Series 1953, No. 9

Issued June 1960

SOIL SURVEY

Polk County Iowa

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

In cooperation with

IOWA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of Polk County was made to help you plan the kind of farming that will protect your soils and provide good yields. This report describes the soils, shows their location on a map, and tells what they will do under different kinds of management.

Find your farm on the map

To use this survey, start by finding your farm on the soil map accompanying this report. This is a large map of the county, on which you can see roads, streams, towns, and other landmarks. The index to map sheets will help you locate your farm; it tells what part of the county is shown on each sheet of the soil map.

Learn about your soils

Each kind of soil mapped in the county is identified on the soil map by a symbol. Suppose you have found on your farm an area marked with the symbol CfC2. You learn the name of the soil this symbol represents by looking at the map legend. The symbol CfC2 identifies Clarion loam, 5 to 9 percent slopes, moderately eroded. To learn how this soil looks in the field and what it can be used for, turn to the section, Descriptions of Soils, and read the descriptions of the Clarion series, of the Clarion loam type, and of Clarion loam, 5 to 9 percent slopes, moderately eroded.

After you have read the description of the soil, you may want to know more about how it can be managed and how much it can be expected to produce. For this information, turn to table 4, in the section, Soil Management.

The Guide to Map Units which is at the end of the report, will simplify use of the map and the report. This guide gives the map symbol and the capability group for each soil, the name of the soil, and the page on which the soil is described.

Make a farm plan

Study your soils and compare the yields you have been getting with those you could expect under different management. Then decide whether or not you need to change your methods of farming. The choice, of course, must be yours. This report will help you make a new farm plan. It does not provide a plan of management for your farm or any other single farm in the county.

If you find that you need help in farm planning, consult local representatives of the Soil Conservation Service or the County Extension Director. The staff of your State experiment station and others familiar with farming in your county will also be glad to help.

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CONTENTS

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SOIL SURVEY OF POLK COUNTY, IOWA

REPORT BY R. J. McCRACKEN, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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

SOIL SURVEYS are made chiefly for the following purposes: To determine the important characteristics of the soils of a county or an area; to classify these soils as defined types and other units; to establish and plot on maps the boundaries between the different kinds of soils; and to interpret the information obtained in such a way that it will have wide usage.

This survey was financed partly by the County government. It is part of the technical assistance given by the Soil Conservation Service of the United States Department of Agriculture to the Polk County Soil Conservation District. The fieldwork was completed in 1952, and, unless otherwise indicated, all statements in this report refer to conditions in Polk County at that time.

General Nature of the County

Polk County is located in the south-central part of Iowa. It is in the fourth tier of counties north of the Missouri boundary, and is the sixth county east of the Missouri River and the seventh county west of the Mississippi River. The principal city is Des Moines, the Iowa State capital; it has a population of about 177,965. The total area of Polk County is approximately 594 square miles, or 380,160 acres. Figure 1 shows the location of Polk County in Iowa.

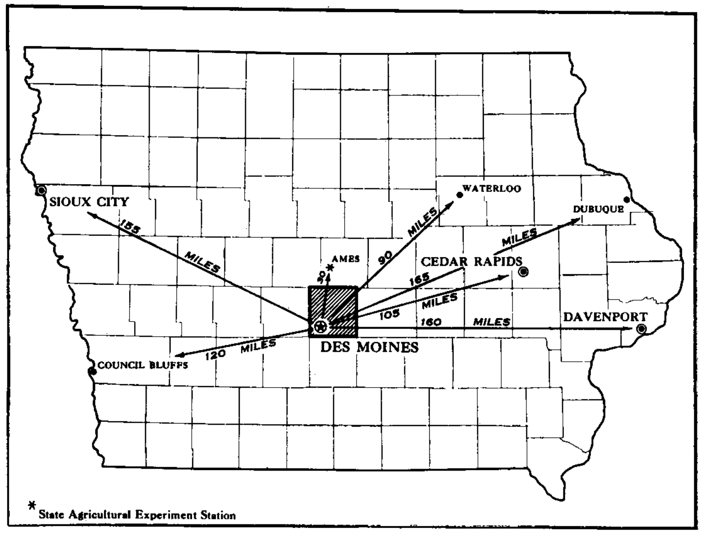

Figure 1.—**Location of Polk County in Iowa.**

Geology

The most extensive geological deposits in Polk County are those of glacial origin. The most recent of these was deposited by the Cary substage of the Wisconsin glacier about 12,000 to 13,500 years ago. This glacier deposited calcareous, loamy material 30 to 60 feet thick over the northern four-fifths of the county. Most of the soils in general soil areas 1, 2, and 6 (see fig. 6, p. 7) were formed from this glacial material.

Two other glaciers, the Kansan and Nebraskan, covered all of Polk County much earlier in the Pleistocene period. The till deposited by these glaciers is exposed in the southern part of the county, in general soil areas 4, 4a, 5, and 5a (see fig. 6). It can be found on the steeper side slopes but has been covered on the upland divides by a deposit of loess. Figure 8, page 9, and figure 9, page 10, illustrate the relationship of the loess to the underlying Kansan till.

The loess deposits are found in the same areas as the Kansan and Nebraskan till but most commonly on the rounded upland divides rather than the steep side slopes. The loess deposits are silty and are free of sand and gravel. They were deposited by the wind.

[1] Employed by Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering, during most of the field survey. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

[2] Employed jointly by BPISAE and Iowa Agricultural Experiment Station.

[3] Employed by the Soil Conservation Service.

[4] Employed through funds made available by the Assessor's Office, Polk County.

In contrast, the glacial material contains many sand and gravel particles and some large boulders.

Alluvial materials are found in general soil area 3. These are water-deposited materials that range from gravel to silty clay in texture. Some of the material was glacial outwash deposited as the glacial ice was melting. In other areas the material was deposited by overflowing streams.

The entire county is underlain by bedrock of the Des Moines group, a shale formation of the Pennsylvanian system. This shale bedrock contains some thin seams of coal and some interbedded limestone or sandstone. Most of the bedrock is buried beneath several feet of glacial till, loess, or stream-deposited material. The unweathered bedrock is predominantly acid, yellow or gray, silty or clayey shale. The bedrock formations are exposed on a few slopes in the southern part of the county.

Topography

The uplands in the northern four-fifths of the county are, for the most part, nearly level to undulating, though there are some steeper areas along the major streams. This part of the county was covered by glacial material that has, in most places, been altered very little since the time of glaciation. The southern part of the county is much rougher and hillier than the northern part, and the glacial material is older and has been cut up extensively by streams. The river valleys are 1 to 3 miles wide, and there are many tributary streams.

Vegetation

The native vegetation of Polk County was prairie grasses and hardwoods. The hardwood forests grew along the major streams, particularly along the Des Moines River. As shown in figure 2, the area originally covered by prairie grasses was much greater than that covered by trees.

Figure 2.—**Original vegetation in Polk County. Dark areas were in forest, and white areas were in grass.**

The native grasses contributed to the development of dark-colored, fertile soils that are fairly high in organic matter. The native trees contributed to the development of light-colored soils that are less fertile and contain less organic matter.

Climate

The average annual rainfall in Polk County is 30.89 inches. Of this, 21.49 inches comes during the growing season (April through September). The average monthly temperature and precipitation, as recorded at the U. S. Weather Bureau Station at Des Moines, are given in table 1.

The average growing season in Polk County is 171 days. The average date of the last frost in spring is April 21. The latest frost recorded was on May 31. The average date of the first frost in fall is October 9. The earliest recorded was on September 13.

Figure 3 shows the normal rainfall by months in central Iowa (*2*), and figure 4, the annual march of temperature in central Iowa.

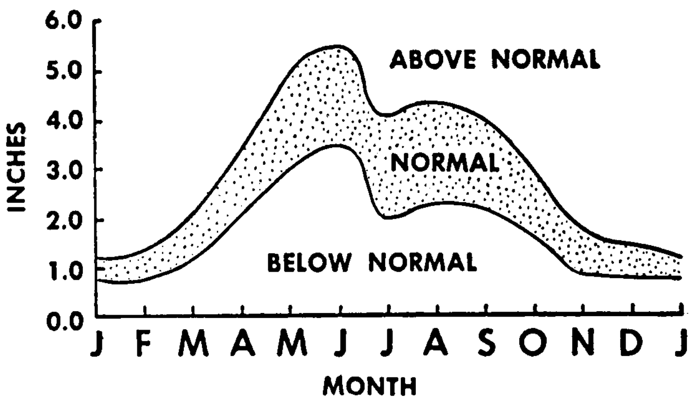

Figure 3.—**Normal monthly rainfall in central Iowa. Shaded area represents the range of normal rainfall.**

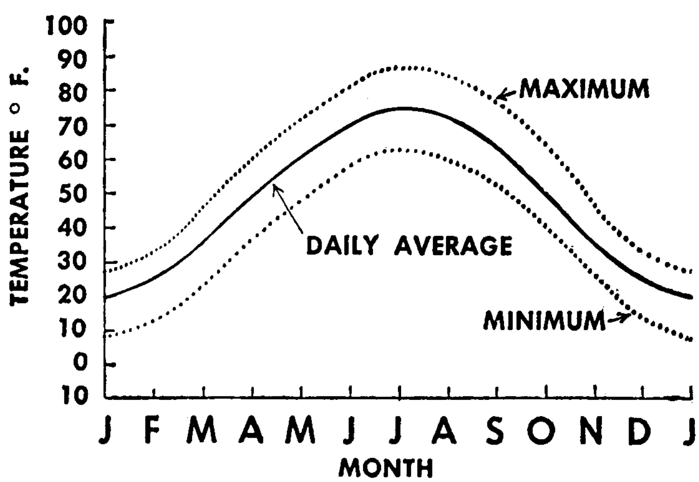

Figure 4.—**Annual march of temperature in central Iowa.**

Drainage

The county is drained by the Des Moines River and its tributaries and by the Skunk River. These rivers flow across the county in a southeasterly direction. The Raccoon River is one of the principal tributaries of the Des Moines River. It enters the county near the southwestern corner and, with Walnut Creek, its principal tributary, drains the southwestern part of the county.

Agriculture

Polk County is predominantly agricultural although it includes the largest city in the State, Des Moines, which is the State capital and a major industrial center of the Midwest.

Approximately 84 percent of the area, or 318,756 acres, is in farms. In 1955, there were 2,174 farms; the average size was 147 acres. In 1945, there were 2,479 farms and the average size was 127 acres (*5*). About 71 percent of the land in farms, or 226,233 acres, is used for crops, and about 21 percent is used for pasture.

About 43 percent of the farmland, or 136,597 acres, was owned by the farm operators in 1955. About 57 percent, or 182,159 acres, was rented by the operators. Lots, roads, buildings, woods, and wasteland totaled 25,098 acres.

Dairy cattle, beef cattle, and poultry are the livestock most extensively raised in Polk County. The number of livestock in the county in 1955 was as follows (*6*):

	Number
Grain-fed cattle marketed	15,044
Grain-fed sheep and lambs marketed	2,502
Calves born	12,731
Lambs born	3,218
Sow farrowings:	
Fall 1955 (between June 1 and Dec. 1)	5,931
Spring 1956 (bred to farrow between the previous Dec. 1 and June 1)	9,586
Milk cows, 2 years old and older	7,651
Beef cows, 2 years old and older	5,954
Hens and pullets of laying age on hand in 1956	194,244
Poultry raised in 1955:	
Chickens	344,161
Turkeys	7,199

Grain or grain-livestock systems of farming are the most common. Grain and hay are sold for cash or fed to livestock on the farms. Corn is the principal grain grown. In 1955, 103,730 acres, or 46 percent of the cropland, was used for this crop. Oats and soybeans

TABLE 1.—*Temperature and precipitation at Des Moines, Polk County, Iowa*

[Elevation, 800 feet]

Month	Temperature [1]					Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average daily maximum	Average daily minimum	Average	Driest year (1956)	Wettest year (1881)	Average snowfall
	°F.	*°F.*	*°F.*	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	27.0	69	−15	34.1	17.9	1.15	0.46	1.85	5.8
January	22.8	62	−21	30.8	13.3	1.22	.51	1.55	8.7
February	26.7	68	−20	35.0	16.9	1.07	.46	2.68	5.9
Winter	25.5	69	−21	33.3	16.0	3.44	1.43	6.08	20.4
March	37.6	82	−12	46.1	27.9	2.05	.51	1.78	6.8
April	51.0	88	17	60.6	40.1	2.36	1.24	3.36	1.0
May	62.0	94	30	71.5	50.9	3.63	1.71	3.82	(3)
Spring	50.2	94	−12	59.4	39.6	8.04	3.46	8.96	7.8
June	71.5	100	38	80.2	60.9	5.05	1.29	15.79	0
July	77.1	105	49	86.8	65.6	2.96	2.76	5.57	0
August	74.5	102	40	83.8	63.7	3.83	3.47	5.29	0
Summer	74.4	105	38	83.6	63.4	11.84	7.52	26.65	0
September	66.5	101	26	76.1	55.4	3.66	1.21	4.70	(3)
October	55.0	92	16	65.1	43.9	2.25	1.66	6.45	(3)
November	39.1	76	−1	47.3	29.4	1.66	1.79	3.97	1.8
Fall	53.5	101	−1	62.8	42.9	7.57	4.66	15.12	1.8
Year	50.9	105	−21	59.8	40.5	30.89	17.07	56.81	30.0

[1] Average temperature based on a 77 year record, through 1955; highest and lowest temperatures based on a 19-year record, through 1958. Average daily maximum temperature and average daily minimum temperature based on a 29-year record, through 1950.

