	158
November	702	837	567
December	1, 039	1, 208	870
January	1, 174	1, 394	954
February	961	1, 178	744
March	771	984	558
April	366	482	250
May	124	205	43
June	15		
Year	5, 492		

times during almost every crop season when soil moisture levels are low and the potential evapotranspiration rate is not reached.

In a year when temperatures are near normal, potential evapotranspiration in Caldwell County is near 28 inches. Most evapotranspiration occurs from April through October, as can be seen in figure 15. It is greatest during the months of June through August, at a time when the likelihood of substantial rain is less than the maximum.

During an average year, the period of October through May has precipitation in excess of the potential loss by evapotranspiration. These are the months when soil moisture is replenished. The available water capacity of the top 3 feet of Caldwell County soils ranges from 1 to 8 inches of water. Most of the soils will hold from 4 to 6 inches. Of course, there are times when soil moisture penetrates to depths lower than 3 feet.

Average precipitation from October through April is about 14 inches. Average runoff in the Thompson River basin above Trenton is about 4 inches during the same months. Potential evapotranspiration in the period is close to 5 inches. Thus, in an average year, there would be approximately 5 inches of water going back into the top layers of the soil from October through April. During the months of May through September, average rainfall is 21 inches, average runoff is near 4 inches, and average potential evapotranspiration is about 23 inches. If there is approximately 6 inches of water in the top layers of the soil at the beginning of May, and average conditions prevail through the summer, the water balance is as follows: 6 + 21 = 27 inches, the total water available, and 4 + 23 = 27 inches, the total water loss.

Problems arise when winter and early spring precipitation is light, or when the soil will not hold as much as 7 inches of water, or when temperatures (hence evapotranspiration) exceed normal.

Figure 16 shows the patterns of precipitation, runoff, and evapotranspiration in a dry year in Caldwell County. Figure 17 shows these patterns in a wet year.

During the late spring, summer, and early fall months, a considerable amount of water evaporates from the surface of ponds. The exact amount of this loss varies from year to year, but it is usually in the range of 34 to 42 inches. About 26 to 31 inches of this loss will occur during May through October.

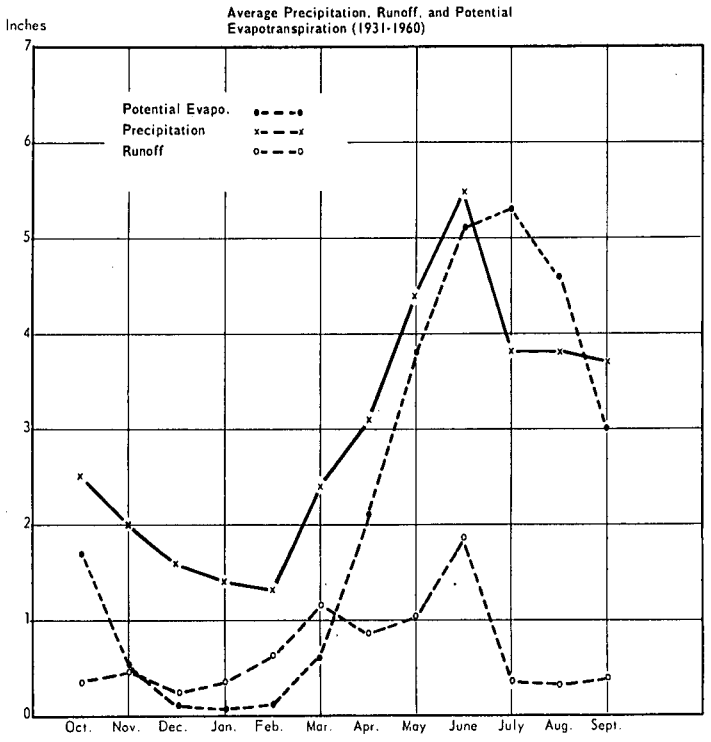

Figure 15.—**Average precipitation, runoff, and potential evapotranspiration (1931–60).**