[2] Average precipitation based on a 79-year record, through 1955; wettest and driest years based on an 82-year record, in the period 1877-1958; snowfall based on a 19-year record, through 1958.

[3] Trace.

are next in importance. Nineteen percent of the cropland was used for soybeans, and 19 percent for oats. Hay ranks next in acreage of harvested crops. About 10 percent of the land in farms is used for hay. The chief hay crops are alfalfa, red clover, bromegrass, and timothy, or mixtures of these grasses and legumes. The acreages of various crops grown in Polk County in 1955 were as follows (*6*):

	Acres
Corn for all purposes	103,730
Oats, threshed or combined	42,507
Soybeans for all purposes	42,204
Wheat, barley, and rye	960
Hay (total)	31,319
Clover, timothy, and mixtures of clover and grasses	15,404
Alfalfa and alfalfa mixtures	15,417
Other (all tame and wild hay not otherwise enumerated)	498
Pasture	67,696
Other crops	1,485

In 1956 there were more tractors than farms in the county. The number of heavy farm machines in the county on January 1, 1956, was as follows:

	Number
Tractors	2,904
Grain combines	893
Cornpickers	1,033
Pickup haybalers	281
Motortrucks	785

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

FIELD STUDY.—The soil surveyor examines road cuts, bores into the soil with an auger, or digs holes with a spade. The places examined are not spaced in a regular pattern but are located according to the lay of the land. Usually they are not more than a few hundred feet apart. Each soil area outlined on the map has been examined. Many borings are made in complex areas. In most soils, the holes or borings reveal several distinct soil layers, called horizons, which collectively are termed the soil profile (fig. 5). The color, texture, consistence, and porosity of each layer are observed, and their content of stones and gravel is noted. The reaction (or degree of acidity) and the presence of free lime or salts are determined by simple tests. Other factors considered are drainage, both internal (through the soil) and external (over the soil); permeability, or the rate at which water moves through the soil; moisture-holding capacity; topography; and the interrelation between soil and vegetation.

Color of the topmost layer is usually related to the amount of organic matter. The darkest soils are usually those that have the highest content of organic matter and nitrogen. Gray and olive colors in the lower layers, or streaks and spots of gray and yellow, called mottles, commonly indicate poor drainage and poor aeration. Uniform brown to yellowish-brown colors indicate good drainage and aeration.

Texture, or the content of sand, silt, and clay, is determined by the proportion of the different sizes of particles that make up the soil. The largest particles are sand; they feel gritty between the fingers. Silt particles are smaller than sand and feel smooth and floury. Clay particles are the smallest; they can be seen only with electron microscopes. Soils that are high in clay feel dense and sticky. The soil scientist judges the texture by the feel of the soil when rubbed between his thumb and forefinger. Frequently, the texture is verified in the laboratory by mechanical analyses.

Some of the terms used to describe texture are silt loam, loam, clay loam, sandy loam, loamy sand, or clay. Loam is about 20 percent clay, about 40 percent silt, and about 40 percent sand. Silt loam has much less sand and more silt. It is about 15 percent clay, about 20 percent sand, and at least 50 percent silt. Clay loam consists of about equal proportions of sand, silt, and clay but may contain up to 40 percent clay and up to 80 percent silt and clay. Sandy loam, loamy sand, and sand have increasing percentages of sand, in that order. Clay is more than 40 percent clay-sized particles.

Texture affects the quantity of moisture the soil will hold available to plants; the permeability, or rate at which air and water move through the soil; and the ease with which the soil can be cultivated. Because of these considerations, silt loam and loam are the most desirable soil textures. Clay restricts the movement of air and water and is difficult to work. Sandy soils do not have good water-holding capacity and may be droughty.

A soil is called "stony" or "gravelly" only if there are enough stones or gravel in the surface layer to interfere with cultivation.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation. Terms used to describe the consistence of moist soil are loose, very friable, friable, slightly firm, firm, very firm, and extremely firm. Friable and slightly firm are the most desirable forms of consistence. The firmer the soil, the more difficult it is to work. Sandy soils are usually loose.

Porosity is the term used to indicate the relative volume of the soil that is occupied by pores, or air spaces. We refer to a soil as porous if a large proportion of the total volume consists of coarse pores.

Vegetation affects the color and other characteristics of soils. Soils that formed under grass usually have a thicker and darker colored surface layer than soils that formed under trees, if other conditions are the same. Soils that formed under trees usually are more acid than those that formed under grass. The dark surface layer is thinner than that of grassland soils. Some soils formed under a mixture of grass and trees and are intermediate in properties between the grassland and the forest soils.

Permeability is the quality of the soil that enables it to transmit water or air. It can be measured quantitatively in terms of rate of flow. The relative classes of soil permeability are rapid, moderate, and slow.

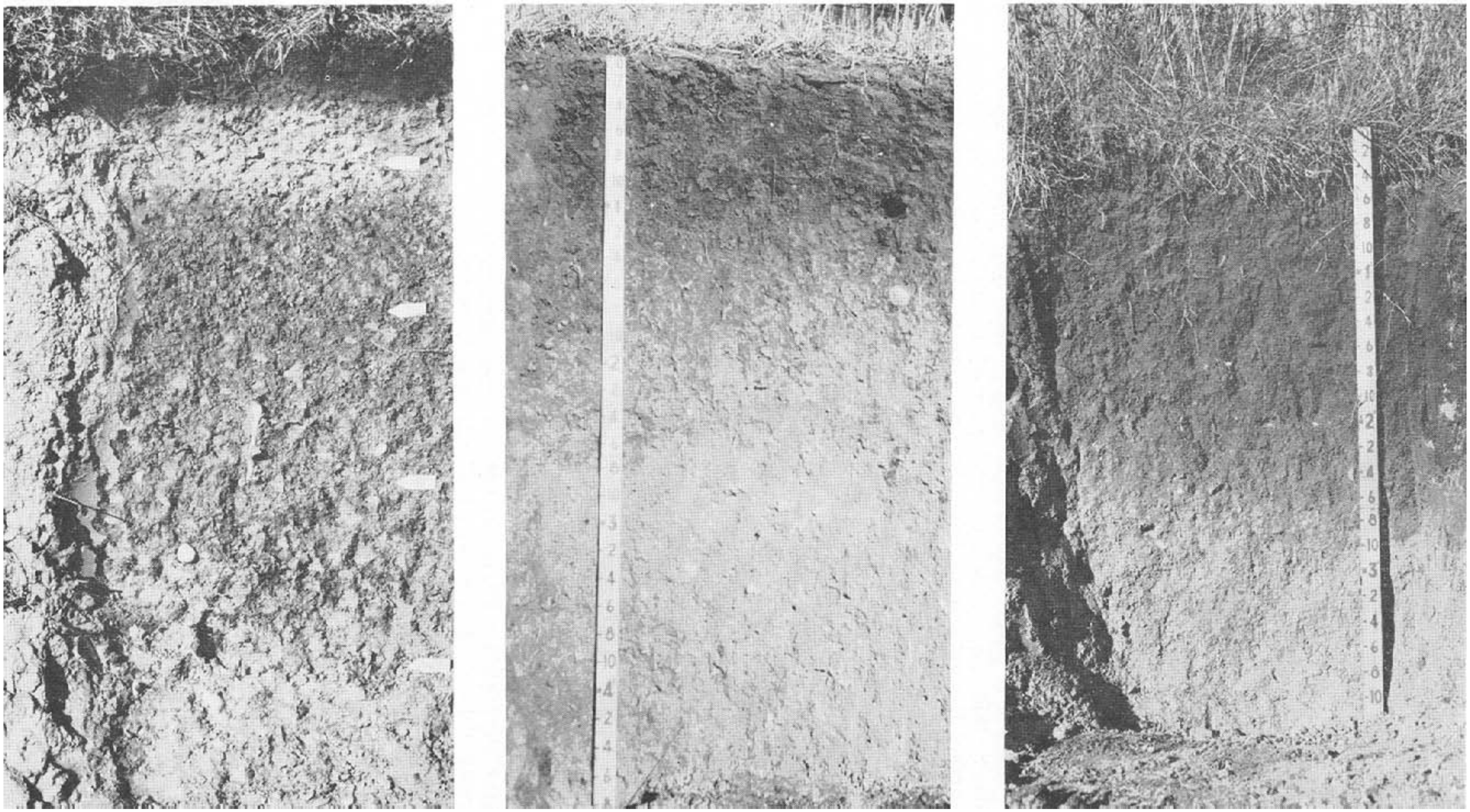

Figure 5.—**Profiles of Hayden loam (left), Clarion loam (center), and Webster silty clay loam (right). The Webster soil is poorly drained and has a thick, dark-colored surface layer. Clarion loam is well drained and has a surface layer that is thinner than that of Webster silty clay loam and thicker than that of Hayden loam. Hayden loam has a thin surface layer and a lighter colored subsurface layer, or A_2 horizon. Hayden loam formed under forest. Clarion loam and Webster silty clay loam formed under prairie.**

Moderate permeability is the most desirable because it permits free movement of air and water, unless the soil has a high water table. Rapidly permeable soils are likely to be so sandy that they do not retain enough moisture for plants.

Tile drains work well in soils that are moderately to rapidly permeable. They work well to moderately well in soils that are slowly permeable. Soils that are very slowly permeable are difficult or impossible to drain with tile and may need surface drainage.

Drainage is determined by observing soil colors and evaluating soil permeability and by the experience and observations of the soil scientists. The drainage class refers to the natural state of the soil before the drainage has been altered by tile or ditches. For example, a soil that was once too wet for cultivation might now be tile drained and be producing excellent crops, but its drainage class—poorly drained—would remain the same.

Very poorly drained soils are those from which water is removed so slowly that the water table remains at or near the surface the greater part of the time. Soils of this drainage class usually occupy level or depressed sites and are frequently ponded. Unless artificially drained, these soils are too wet for cultivation. The Glencoe and Okoboji soils are examples of very poorly drained soils.

Poorly drained soils are those from which water is removed so slowly that the soils are wet much of the time. The water table is commonly at or near the surface a considerable part of the year. Poor drainage is due to a high water table, to a slowly permeable layer within the profile, to seepage, or to some combination of these conditions. The large quantities of water that remain in and on the poorly drained soils prevent satisfactory growth of field crops. Artificial drainage is generally necessary for satisfactory crop production. The Webster and Marshan soils are examples of poorly drained soils.

Imperfectly drained (or somewhat poorly drained) soils are those from which water is removed so slowly that the soils are wet for significant periods but not all of the time. Such soils commonly have a slowly permeable layer or a high water table, or they receive seepage water, or they have combinations of these conditions. Growth of crops may be restricted, and artificial drainage is sometimes needed. The Nicollet and Kato soils are imperfectly drained.

Moderately well drained soils are those from which water is removed somewhat slowly, so that the profile is wet for a small but significant part of the time. Such soils commonly have a slowly permeable layer within or immediately below the subsoil, or they have a relatively high water table, or they receive seepage water, or they have some combination of these conditions. Except in years of excessive rainfall, the growth of crops normally is not restricted because of wetness. Moderately well drained soils seldom, if ever, need artificial drainage. The Sharpsburg and Shelby soils are examples of moderately well drained soils.

Well-drained soils are those from which water is removed readily but not rapidly. They usually retain optimum amounts of moisture for plant growth. Artificial drainage is not needed. The Tama, Clarion, Hayden, and Fayette soils are well drained.

Somewhat excessively drained soils are those from which water is removed rapidly. They are sandy and very porous and are droughty even in years of average rainfall. The Ankeny and Dickinson soils, for example, are somewhat excessively drained.

Excessively drained soils are those from which water is removed very rapidly. They are sandy and very porous. Ordinarily, enough moisture is lost from these soils to make them undesirable for ordinary crops. The Chelsea and Buckner soils are examples of excessively drained soils.

CLASSIFICATION.—On the basis of the characteristics observed by the soil survey party, soils are classified by series. Soils that, except for the texture of the surface layer, are alike in the characteristics, thickness, and arrangement of their horizons are mapped as one soil *series*. A soil series may be separated into two or more soil *types* because of differences in texture of the surface soil. A soil type may be subdivided into *phases*. In Polk County types are divided primarily because of differences in slope, depth, or degree of erosion. For example, if a soil has slopes that range from 2 to 9 percent, it may be mapped in two phases: a gently sloping phase (2 to 5 percent slopes) and a sloping phase (5 to 9 percent slopes); or if a soil has undergone various degrees of erosion, it may be mapped in two or more phases: a slightly eroded phase, a moderately eroded phase, and perhaps, a severely eroded phase. These characteristics that are the basis of subdivision into phases are significant to the use and management of the soil. Consequently, management suggestions can be more specific for phases than for broader categories.

If very small areas of two or more kinds of soil are so intricately mixed that they cannot be shown separately on a map of the scale used, they are mapped together, and the resulting map unit is called a soil complex. For example, the Colo-Terril complex consists of Colo silty clay loam and Terril loam.

Fresh stream deposits or other areas that have little true soil are not classified as series or types; they are identified by descriptive names, such as Alluvial land and Riverwash, and are called miscellaneous land types.

General Soil Areas of Polk County

Figure 6 shows the general soil areas in Polk County. Most of these areas contain two or more dominant soils and other soils of lesser extent, all of which occur together in a characteristic pattern. The map is useful in understanding how the different soils occur in the county, and in planning, in a general way, for good use and management of soils on a community-wide basis.

Area 1.—The soils of area 1 formed under prairie vegetation. They occupy most of the uplands in the northern four-fifths of the county. The Clarion soils are gently sloping and well drained. The Webster soils are level and poorly drained. Figure 7 shows the rela-

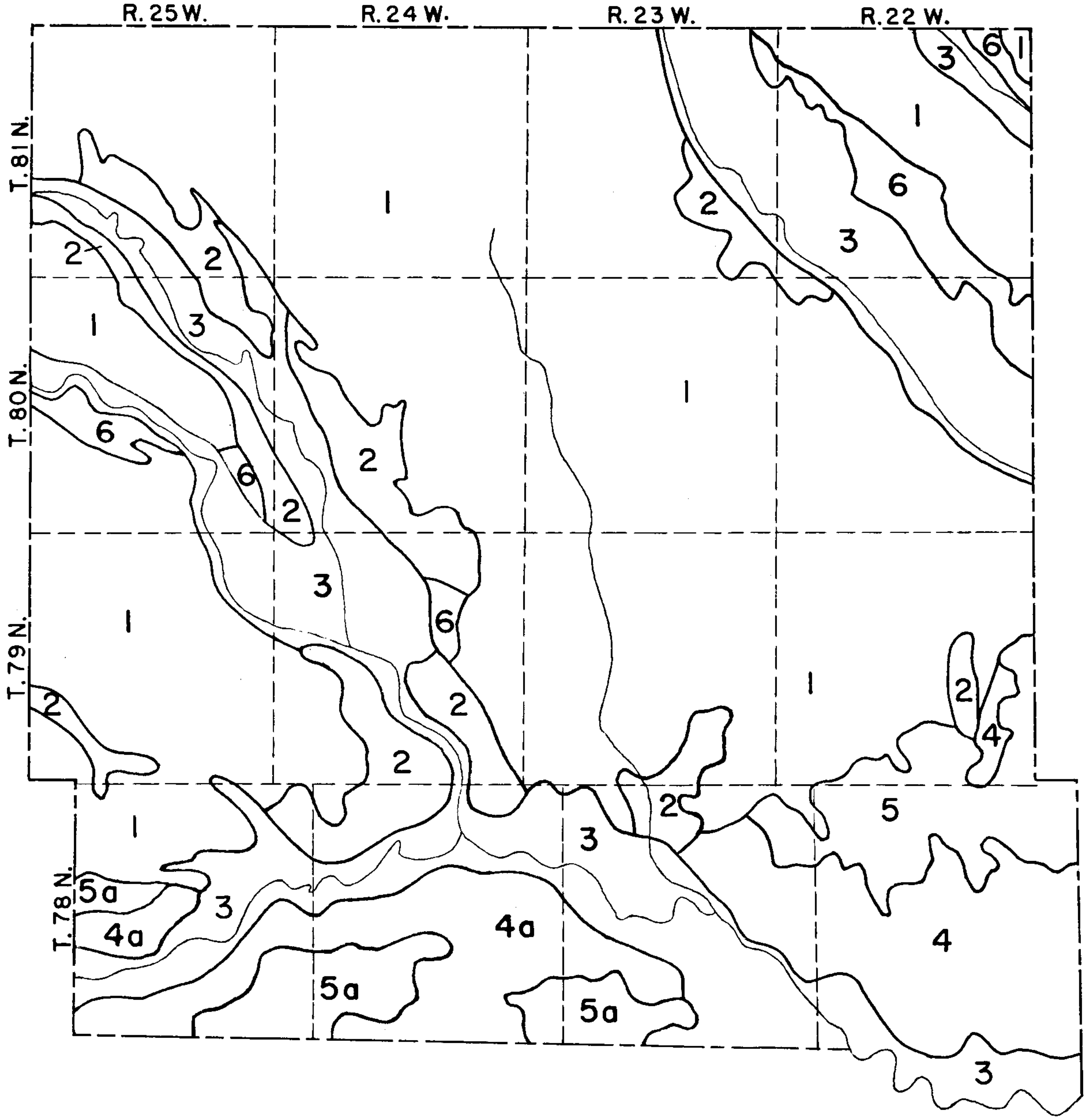

Figure 6.—**General soil areas of Polk County.**

1. Level to gently sloping, dark-colored soils formed from glacial till: chiefly Clarion, Nicollet, and Webster soils.

2. Gently sloping to steep, light colored to moderately dark colored soils formed from glacial till: chiefly Hayden and Lester soils.

3. Nearly level soils formed from outwash and alluvium: chiefly Colo, Waukegan, Dickinson, and Dorchester soils.

4. Gently sloping to steep, light colored to moderately dark colored soils formed from loess: chiefly Fayette and Downs soils.

4a. Gently sloping to steep, light colored to moderately dark colored soils formed from loess or till: chiefly Ladoga and Lindley soils.

5. Nearly level to moderately sloping, dark-colored soils formed from loess: chiefly Tama and Muscatine soils.

5a. Nearly level to moderately sloping, dark-colored soils formed from loess and till: chiefly Sharpsburg and Shelby soils.

6. Gently sloping to steep, sandy soils: chiefly Hagener, Farrar, and Chelsea soils.

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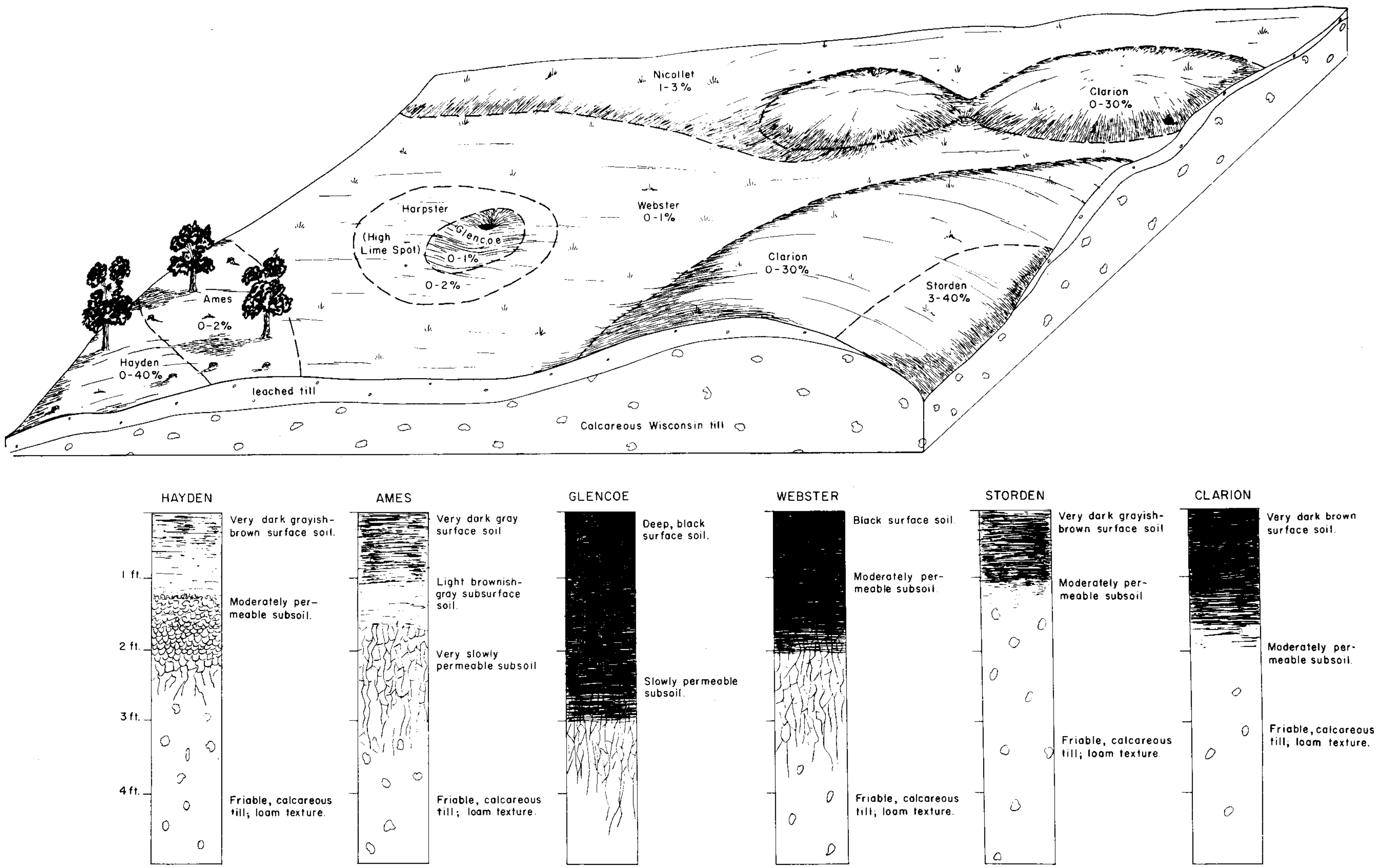

***Figure 7.*—Relationship of major upland soils in general soil areas 1 and 2 to parent material, slope, and native vegetation.**

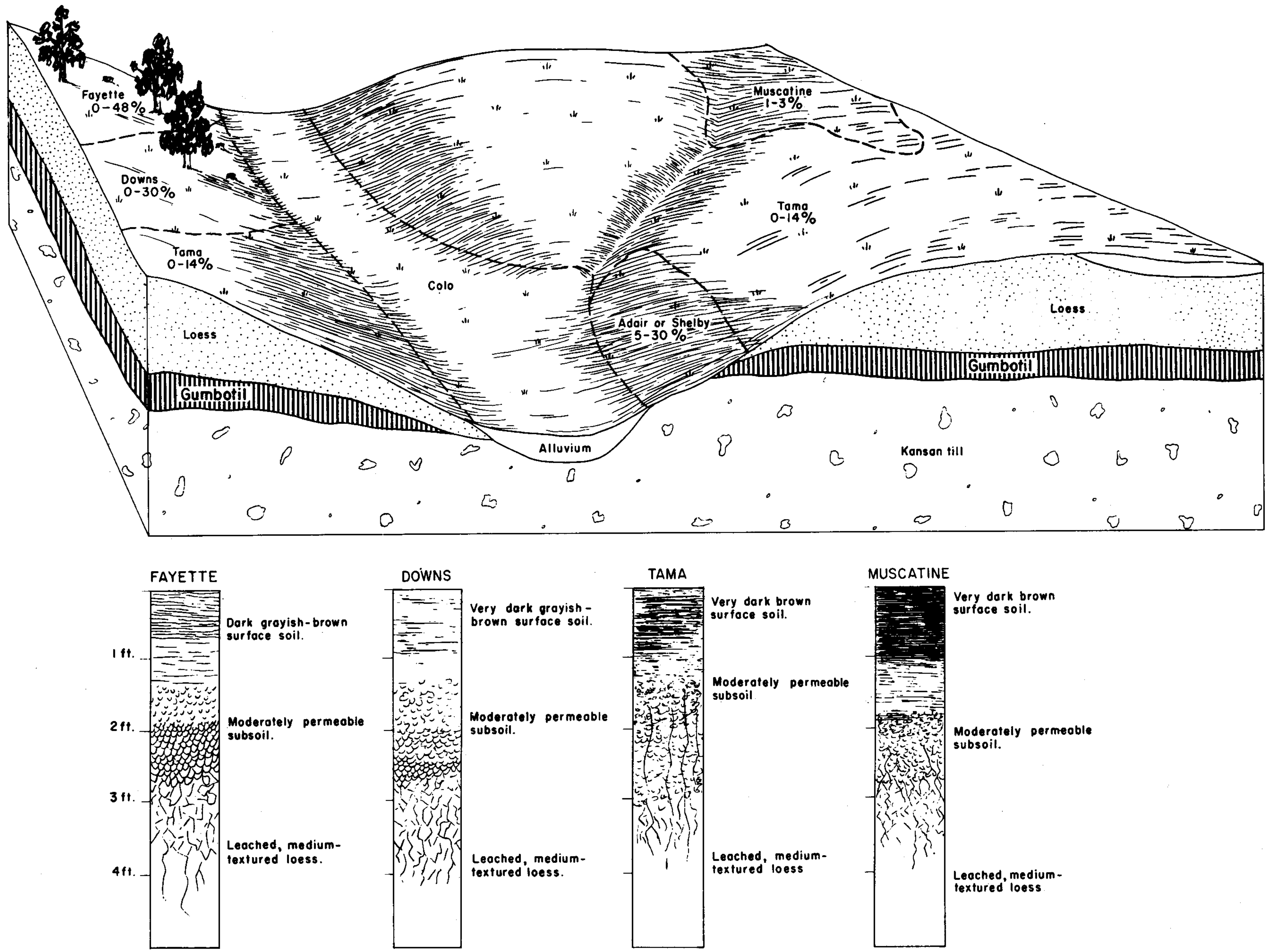

Figure 8.—**Relationship of major upland soils in general soil areas 4 and 5 to parent material, slope, and native vegetation.**