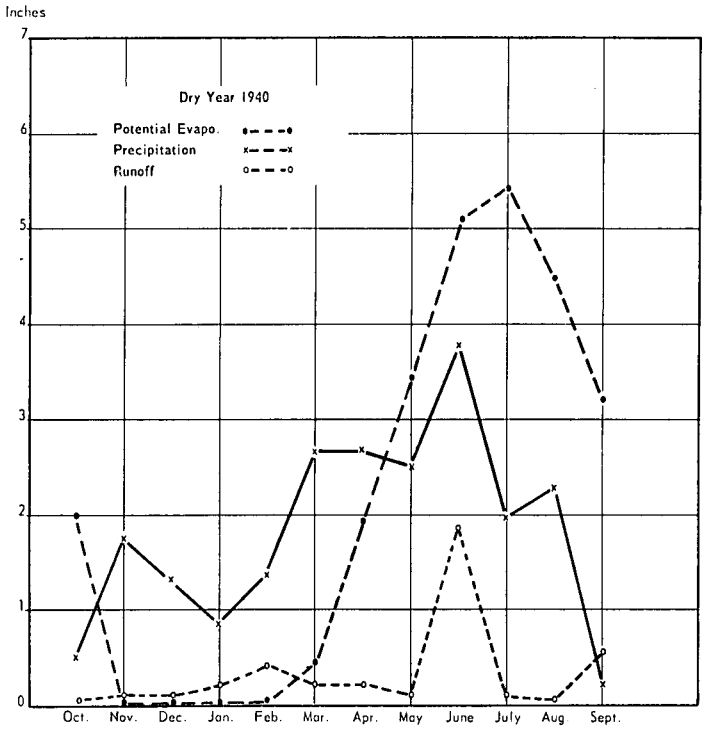

Figure 16.—**Precipitation, runoff, and potential evapotranspiration in a dry year (1940).**

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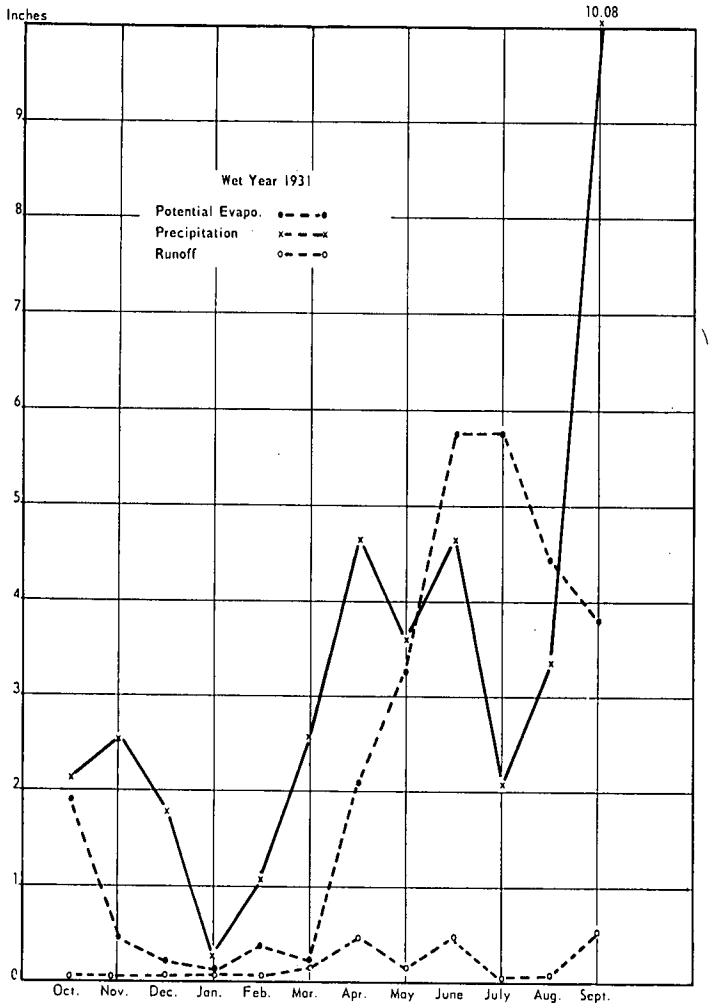

***Figure 17.*—Precipitation, runoff, and potential evapotranspiration in a wet year (1931).**

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

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.

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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes, or to loess in blankets on the surface.

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

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

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

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 residue.

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.

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

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

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 water-holding capacity.

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

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

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

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

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

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

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 rapid decomposition.

Parent material. The disintegrated and partly weathered rock from which soil has formed.

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

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

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. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.2 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

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

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

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. The following classes of slope are used in this soil survey:

	Percent of slope
Nearly level	0 to 2
Gently sloping	2 to 5
Sloping	5 to 9
Strongly sloping	9 to 14
Moderately steep	14 to 20
Steep	More than 20

Slope. The following classes of slope are used in this soil survey:

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.

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

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

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans.

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

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

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 surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

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

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

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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.

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