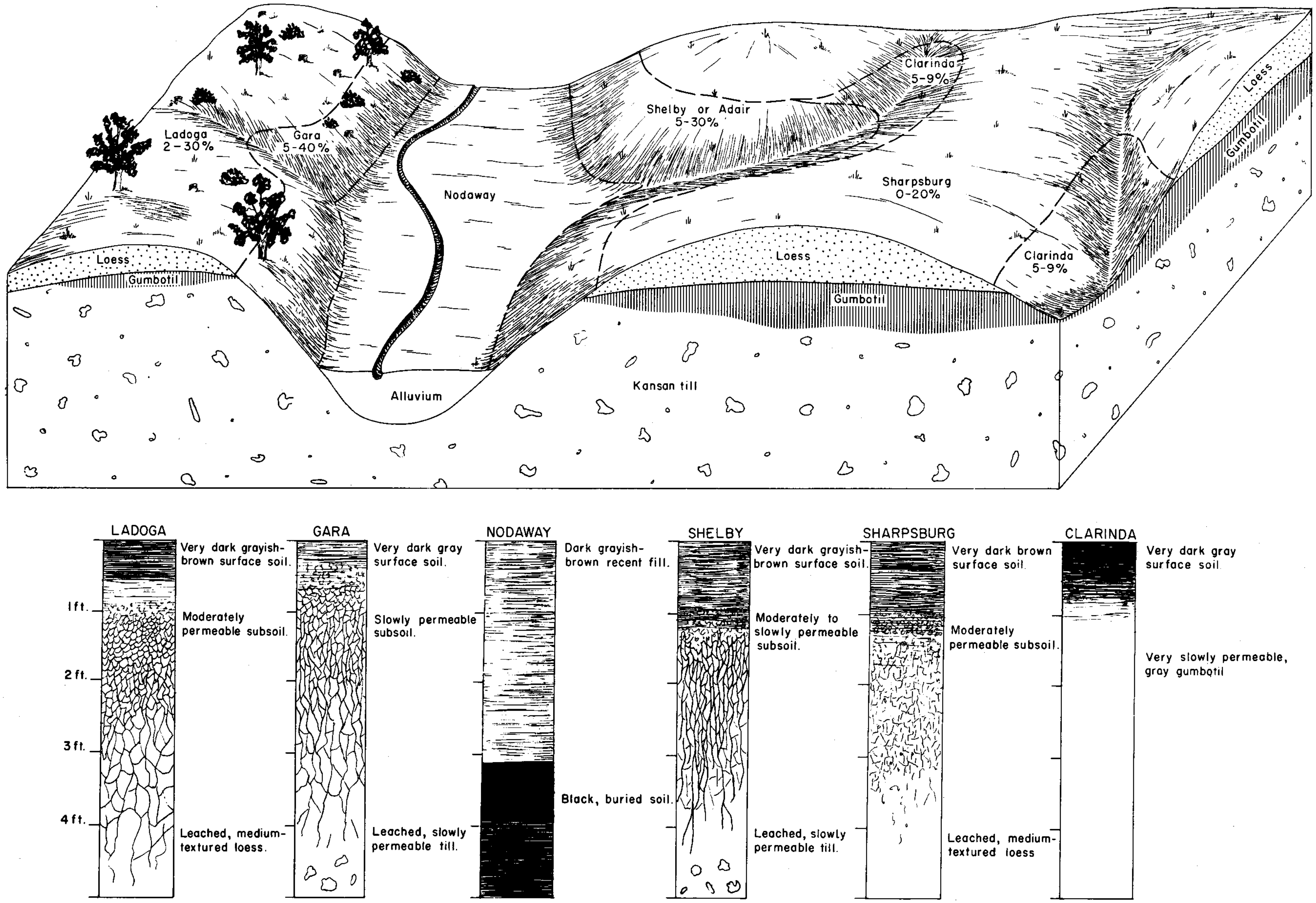

***Figure 9*.—Relationship of major upland soils in general soil areas 4a and 5a to parent material, slope, and native vegetation.**

tionship of these soils to parent material, slope, and native vegetation.

Area 2.—This area is much less extensive than area 1. Most of it is on the steeper slopes along the major streams. All of it is in the northern four-fifths of the county. The soils of area 2 formed under forest in the uplands. They are well drained. The Hayden soils are light colored. The Lester soils are moderately dark colored.

Area 3.—The soils of area 3 are on the bottom lands or benches along the principal streams. The Waukegan and Dickinson soils are underlain by sand and gravel. The native vegetation was prairie grass or trees or mixed prairie and forest vegetation.

Area 4.—The soils of area 4 formed under forest or mixed forest-prairie vegetation. The Fayette soils are lighter colored than the Downs soils. Some Lindley soils that developed from glacial till are included in this area. Area 4 is in the southern one-fifth of the county, east and north of the Des Moines River. Figure 8 shows the relationship of the soils to parent material, slope, and native vegetation.

Area 4a.—This area is in the southern one-fifth of the county, west of the Des Moines River. The soils of area 4a formed under forest or mixed forest-prairie vegetation. The Ladoga soils formed from loess, and the Lindley soils formed from glacial till.

Area 5.—The soils of area 5 formed under prairie vegetation. The Tama soils are well drained and moderately sloping. The Muscatine soils are imperfectly drained and nearly level. They are darker colored than the Tama soils. On the stronger slopes of this area are some Shelby soils, which formed from glacial material. Figure 8 shows the relationship of these soils to parent material, slope, and native vegetation.

Area 5a.—The soils of area 5a formed under prairie vegetation in the uplands in the southern part of the county. The Sharpsburg soils developed from loess. They are gently sloping. The Shelby soils developed from glacial till and are moderately sloping. Figure 9 shows the relationship of these soils to parent material, slope, and native vegetation.

Area 6.—The soils of this area formed from sandy material under prairie grass and trees. Area 6 is mostly on the eastern side of the major streams in the northern four-fifths of the county. It is comprised of small acreages.

Descriptions of Soils

This section contains descriptions of the soil series, types, and phases of Polk County, along with some general suggestions for use and management. More specific information on suitable uses and management needs are given in table 4, in the section, Soil Management. The acreage and proportionate extent of each soil are given in table 2. Table 3, which follows the soil descriptions, is a summary of the major characteristics of the soil types.

Adair series

The Adair soils have a long and complex history. They developed from Kansan glacial till. Many thousands of years later, they were buried by Wisconsin loess. Later, the slopes were worn back by geologic erosion, which removed the loess and all or part of the buried soil. Where all of the loess and soil were removed and unweathered Kansan till was exposed, Shelby soils developed. Where the loess and only a little of the buried soil was removed, the Adair soils formed anew.

The Clarinda soils developed from the same kind of parent material as the older Adair soils and at the same time.

The Adair soils are in the southern part of Polk County, generally in narrow, ribbonlike bands on the lower parts of rolling to steep slopes, below Tama and Sharpsburg soils. They also occur at the upper end of drainageways, below Clearfield soils. In other areas, they occur with the Shelby soils. The Adair soils have slopes of 5 to 14 percent. They formed mainly under prairie vegetation.

Because of the moderate slopes, the poor vegetative cover, and the very slow permeability of the subsoil, these soils erode readily and severely if cultivated without regard to soil conservation. In seasons that are wetter than normal, seepage keeps them wet. The fertility is low. Even under good management, the Adair soils are only fairly productive of crops and pasture. As they occur in small areas, they are difficult to farm separately. Much of the acreage is used along with the adjacent Tama and Sharpsburg soils and is severely eroded. Areas that adjoin Shelby soils are often used for pasture.

ADAIR CLAY LOAM

The following profile is representative of Adair clay loams. Departures from this are noted in the descriptions of the map units.

0 to 8 inches, very dark grayish-brown, firm clay loam.
8 to 30 inches, dark grayish-brown, very firm, gritty silty clay mottled with reddish yellow.
30 to 45 inches +, olive-brown, dark-gray, yellowish-brown, and reddish-yellow, firm clay loam.

The profile varies considerably; in some places it resembles that of the Shelby soils and in other places it resembles that of the Clarinda soils. In areas where some loess remains, the surface soil is silt loam. In some areas the subsoil is strongly mottled with reddish brown, like that of some Lindley soils. In other areas, the lower part of the subsoil is gray and somewhat like that of the Clarinda soils. Concentrations of small stones and coarse gravel are common in the upper part of the subsoil.

Adair clay loam, 5 to 9 percent slopes (AaC).—The profile of this soil is like the representative profile described, except that the surface layer is 10 to 15 inches thick in some places. Included are a few areas in the western part of Bloomfield Township in which the subsoil is underlain by loam or sandy loam rather than clay loam.

TABLE 2.—*Approximate acreage and proportionate extent of soils mapped*

Soil	Acres	Percent
Adair clay loam, 5 to 9 percent slopes	27	[1]
Adair clay loam, 5 to 9 percent slopes, moderately eroded	48	[1]
Adair clay loam, 9 to 14 percent slopes, moderately eroded	111	[1]
Adair soils, 5 to 9 percent slopes, severely eroded	3	[1]
Adair soils, 9 to 14 percent slopes, severely eroded	4	[1]
Alluvial land	6,628	1.7
Ames loam	53	[1]
Ankeny sandy loam, 0 to 2 percent slopes	401	.1
Ankeny sandy loam, 2 to 5 percent slopes	482	.1
Atterberry silt loam, 1 to 3 percent slopes	514	.1
Atterberry silt loam, bench position, 1 to 3 percent slopes	111	[1]
Bauer silt loam, 5 to 9 percent slopes, moderately eroded	6	[1]
Bauer silt loam, 9 to 14 percent slopes, moderately eroded	19	[1]
Bauer silt loam, 14 to 20 percent slopes, moderately eroded	8	[1]
Bauer silt loam, 20 to 40 percent slopes, moderately eroded	37	[1]
Blockton silt loam, 0 to 2 percent slopes	50	[1]
Blockton silt loam, 2 to 5 percent slopes	5	[1]
Buckner loamy sand, 0 to 2 percent slopes	362	.1
Buckner loamy sand, 2 to 5 percent slopes	8	[1]
Buckner loamy sand, 5 to 9 percent slopes	7	[1]
Buckner-Hagener complex, 2 to 5 percent slopes	441	.1
Buckner-Hagener complex, 5 to 9 percent slopes	39	[1]
Cantril silt loam, 0 to 2 percent slopes	65	[1]
Cantril silt loam, 2 to 5 percent slopes	177	[1]
Chaseburg silt loam, 0 to 2 percent slopes	13	[1]
Chaseburg silt loam, 2 to 5 percent slopes	444	.1
Chelsea loamy fine sand, 5 to 9 percent slopes, eroded	67	[1]
Chelsea loamy fine sand, 9 to 14 percent slopes, eroded	14	[1]
Chelsea loamy fine sand, 14 to 20 percent slopes, eroded	4	[1]
Chelsea loamy fine sand, 20 to 30 percent slopes, eroded	6	[1]
Clarinda silty clay loam, 5 to 9 percent slopes	14	[1]
Clarinda soils, 5 to 9 percent slopes, severely eroded	7	[1]
Clarion loam, 0 to 2 percent slopes	58	[1]
Clarion loam, 2 to 5 percent slopes	44,867	11.8
Clarion loam, 2 to 5 percent slopes, moderately eroded	132	[1]
Clarion loam, 5 to 9 percent slopes	9,644	2.5
Clarion loam, 5 to 9 percent slopes, moderately eroded	5,634	1.5
Clarion loam, 9 to 14 percent slopes, moderately eroded	5,127	1.4
Clarion loam, 14 to 20 percent slopes, moderately eroded	603	.2
Clarion loam, 20 to 30 percent slopes, moderately eroded	78	[1]
Clarion soils, 5 to 9 percent slopes, severely eroded	15	[1]
Clarion soils, 9 to 14 percent slopes, severely eroded	148	[1]
Clarion soils, 14 to 20 percent slopes, severely eroded	16	[1]
Clarion loam, thin solum, 2 to 5 percent slopes	454	.1
Clarion loam, thin solum, 2 to 5 percent slopes, moderately eroded	23	[1]
Clarion loam, thin solum, 5 to 9 percent slopes, moderately eroded	214	.1
Clarion silt loam, 2 to 5 percent slopes	745	.2
Clarion silt loam, 5 to 9 percent slopes, moderately eroded	270	.1
Clarion silt loam, 9 to 14 percent slopes, moderately eroded	94	[1]
Clarion silt loam, 14 to 20 percent slopes, moderately eroded	2	[1]
Clearfield silty clay loam, 5 to 9 percent slopes	6	[1]
Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded	3	[1]
Clearfield silty clay loam, 9 to 14 percent slopes, moderately eroded	10	[1]
Colo silty clay loam	9,846	2.6
Colo silty clay loam, channeled	76	[1]
Colo loam, loamy subsoil variant	3,631	1.0
Colo-Judson-Nodaway complex	527	.1
Colo-Terril complex, 0 to 2 percent slopes	4,620	1.2
Colo-Terril complex, 2 to 5 percent slopes	1,918	.5
Cooper silt loam, acid variant	1,794	.5
Crocker loamy fine sand, 2 to 5 percent slopes	29	[1]
Crocker loamy fine sand, 5 to 9 percent slopes, moderately eroded	75	[1]
Crocker loamy fine sand, 9 to 14 percent slopes, moderately eroded	13	[1]
Crocker loamy fine sand, 14 to 20 percent slopes, moderately eroded	9	[1]
Crocker loamy fine sand, 20 to 30 percent slopes	3	[1]
Dickinson fine sandy loam, 0 to 2 percent slopes	87	[1]
Dickinson fine sandy loam, 2 to 5 percent slopes	2,427	.6
Dickinson fine sandy loam, 2 to 5 percent slopes, moderately eroded	9	[1]
Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded	804	.2
Dickinson fine sandy loam, 9 to 14 percent slopes, moderately eroded	421	.1
Dickinson fine sandy loam, 14 to 20 percent slopes, moderately eroded	164	[1]
Dickinson fine sandy loam, 20 to 30 percent slopes, moderately eroded	30	[1]
Dickinson soils, 9 to 14 percent slopes, severely eroded	2	[1]
Dickinson soils, 14 to 20 percent slopes, severely eroded	4	[1]
Dickinson loam, 2 to 5 percent slopes	741	.2
Dickinson loam, 5 to 9 percent slopes, moderately eroded	321	.1
Dickinson loam, 9 to 14 percent slopes, moderately eroded	122	[1]
Dickinson loam, 14 to 20 percent slopes, moderately eroded	3	[1]
Dickinson loam, 20 to 30 percent slopes, moderately eroded	12	[1]
Dickinson sandy loam, bench position, 0 to 2 percent slopes	1,312	.4
Dickinson sandy loam, bench position, 2 to 5 percent slopes	768	.2
Dickinson sandy loam, bench position, 5 to 9 percent slopes	2	[1]
Dorchester silt loam	1,567	.4
Dorchester silt loam, moderately shallow over sand	930	.2
Dorchester silt loam, deep over sand	994	.3
Downs silt loam, 0 to 2 percent slopes	42	[1]
Downs silt loam, 2 to 5 percent slopes	1,528	.4
Downs silt loam, 5 to 9 percent slopes, moderately eroded	5,567	1.5
Downs silt loam, 9 to 14 percent slopes, moderately eroded	2,390	.6
Downs silt loam, 14 to 20 percent slopes, moderately eroded	189	[1]
Downs silt loam, 20 to 30 percent slopes, moderately eroded	22	[1]
Downs soils, 5 to 9 percent slopes, severely eroded	8	[1]
Downs soils, 9 to 14 percent slopes, severely eroded	43	[1]

TABLE 2.—*Approximate acreage and proportonate extent of soils mapped*—Continued

Soil	Acres	Percent
Downs soils, 14 to 20 percent slopes, severely eroded	3	[1]
Farrar fine sandy loam, 2 to 5 percent slopes	1,840	.5
Farrar fine sandy loam, 5 to 9 percent slopes	568	.2
Farrar fine sandy loam, 5 to 9 percent slopes, moderately eroded	330	.1
Farrar fine sandy loam, 9 to 14 percent slopes, moderately eroded	313	.1
Farrar fine sandy loam, 14 to 20 percent slopes, moderately eroded	16	[1]
Farrar fine sandy loam, 20 to 30 percent slopes, moderately eroded	59	[1]
Fayette silt loam, 0 to 2 percent slopes	71	[1]
Fayette silt loam, 2 to 5 percent slopes	1,423	.4
Fayette silt loam, 2 to 5 percent slopes, moderately eroded	20	[1]
Fayette silt loam, 5 to 9 percent slopes, moderately eroded	1,984	.5
Fayette silt loam, 9 to 14 percent slopes, moderately eroded	2,142	.6
Fayette silt loam, 14 to 20 percent slopes, moderately eroded	1,478	.5
Fayette silt loam, 20 to 30 percent slopes, moderately eroded	453	.1
Fayette silt loam, 30 to 40 percent slopes, moderately eroded	84	[1]
Fayette silt loam, bench position, 2 to 5 percent slopes	43	[1]
Fayette soils, 5 to 9 percent slopes, severely eroded	5	[1]
Fayette soils, 9 to 14 percent slopes, severely eroded	62	[1]
Fayette soils, 14 to 20 percent slopes, severely eroded	31	[1]
Gara loam, 5 to 9 percent slopes, moderately eroded	41	[1]
Gara loam, 9 to 14 percent slopes, moderately eroded	1,210	.3
Gara loam, 14 to 20 percent slopes, moderately eroded	777	.2
Gara soils, 9 to 14 percent slopes, severely eroded	73	[1]
Gara soils, 14 to 20 percent slopes, severely eroded	15	[1]
Gara soils, 20 to 40 percent slopes, slightly to severely eroded	251	.1
Glencoe silty clay loam	679	.2
Gosport silt loam, 5 to 9 percent slopes, moderately eroded	20	[1]
Gosport silt loam, 9 to 14 percent slopes, moderately eroded	192	.1
Gosport silt loam, 14 to 20 percent slopes, moderately eroded	83	[1]
Gosport silt loam, 20 to 40 percent slopes, moderately eroded	194	.1
Gosport soils, 14 to 20 percent slopes, severely eroded	14	[1]
Gravity silty clay loam, 2 to 4 percent slopes	231	.1
Hagener loamy fine sand, 0 to 2 percent slopes	8	[1]
Hagener loamy fine sand, 0 to 2 percent slopes, moderately eroded	10	[1]
Hagener loamy fine sand, 2 to 5 percent slopes	320	.1
Hagener loamy fine sand, 2 to 5 percent slopes, moderately eroded	106	[1]
Hagener loamy fine sand, 5 to 9 percent slopes	116	[1]
Hagener loamy fine sand, 5 to 9 percent slopes, moderately eroded	93	[1]
Hagener loamy fine sand, 9 to 14 percent slopes, moderately eroded	81	[1]
Hagener loamy fine sand, 9 to 14 percent slopes, severely eroded	3	[1]
Hagener loamy fine sand, 14 to 20 percent slopes, eroded	2	[1]
Harpster loam	1,416	.4
Hayden loam, 0 to 2 percent slopes	1	[1]
Hayden loam, 2 to 5 percent slopes	1,335	.4
Hayden loam, 2 to 5 percent slopes, moderately eroded	26	[1]
Hayden loam, 5 to 9 percent slopes, moderately eroded	821	.2
Hayden loam, 9 to 14 percent slopes, moderately eroded	257	.1
Hayden loam, 14 to 20 percent slopes, moderately eroded	141	[1]
Hayden loam, 20 to 30 percent slopes, moderately eroded	170	[1]
Hayden loam, 30 to 40 percent slopes, moderately eroded	296	.1
Huntsville silt loam	8,168	2.1
Huntsville silt loam, channeled	2,599	.7
Huntsville sandy loam	531	.1
Huntsville sandy loam, channeled	12	[1]
Ida silt loam, 5 to 9 percent slopes, eroded	1	[1]
Judson silt loam, 2 to 5 percent slopes	879	.2
Judson silt loam, 5 to 9 percent slopes	9	[1]
Kato loam, moderately deep over sand and gravel, 1 to 3 percent slopes	1,150	.3
Kato loam, deep over sand and gravel, 1 to 3 percent slopes	9,160	2.4
Ladoga silt loam, 2 to 5 percent slopes	464	.1
Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	1,510	.4
Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	1,386	.4
Ladoga silt loam, 14 to 20 percent slopes, moderately eroded	161	[1]
Ladoga silt loam, 20 to 30 percent slopes, moderately eroded	27	[1]
Ladoga soils, 5 to 9 percent slopes, severely eroded	3	[1]
Lakeville sandy loam, 2 to 5 percent slopes	301	.1
Lakeville sandy loam, 5 to 9 percent slopes, moderately eroded	723	.2
Lakeville sandy loam, 9 to 14 percent slopes, moderately eroded	145	[1]
Lakeville sandy loam, 14 to 20 percent slopes, moderately eroded	47	[1]
Lakeville sandy loam, 20 to 40 percent slopes, moderately eroded	60	[1]
Lamont fine sandy loam, 2 to 5 percent slopes	247	.1
Lamont fine sandy loam, 5 to 9 percent slopes	240	.1
Lamont fine sandy loam, 9 to 14 percent slopes	69	[1]
Lamont fine sandy loam, 14 to 20 percent slopes	51	[1]
Lamont fine sandy loam, 20 to 30 percent slopes	110	[1]
Lester loam, 0 to 2 percent slopes	25	[1]
Lester loam, 2 to 5 percent slopes	5,202	1.4
Lester loam, 2 to 5 percent slopes, moderately eroded	198	.1
Lester loam, 5 to 9 percent slopes, moderately eroded	2,637	.7
Lester loam, 9 to 14 percent slopes, moderately eroded	1,107	.3
Lester loam, 14 to 20 percent slopes, moderately eroded	847	.2
Lester loam, 20 to 40 percent slopes	314	.1
Lester soils, 5 to 9 percent slopes, severely eroded	118	[1]
Lester soils, 9 to 14 percent slopes, severely eroded	22	[1]
Lester-Colo complex, 0 to 20 percent slopes	770	.2
Lester-Colo complex, 0 to 40 percent slopes	5,846	1.5
LeSueur loam, 1 to 3 percent slopes	552	.2
Lindley loam, 9 to 14 percent slopes, moderately eroded	194	.1

TABLE 2.—*Approximate acreage and proportonate extent of soils mapped*—Continued

Soil	Acres	Percent
Lindley loam, 14 to 20 percent slopes, moderately eroded	773	.2
Lindley soils, 9 to 14 percent slopes, severely eroded	12	(1)
Lindley soils, 14 to 20 percent slopes, severely eroded	34	(1)
Lindley soils, 20 to 40 percent slopes, moderately eroded	592	.2
Marshan silty clay loam, deep over sand and gravel	6,550	1.7
Marshan silty clay loam, moderately deep over sand and gravel	487	.1
Muck, moderately shallow	369	.1
Muck, very shallow	398	.1
Muscatine silt loam, 1 to 3 percent slopes	1,426	.4
Nicollet loam, 1 to 3 percent slopes	48,716	12.8
Nodaway silt loam	5,087	1.3
Okoboji silt loam	156	(1)
Olmitz loam, 2 to 5 percent slopes	303	.1
Olmitz loam, 5 to 9 percent slopes	22	(1)
Olmitz sandy loam, 0 to 2 percent slopes	7	(1)
Olmitz sandy loam, 2 to 5 percent slopes	69	(1)
Peat	20	(1)
Riverwash	401	.1
Rolfe loam	50	(1)
Rolfe loam, bench position	135	(1)
Runnells silt loam, 5 to 9 percent slopes, moderately eroded	84	(1)
Runnells silt loam, 9 to 14 percent slopes, moderately eroded	466	.1
Runnells silt loam, 14 to 20 percent slopes, moderately eroded	229	.1
Runnells silt loam, 20 to 40 percent slopes, moderately eroded	70	(1)
Runnells soils, 9 to 14 percent slopes, severely eroded	44	(1)
Sarpy loamy sand	278	.1
Saylor fine sandy loam, 0 to 2 percent slopes	331	.1
Sharpsburg silt loam, 0 to 2 percent slopes	840	.2
Sharpsburg silt loam, 2 to 5 percent slopes	1,841	.5
Sharpsburg silt loam, 5 to 9 percent slopes	1,571	.4
Sharpsburg silt loam, 5 to 9 percent slopes, moderately eroded	905	.2
Sharpsburg silt loam, 9 to 14 percent slopes, moderately eroded	488	.1
Sharpsburg silt loam, 14 to 20 percent slopes, moderately eroded	6	(1)
Sharpsburg soils, 9 to 14 percent slopes, severely eroded	4	(1)
Shelby loam, 5 to 9 percent slopes, moderately eroded	118	(1)
Shelby loam, 9 to 14 percent, slopes moderately eroded	656	.2
Shelby loam, 14 to 20 percent slopes, moderately eroded	165	(1)
Shelby soils, 14 to 20 percent slopes, severely eroded	29	(1)
Shelby soils, 20 to 30 percent slopes, severely eroded	345	.1
Storden loam, 3 to 9 percent slopes	125	(1)
Storden loam, 20 to 40 percent slopes, moderately eroded	140	(1)
Storden soils, 5 to 9 percent slopes, severely eroded	37	(1)
Storden soils, 9 to 14 percent slopes, severely eroded	603	.2
Storden soils, 14 to 20 percent slopes, severely eroded	594	.2
Storden-Colo complex, 0 to 20 percent slopes	2,380	.6
Storden-Colo complex, 0 to 40 percent slopes	389	.1
Storden-Lakeville complex, 5 to 9 percent slopes, moderately eroded	57	(1)
Storden-Lakeville complex, 9 to 14 percent slopes, moderately eroded	71	(1)
Storden-Lakeville complex, 14 to 20 percent slopes, moderately eroded	53	(1)
Stronghurst silt loam	253	.1
Stronghurst silt loam, bench position	104	(1)
Tama silt loam, 0 to 2 percent slopes	81	(1)
Tama silt loam, 2 to 5 percent slopes	2,004	.5
Tama silt loam, 2 to 5 percent slopes, moderately eroded	36	(1)
Tama silt loam, 5 to 9 percent slopes	1,957	.5
Tama silt loam, 5 to 9 percent slopes, moderately eroded	1,954	.5
Tama silt loam, 9 to 14 percent slopes, moderately eroded	1,184	.3
Tama soils, 9 to 14 percent slopes, severely eroded	63	(1)
Terril loam, 0 to 2 percent slopes	1,047	.3
Terril loam, 2 to 5 percent slopes	2,042	.5
Terril loam, 5 to 9 percent slopes	75	(1)
Wabash silty clay	1,267	.3
Wabash silt loam	322	.1
Wabash-Gravity-Nodaway complex	879	.2
Waukegan loam, moderately deep over sand and gravel, 0 to 2 percent slopes	736	.2
Waukegan loam, moderately deep over sand and gravel, 2 to 5 percent slopes	707	.2
Waukegan loam, moderately deep over sand and gravel, 5 to 9 percent slopes	32	(1)
Waukegan loam, deep over sand and gravel, 0 to 2 percent slopes	2,315	.6
Waukegan loam, deep over sand and gravel, 2 to 5 percent slopes	994	.3
Waukegan loam, deep over sand and gravel, 5 to 9 percent slopes	56	(1)
Webster silty clay loam	35,194	9.3
Webster silty clay loam, calcareous variant	18,592	4.9
Mines and pits	750	.2
Coal mine dump	96	(1)
Made land	216	.1
Water	366	.1
City of Des Moines	40,882	10.8
Total	380,160	--------

[1] Less than 0.1 percent.

This soil is not very productive. Because it occurs in small areas, it is normally cropped the same as the adjacent soils. If used for row crops, this soil should be contoured or terraced to help control erosion. Laying interceptor tile lines in the more permeable, higher lying, adjacent soils will improve the drainage. (Capability subclass IIIw.)

Adair clay loam, 5 to 9 percent slopes, moderately eroded (AaC2).—At best, this soil is suitable for only limited cultivation. As a rule, it is cropped along with the adjacent soils. It may need drains and terraces. Yields are normally low. (Capability subclass IIIw.)

Adair clay loam, 9 to 14 percent slopes, moderately eroded (AaD2).—This soil includes areas in which the surface layer is more than 8 inches thick.

This soil is best suited to long-term pasture. If it is needed for meadows, oats followed by several years of hay is a good cropping sequence. (Capability subclass IVe.)

ADAIR SOILS, SEVERELY ERODED

Adair soils, 5 to 9 percent slopes, severely eroded (AbC3).—The profile of these soils is like the representative profile of Adair clay loam, except that the surface layer is less than 4 inches thick. The gritty silty clay subsoil is exposed in some spots.

These soils are difficult to till because some of the clayey subsoil is mixed with the original surface soil. Meadow or pasture is the best long-time use. To insure good yields, the fertility will probably have to be improved. (Capability subclass IVe.)

Adair soils, 9 to 14 percent slopes, severely eroded (AbD3).—The profile is like the representative profile of Adair clay loam, except that the surface layer is generally less than 4 inches thick. In some areas, the gritty silty clay subsoil is exposed.

This unit is best suited to hay or pasture. Probably the fertility will have to be improved before pastures can be established. (Capability subclass IVe.)

Alluvial land

This land type is composed of freshly laid river deposits that have not been in place long enough for distinct horizons to develop. The texture varies but is predominantly loam or silt loam. The areas are channeled and contain many low natural levees, or ridges, and numerous small ponds, sloughs, and little oxbow lakes. They are frequently flooded. The natural drainage varies from poor in the channels to good on the ridges. Because of the flood hazard, this land type is not suitable for cultivation unless it is protected by levees. In many protected areas, there are good stands of hardwood.

Alluvial land (Ac).—Much of this land type lies along the Des Moines River and the Raccoon River. A few areas are along the Skunk River and the larger creeks. If this land type is cultivated, a corn-soybean rotation is suitable. (Capability subclass IIw.)

Ames series

The Ames soils developed from Cary glacial till, under forest. They occur in the northern part of the county on upland flats near the Skunk and Des Moines Rivers and are near the Hayden soils. They are nearly level and are of minor extent. Figure 7 shows the position of the Ames soils on the landscape.

These soils are low in fertility and are not very productive. Generally, the surface soil and the upper part of the subsoil are medium acid. The water-holding capacity is good. Drainage is poor, and artificial drainage is needed to insure good yields. Tile drains do not work well, because the subsoil is very slowly permeable.

Some areas of Ames soils are used for crops; others are used for wooded pasture.

AMES LOAM

The following profile is representative of Ames loam.

- 0 to 4 inches, very dark gray, friable, slightly acid loam.
- 4 to 12 inches, grayish-brown to light brownish-gray, friable loam to sandy loam; light gray when dry; breaks into platy pieces.
- 12 to 36 inches, olive-brown to olive-gray, firm to very firm, heavy clay loam; middle part of layer is gritty, light silty clay; mottles of olive yellow and yellowish brown are common.
- 36 to 60 inches, light brownish-gray, firm loam; generally calcareous at 40 inches.

Ames loam (Ad).—The profile of this soil is like the representative profile. If the drainage can be improved, preferably by shallow surface ditches, a crop sequence of corn-soybeans-oats-meadow can be used. An alternative use is pasture. (Capability subclass IIIw.)

Ankeny series

The Ankeny series consists of droughty soils that developed from sandy material washed down from the slopes above. They are found mostly on foot slopes in the northeastern part of the county, east of the Skunk River. Generally, they lie downslope from the more rolling Hagener and Farrar soils. The slope range is 1 to 4 percent. The natural vegetation was mostly prairie grass.

These soils have a low water-holding capacity and are somewhat excessively drained. They are slightly acid to medium acid. They are low in fertility and only moderately productive. Wind erosion is a hazard.

ANKENY SANDY LOAM

The following profile is representative of Ankeny sandy loam.

- 0 to 10 inches, very dark grayish-brown, very friable sandy loam
- 10 to 30 inches, dark-brown to brown, very friable to loose sandy loam.
- 30 to 40 inches, yellowish-brown, loose sandy loam to sand.

In some areas the texture is loamy sand in all layers, and in other areas it is more loamy throughout. Some of the level areas have a foot or so of recently deposited coarse sand that has washed down from the slopes above.

Ankeny sandy loam, 0 to 2 percent slopes (AeA).—The profile of this soil is like the representative profile described. Coarse sand sediments have been deposited in some areas.

This soil is suitable for cultivation. It can be used for a corn-oats-meadow rotation if protected from wind erosion. It can also be used for alfalfa. Tillage methods that leave the crop residues on the surface will help to reduce wind erosion. (Capability subclass IIs.)

Ankeny sandy loam, 2 to 5 percent slopes (AeB).—Harmful deposits of sand are less common on this soil than on Ankeny sandy loam, 0 to 2 percent slopes.

This soil is suitable for cultivation. It can be used for a corn-oats-meadow rotation if protected from wind erosion. It can also be used for alfalfa. Tillage methods that leave the crop residues on the surface will help to control wind erosion. (Capability subclass IIs.)

Atterberry series

The Atterberry series consists of nearly level soils that formed from Wisconsin loess. They are imperfectly drained to moderately well drained. They are associated with the Fayette and Downs soils in the southeastern part of the county, both in the uplands and on river terraces. The Atterberry soils were influenced by both grass and trees; presumably, the trees encroached on a former prairie.

The Atterberry soils tend to be somewhat wet, and some areas may need tile drainage. The permeability is moderate to moderately slow, and the water-holding capacity is high. The upper part of the profile is slightly acid to medium acid. The fertility is only moderate, but the potential productivity is fairly high. Erosion is only a slight problem.

ATTERBERRY SILT LOAM

The following profile is representative of Atterberry silt loam.

0 to 8 inches, very dark gray, friable silt loam.
8 to 12 inches, dark-gray, friable silt loam.
12 to 30 inches, dark grayish-brown, firm silty clay loam mottled with yellowish brown.
30 to 50 inches, grayish-brown, friable silt loam mottled with yellowish brown and olive brown.

Atterberry silt loam, 1 to 3 percent slopes (AfA).—This soil occurs in the uplands. It is by far the more extensive of the two Atterberry soils mapped in Polk County. A suggested rotation is corn-corn-oats-meadow. (Capability class I.)

Atterberry silt loam, bench position, 1 to 3 percent slopes (AgA).—This soil has developed on loess-covered low terraces (second bottoms) bordering large creeks, mainly in the southeastern part of Polk County. Ordinarily, the subsurface layer is not so gray and platy nor the subsoil so clayey as those of the Atterberry soils in the uplands.

Because it receives some runoff from adjacent slopes, this soil may be more productive in dry years than the Atterberry soils in the uplands. If the runoff from higher areas is excessive, diversion terraces may be needed to protect this soil. A suggested rotation is corn-corn-oats-meadow. (Capability class I.)

Bauer series

The Bauer series consists of shallow soils that developed from shale and have shale fragments in the profile below a depth of 15 inches. They occur in hilly and steep areas along the Des Moines River. The slope range is 5 to 40 percent.

These soils are medium acid to strongly acid. They are very erodible. The drainage is moderately good, and the permeability is slow to moderate. The fertility and productivity are low. Woodland and wooded pasture are the chief uses.

BAUER SILT LOAM

The following profile is representative of Bauer silt loam. Departures from this profile are mentioned in the descriptions of the map units.

0 to 10 inches, very dark grayish-brown, friable silt loam.
10 to 15 inches, brown to dark grayish-brown, friable silt loam.
15 inches and extending to a depth of many feet, light brownish-gray, firm to very firm silty clay loam or silty clay; shale fragments common.

The profile varies considerably from area to area. The upper layers are a mixture of loess and glacial till. The shaly subsoil varies in texture and consistence.

Bauer silt loam, 5 to 9 percent slopes, moderately eroded (BaC2).—This soil has a thicker dark surface layer than that described in the representative profile. At best, it is suitable for only limited cultivation. A suggested rotation consists of 1 year of corn, 1 year of oats, and 4 years of meadow. Alternative uses are permanent hay and pasture. (Capability subclass IVe.)

Bauer silt loam, 9 to 14 percent slopes, moderately eroded (BaD2).—This soil is shallow and strongly sloping. If it is cultivated, it will probably erode severely. It is best suited to pasture or woodland. (Capability subclass VIe.)

Bauer silt loam, 14 to 20 percent slopes, moderately eroded (BaE2).—This soil has a profile like the representative profile, except that the dark surface layer is not so thick. Its best use is probably pasture or woodland. (Capability subclass VIIe.)

Bauer silt loam, 20 to 40 percent slopes, moderately eroded (BaF2).—This soil has a thin dark surface layer, commonly 3 to 4 inches thick. Its profile is shallower than the representative profile. In most places, the depth to shale is less than 12 inches. The best use for this soil is probably woodland or pasture. (Capability subclass VIIe.)

Blockton series

The Blockton series consists of poorly drained soils developed in alluvial material. They occur on foot slopes near the smaller streams in the southeastern part of the county. They have slopes of 0 to 5 percent. They are often wet because they receive runoff and seepage water from higher lying soils. Tile drains are not very effective, because the subsoil is very slowly permeable. The upper part of the profile is slightly acid to medium acid. The native vegetation was prairie grass.

These soils are moderately fertile and are moderately productive under good management. Some of the acreage is used for crops. Small areas that are associated with steep soils are used for pasture.

BLOCKTON SILT LOAM

The following profile is representative of Blockton silt loam. The two units mapped in Polk County have profiles that differ slightly from this, and these differences are noted in their descriptions.

0 to 12 inches, black, friable silt loam.
12 to 18 inches, black and gray, friable silt loam.
18 to 42 inches +, very dark gray to dark gray, very firm silty clay.

The surface layer varies in thickness and color. The 12- to 18-inch layer is platy in some areas.

Blockton silt loam, 0 to 2 percent slopes (BbA).—This soil has a thicker surface layer than that of the representative profile. In many areas, it seems to be a "two-storied" soil consisting of young alluvium deposited over older alluvium that shows evidence of some soil development. It is wetter and less easy to drain than Blockton silt loam, 2 to 5 percent slopes. Diversion terraces may be needed to protect this soil from water that runs off the slopes above.

If artificial drainage can be established, this soil can be used for crops in a short rotation consisting of 2 years of corn followed by oats with clover to be turned under as green manure. (Capability subclass IIw.)

Blockton silt loam, 2 to 5 percent slopes (BbB).—This soil developed from local alluvium on alluvial fans and foot slopes below Fayette, Downs, Tama, Gara, and other upland soils. The dark surface soil is thinner and the subsurface soil is less gray and platy than those of Blockton silt loam, 0 to 2 percent slopes. This soil is not so wet as the less strongly sloping soil, and it is not so likely to receive runoff. The subsoil is generally less firm and less clayey than that in the representative profile.

Where artificial drainage can be established, this soil can be cropped intensively. A suitable rotation is 2 years of corn followed by oats with clover to be used for green manure. (Capability subclass IIw.)

Buckner series

The Buckner series consists of sandy, extremely droughty soils that occur on the terraces of the Des Moines and Skunk Rivers. The sandy material was laid down by rivers. In some areas the soil material was reworked by wind, and in such places the Buckner soils are mapped in a complex with Hagener soils. The slope range is 0 to 9 percent.

These soils are low in fertility and productivity. They have a low water-holding capacity and are excessively drained. The upper part of the profile is medium acid to slightly acid. Wind erosion is a serious problem. Yields of field crops are low.

BUCKNER LOAMY SAND

The following profile is representative of Buckner loamy sand.

0 to 9 inches, dark grayish-brown, loose, loamy coarse sand.
9 to 30 inches, dark-brown, loose, loamy coarse sand.
30 to 50 inches +, very dark grayish-brown, loose, loamy coarse sand.

In some areas, the texture is sandy loam. In level or nearly level areas, the profile contains fine gravel.

Buckner loamy sand, 0 to 2 percent slopes (BcA).—Where water is available for irrigation, this soil has some potential for melons and other specialty and truck crops and for small grains and alfalfa. Tillage practices that leave crop residues on the surface will help protect the soil from wind erosion. (Capability subclass IIIs.)

Buckner loamy sand, 2 to 5 percent slopes (BcB).—This soil is subject to erosion by water as well as by wind. Use and management are the same as for Buckner loamy sand, 0 to 2 percent slopes. (Capability subclass IIIs.)

Buckner loamy sand, 5 to 9 percent slopes (BcC).—This soil is subject to water erosion as well as wind erosion. It can be used and managed in the same way as Buckner loamy sand, 0 to 2 percent slopes. (Capability subclass IIIs.)

Buckner-Hagener complex

In some areas where the soil materials were reworked by wind, Buckner and Hagener soils occur in such close association that they are not shown separately on the soil map. The Hagener soils, which are described on page 31, resemble the Buckner soils in many characteristics, but the sand in them is much finer.

This complex occurs on stream terraces. The soils are sandy and extremely droughty. They are ordinarily underlain by stratified sand and gravel at depths of about 5 to 10 feet. The principal management problems result from droughtiness, wind and water erosion, and the difficulty of maintaining fertility.

Buckner-Hagener complex, 2 to 5 percent slopes (BdB).—These soils should be cultivated on the contour, and the crop residues should be left on the surface to help prevent wind and water erosion. A crop sequence of corn-oats-meadow is suggested. Alternative crops are winter small grains, such as rye or wheat, or permanent alfalfa. Yields will be low in most years because the soils are droughty. (Capability subclass IIIs.)

Buckner-Hagener complex, 5 to 9 percent slopes (BdC).—This unit can be used and managed in the same way as Buckner-Hagener complex, 2 to 5 percent slopes. (Capability subclass IIIs.)

Cantril series

The Cantril series consists of imperfectly drained soils that developed from local alluvium. They occur on gentle foot slopes along drainageways in the more rolling southern part of the county. The native vegetation was grass and trees.

These soils are moderately fertile and are potentially fairly productive of both row crops and pasture.

They are occasionally wet because of runoff and seepage from the slopes above. Because the subsoil varies in permeability from moderate to slow, tile drains may not work well in all areas. The upper part of the profile is medium acid. Because these soils generally occur in small areas, they are farmed like the adjacent soils.

CANTRIL SILT LOAM

The following profile is representative of Cantril silt loam.

- 0 to 10 inches, very dark grayish-brown, friable silt loam.
- 10 to 18 inches, grayish-brown, friable silt loam.
- 18 to 40 inches, dark grayish-brown, firm silty clay loam; mottles of strong brown and yellowish brown are common.
- 40 to 48 inches +, dark-gray, friable silt loam; many strong-brown mottles.

The surface layer varies in thickness. In some level areas the color of the subsoil approaches olive gray, which indicates somewhat poorer natural drainage in these spots. In some places the texture approaches loam or clay loam.

Cantril silt loam, 0 to 2 percent slopes (CaA).—The profile of this soil is like the representative profile. Some areas that are poorly drained and have a gray subsurface horizon are included with this soil. This soil receives some runoff from adjacent slopes.

If this soil is drained and protected from runoff, it is suitable for intensive cultivation. However, because it occurs in small areas, it is usually farmed in the same way as the adjacent soils. (Capability subclass IIw.)

Cantril silt loam, 2 to 5 percent slopes (CaB).—This soil has a profile like the representative profile described. It has a slight erosion hazard if farmed intensively. Ordinarily, it is not subject to flooding. Some areas need grassed waterways to prevent gullying. This soil is suitable for intensive cultivation, but, because it occurs in small areas, it is generally farmed in the same way as the adjacent soils. (Capability subclass IIe.)

Chaseburg series

The Chaseburg series consists of moderately well drained to imperfectly drained, light-colored soils that developed from local alluvial material. They occur in the southeastern part of the county, on gentle foot slopes below Fayette soils and on the level bottoms along small streams. The native vegetation was grass or trees.

These soils are moderately fertile; their potential productivity is high if they can be protected from flooding. The upper part of the profile is slightly acid to medium acid. Most areas receive some runoff and seepage water from the slopes above. Tile drains may be needed in some cultivated areas. They work well if suitable outlets can be established.

Some areas of these soils are used for pasture; others are cropped along with the adjacent sloping soils.

CHASEBURG SILT LOAM

The following profile is representative of Chaseburg silt loam.

- 0 to 40 inches +, grayish-brown to dark grayish-brown, friable silt loam; light brownish gray in the lower part.

The upper part of the profile varies somewhat in color. The more nearly level areas are somewhat grayer and more mottled in the lower part.

Chaseburg silt loam, 0 to 2 percent slopes (CbA).—The profile of this soil is like the representative profile described. Some areas are inadequately drained and are likely to be flooded. Where water concentrates, grassed waterways are desirable. Diversion terraces may be needed to divert water that runs off the adjacent slopes.

This soil is potentially very productive. It is well suited to corn, soybeans, and pasture. Because it occurs in small areas, it is usually cropped in the same way as the adjacent soils. (Capability class I; some areas subject to flooding are in class V.)

Chaseburg silt loam, 2 to 5 percent slopes (CbB).—This soil has a profile like the representative profile described. It has a slight erosion problem as well as a wetness problem. Water often concentrates in the lower areas. Grassed waterways will help to control runoff and prevent gullying. Diversion terraces may be needed to divert water that runs off the higher adjacent slopes. Because this soil occurs in small areas, it is usually cropped in the same way as the adjacent soils. (Capability subclass IIe.)

Chelsea series

The Chelsea series consists of sandy, excessively drained soils that are very droughty. They occur on a few slopes along the eastern and southern sides of the Des Moines and Raccoon Rivers, where the wind blew the fine sand from the river bottoms. They formed under forest and are low in organic matter.

These soils are low in fertility and productivity. They are slightly acid to medium acid in the upper part of the profile. Each of the soils is eroded to varying degrees. At present, they are used mostly for woodland and pasture. Wind and water erosion are serious hazards.

CHELSEA LOAMY FINE SAND

The following profile is representative of Chelsea loamy fine sand.

- 0 to 2 inches, very dark brown, loose loamy fine sand.
- 2 to 8 inches, dark-gray, loose loamy fine sand.
- 8 to 33 inches, yellowish-brown, loose loamy fine sand.
- 33 to 48 inches +, like the layer above but containing a few grayish-brown mottles and reddish-brown iron stains.

In some of these soils, thin lenses or bands, apparently iron-clay accumulations, occur below a depth of 48 inches. Some small areas are included where, because of seepage water, the surface layer is thicker and darker colored.

Chelsea loamy fine sand, 5 to 9 percent slopes, eroded (CcC2).—This soil is droughty and erodible. Fertility is hard to maintain. For these reasons, this soil is not well suited to row crops. It can be used for a small grain followed by several years of meadow, or it can be used for rye or other small grain every year. Crop residues left on the surface will help to control wind erosion. Long-term pasture and woodland are suitable uses for this soil if it is not needed for hay or small grains. (Capability subclass IVs.)

Chelsea loamy fine sand, 9 to 14 percent slopes, eroded (CcD2).—Because this soil is droughty, has a severe erosion hazard, and is difficult to keep fertile, long-term pasture and woodland are the best uses for it. (Capability subclass VIs.)

Chelsea loamy fine sand, 14 to 20 percent slopes, eroded (CcE2).—Pasture and woodland are suggested uses for this droughty, extremely erodible soil. (Capability subclass VIIs.)

Chelsea loamy fine sand, 20 to 30 percent slopes, eroded (CcF2).—The surface soil and subsoil are thinner than those in the representative profile. Because this soil is droughty and extremely erodible, it should be used for woodland or pasture. (Capability subclass VIIs.)

Clarinda series

The Clarinda soils, like the Adair soils, have a long and complex history. The gray subsoil of clay or gritty silty clay (gumbotil) developed from Kansan glacial till more than 50,000 years ago. Then the Clarinda soils were buried by loess deposited during the Wisconsin glacial age about 16,000 years ago. A few thousand years later, the buried Clarinda subsoil was exposed by erosion, and soil formation started again.

Clarinda soils are of minor extent. They are found in the southern part of the county, mostly in coves at heads of drainageways. Seepage areas are common just above them. In many places, the Clarinda soils are associated with Clearfield or Sharpsburg soils.

These soils are low in fertility and productivity. They are very slowly permeable. They erode easily when cultivated. When the silty surface layer has been removed by erosion, these soils are no longer useful for cultivation and of practically no use for pasture. Because they occur in small areas, they are commonly used for the same crops as the adjacent sloping soils.

CLARINDA SILTY CLAY LOAM

A representative profile of Clarinda silty clay loam follows.

0 to 12 inches, very dark gray, slightly firm silty clay loam to friable silt loam.
12 to 45 inches +, dark olive-gray, very firm silty clay to clay.

Clarinda silty clay loam, 5 to 9 percent slopes (CdC).—Hay or pasture is probably the most suitable use for this soil. Many of the areas are small, however, and it may be best to use them in the same way as the adjacent soils. Yields will usually be low. Seepage can be partially controlled by laying interceptor tile in the more permeable soils upslope.

Included are some areas of Clarinda soils that have slopes of less than 5 percent. (Capability subclass IIIw.)

CLARINDA SOILS, SEVERELY ERODED

Clarinda soils, 5 to 9 percent slopes, severely eroded (CeC3).—The dark surface layer is less than 3 inches thick. The texture of the plow layer is silty clay.

These soils are best suited to hay or pasture. Renovating pastures may be difficult because the surface soil is clayey and sticky. Many areas are too small to manage separately. Seepage can be controlled to some extent by laying interceptor tile in the more permeable soils upslope. (Capability subclass IVe.)

Clarion series

The Clarion series consists of well-drained soils that developed from calcareous Cary glacial till of loam texture. They occur in the northern four-fifths of the county, with the Nicollet and Storden soils (fig. 7). The slopes range from 0 to 30 percent and are mostly short and irregular. The surface layer is generally loam, but some of the Clarion soils have surface layers of sandy loam, silt loam, or clay loam. The surface layer is thinner on the steeper slopes. Small, knobby spots of Storden and Lakeville loam are included; most of these spots are on the steeper slopes of the Clarion loams.

These soils are moderately fertile. The upper layers are slightly acid. The gently sloping phases are highly productive under good management and are used intensively for row crops. The steeper slopes are used mostly for pasture. Erosion control is a serious problem on many of these soils. Contouring and terracing are difficult because of the irregularity of the slopes; nevertheless, in many areas these practices help to control erosion.

CLARION LOAM

A representative profile of Clarion loam follows.

0 to 10 inches, very dark brown, friable loam.
10 to 36 inches, dark-brown to yellowish-brown, slightly firm loam to light clay loam.
36 to 50 inches, light yellowish-brown, friable, calcareous loam.

The amount of fine gravel and small stones varies from place to place. In most areas it is not large enough to interfere with tillage. Small sand pockets are fairly common. The depth to calcareous material ranges from 24 to 50 inches. A depth of 2½ feet is most common.

Clarion loam, 0 to 2 percent slopes (CfA).—This soil is somewhat similar to Nicollet loam. Its surface layer is slightly thicker and darker colored than that in the representative profile of Clarion loam. There is no appreciable erosion hazard.

This soil can be farmed intensively. A suitable rotation is corn-soybeans-corn-oats-meadow. (Capability class I.)

Clarion loam, 2 to 5 percent slopes (CfB).—This soil is the most extensive of the Clarion loams mapped in this county. It has a profile like the representative profile described. It is slightly erodible when farmed intensively.

If the row crops are planted on the contour, a rotation of corn-soybeans-corn-oats-meadow is suitable for this soil. If the row crops are not planted on the contour, a rotation of corn-corn-oats-meadow-meadow is suitable. (Capability subclass IIe.)

Clarion loam, 2 to 5 percent slopes, moderately eroded (CfB2).—This soil has a profile like the representative profile described, except that the dark surface layer is thinner and the depth to calcareous material is normally less. Because this soil ordinarily occurs on low, sharply rounded knobs, it has a slightly greater erosion hazard than Clarion loam, 2 to 5 percent slopes.

A crop sequence of corn-corn-oats-meadow-meadow is suggested if the corn is not planted on the contour. A rotation of corn-soybeans-corn-oats-meadow is suggested if the row crops are planted on the contour. Soil tests should be made to determine lime and fertilizer needs. (Capability subclass IIe.)

Clarion loam, 5 to 9 percent slopes (CfC).—This soil has a slight to moderate erosion hazard. If the row crops are planted on the contour, a rotation of corn-corn-oats-meadow-meadow is suggested. If the soil is terraced, a rotation of corn-corn-oats-meadow is suitable. If the soil is neither contoured nor terraced, 3 years of meadow following 1 year of corn and 1 year of oats are necessary to keep erosion to a reasonable level and maintain longtime productivity. (Capability subclass IIIe.)

Clarion loam, 5 to 9 percent slopes, moderately eroded (CfC2).—The profile of this soil is generally a few inches shallower to calcareous material than the representative profile of Clarion loam. The dark surface soil is thinner than that in the representative profile.

A rotation of corn-corn-oats-meadow is suitable if this soil is terraced. If it is contoured but not terraced, a rotation of corn-corn-oats-meadow-meadow is suggested. If it is neither terraced nor contoured, a rotation of corn-oats-meadow-meadow-meadow will be necessary to keep soil losses low and to maintain long-term productivity. (Capability subclass IIIe.)

Clarion loam, 9 to 14 percent slopes, moderately eroded (CfD2).—The profile of this soil is shallower to calcareous material than the representative profile of Clarion loam. Generally, the dark surface soil is thinner (4 to 7 inches thick) than that in the representative profile, but in some areas the surface layer is as thick as or thicker than that in the profile described. The hazard of erosion is greater than on less strongly sloping Clarion loams.

If this soil is terraced, a rotation of corn-corn-oats-meadow-meadow is suitable. Alternative uses are permanent hay and pasture. (Capability subclass IIIe.)

Clarion loam, 14 to 20 percent slopes, moderately eroded (CfE2).—The profile of this soil is like the representative profile described, except that the dark surface layer is generally thinner (less than 8 inches thick) and the depth to calcareous material is less. Included are some areas in which the surface soil is 10 to 12 inches thick. These areas are mostly pastures that have not been grazed heavily and have never been cultivated. Also included are many small spots of Storden soils, which are calcareous at, or within 12 inches of, the surface.

Permanent hay or pasture is a suitable use for this soil. (Capability subclass IVe.)

Clarion loam, 20 to 30 percent slopes, moderately eroded (CfF2).—This soil is found along drainageways and small creeks, in places where the native vegetation was not forest. The surface layer is generally less than 4 inches thick, and in many areas all of it has been removed by erosion. Small gullies have formed in some areas. Included are many areas, less than half an acre in size, of Storden soils, which are calcareous at, or within 12 inches of, the surface.

Permanent pasture is the most suitable use for this soil. (Capability subclass VIIe.)

CLARION SOILS, SEVERELY ERODED

Clarion soils, 5 to 9 percent slopes, severely eroded (CkC3).—The dark surface layer is less than 4 inches thick. In many places, all of the original surface soil has been lost through erosion and the brown or yellowish-brown subsoil is exposed. The depth to calcareous material ordinarily ranges from 18 to 30 inches.

The sharp ridges and knobs on which this unit developed are particularly subject to geologic erosion, but some of the erosion has been caused by growing cultivated crops continuously in rows running straight up and down the slope.

If this unit is terraced, a rotation of corn-corn-oats-meadow-meadow is suitable. If it is contoured but not terraced, a rotation of corn-oats-meadow-meadow is suggested. If it is neither contoured nor terraced, 4 years of meadow should follow 1 year of corn and 1 year of oats. (Capability subclass IIIe.)

Clarion soils, 9 to 14 percent slopes, severely eroded (CkD3).—The surface layer of this unit is generally less than 4 inches thick. In many places, all of the original dark surface layer has been removed by erosion and the yellowish-brown subsoil is exposed. The depth to calcareous material is ordinarily 18 to 30 inches.

The thinness of the dark surface layer is partly due to geologic erosion of the ridges and knobs on which this unit occurs, and partly due to the practice of growing row crops too often in rows running up and down hill.

If this unit is terraced, a rotation of corn-oats-meadow is suitable. Otherwise, permanent hay or pasture is the most suitable use. (Capability subclass IVe.)

Clarion soils, 14 to 20 percent slopes, severely eroded (CkE3).—The dark surface layer of this unit is generally less than 4 inches thick. In many places, all of the original dark surface layer has been removed by erosion and the yellowish-brown subsoil is exposed. The depth to calcareous material is ordinarily 18 to 30 inches. Included are numerous areas, mostly less than half an acre in size, of Storden soils, which are calcareous at or near the surface. Long-term pasture is a suitable use for this unit. (Capability subclass VIe.)

CLARION LOAM, THIN SOLUM

Except for some gravelly spots, a slightly thinner and lighter colored surface layer, and the shallower depth to calcareous loam, Clarion loam, thin solum, resembles Clarion loam. A representative profile of Clarion loam, thin solum, follows.

0 to 6 inches, very dark grayish-brown, friable loam.
6 to 20 inches, dark-brown to yellowish-brown, friable loam.
20 to 50 inches or more, yellowish-brown, friable, calcareous loam.

The depth to calcareous loam till ranges from 12 to 24 inches. The depth to carbonates is variable over a distance of a few hundred feet. Clarion loam, thin solum, is intermediate between Storden loam and Clarion loam in soil properties.

Further study of this soil is needed to determine whether it is important to separate Clarion loam, thin solum, from Clarion loam. A few observations indicate that Clarion loam, thin solum, needs slightly more phosphate fertilizer than Clarion loam for best growth of alfalfa.

Clarion loam, thin solum, 2 to 5 percent slopes (CgB).—The surface layer of this soil is a few inches thicker and a little darker colored than that in the representative profile of Clarion loam, thin solum. A rotation of corn-corn-oats-meadow-meadow is suggested. (Capability subclass IIe.)

Clarion loam, thin solum, 2 to 5 percent slopes, moderately eroded (CgB2).—The profile of this soil is like the representative profile of Clarion loam, thin solum. A suitable rotation is corn-corn-oats-meadow-meadow. (Capability subclass IIe.)

Clarion loam, thin solum, 5 to 9 percent slopes, moderately eroded (CgC2).—The profile of this soil is like the representative profile of Clarion loam, thin solum, except that the depth to calcareous material is about 15 inches. Small areas of Storden soils are included.

If this soil is contoured, a rotation of corn-corn-oats-meadow-meadow or corn-oats-meadow is suggested. If this soil is not contoured, corn or other row crops probably should not be grown more than 1 year in 5, to keep erosion at a minimum. (Capability subclass IIIe.)

CLARION SILT LOAM

Clarion silt loams occur near the southeastern border of the Cary till area in Polk County. The silty material was probably deposited by wind. It is of local origin. Clarion silt loams are probably slightly more fertile than Clarion loams; particularly, they contain more available potassium.

A representative profile of Clarion silt loam follows.

0 to 9 inches, very dark brown, friable silt loam.
9 to 18 inches, dark-brown, friable silt loam.
18 to 33 inches, dark yellowish-brown to dark-brown, friable to slightly firm loam.
33 to 48 inches, yellowish-brown, friable, calcareous loam.

The thickness of the silty material ranges from 6 to 20 inches. As a result of frost heaving and of the activity of rodents, some gravel is mixed with the silty material. The depth to calcareous glacial till ranges from 18 to 40 inches.

Clarion silt loam, 2 to 5 percent slopes (ChB).—This soil has a slight erosion hazard. If the row crops are planted on the contour, a rotation of corn-soybeans-corn-oats-meadow is suitable. If the soil is not contoured, a rotation of corn-corn-oats-meadow-meadow is suggested. (Capability subclass IIe.)

Clarion silt loam, 5 to 9 percent slopes, moderately eroded (ChC2).—The profile of this soil is like the representative profile of Clarion silt loam, but in some places the dark surface layer is only 4 to 7 inches thick. When cultivated, this soil erodes readily unless it is contoured and terraced. If it is contoured, a suggested rotation is corn-corn-oats-meadow-meadow. If it is terraced, a rotation of corn-corn-oats-meadow is suitable. If it is neither contoured nor terraced, a suggested rotation is corn-oats-meadow-meadow-meadow. (Capability subclass IIIe.)

Clarion silt loam, 9 to 14 percent slopes, moderately eroded (ChD2).—In some places the dark surface layer of this soil is only 4 to 7 inches thick. This soil erodes readily when cultivated. If it is terraced, a rotation of corn-corn-oats-meadow-meadow is suggested. An alternative use is permanent pasture. (Capability subclass IIIe.)

Clarion silt loam, 14 to 20 percent slopes, moderately eroded (ChE2).—The dark surface layer of this soil is generally only 4 to 8 inches thick. Some small areas of Storden soils are included. This soil is best suited to permanent hay or pasture. (Capability subclass IVe.)

Clearfield series

The Clearfield series consists of dark-colored, imperfectly drained soils that developed in Wisconsin loess. They occur in the southwestern part of the county near Sharpsburg and Adair soils. They generally occur in coves at the heads of upland drainageways, downslope from the Sharpsburg soils. The slope range of the Clearfield soils is 5 to 14 percent. The native vegetation was grass.

Clearfield soils tend to be wet in seasons when rainfall is above normal. This is chiefly because of seepage water that moves laterally downslope on top of a dense, very slowly permeable, clayey layer. By careful placement of tile, much of the seepage water can be removed. Contouring on a slight grade will help remove excess water. Controlling water erosion is also a serious problem on these soils.

The Clearfield soils are moderately fertile. They are fairly productive if managed properly. They are medium acid in the upper part of the profile. Ordinarily, they are used for row crops, oats, and meadow, as are the adjacent Sharpsburg soils.

CLEARFIELD SILTY CLAY LOAM

A representative profile of Clearfield silty clay loam follows.

0 to 12 inches, very dark gray, slightly firm silty clay loam.
12 to 38 inches, dark grayish-brown, firm silty clay loam; prominent mottles.

38 to 48 inches, mottled grayish-brown, pale-brown, and light brownish-gray, slightly firm silty clay loam.

The thickness of the dark surface layer ranges from 6 to 18 inches. In most areas, at depths of 3½ to 5 feet, there is a buried soil of gritty silty clay, sometimes called gumbotil.

Clearfield silty clay loam, 5 to 9 percent slopes (CmC).—The profile of this soil is like the representative profile, except that it is ordinarily overlain by silty material washed down from the slopes above. Most areas of this soil are too small to manage separately and must be farmed with the surrounding Sharpsburg soils. (Capability subclass IIIw.)

Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded (CmC2).—The profile of this soil is ordinarily shallower than the representative profile, and the dark surface layer is thinner than that in the representative profile. Most areas are too small to farm separately. (Capability subclass IIIw.)

Clearfield silty clay loam, 9 to 14 percent slopes, moderately eroded (CmD2).—The dark surface layer of this soil is only 4 to 7 inches thick. Hay or pasture is the best use for this soil. (Capability subclass IVe.)

Colo series

The Colo series consists of poorly drained, dark-colored, young soils of the bottom lands. They lie along rivers and creeks and are most extensive along the Skunk River. They border the Huntsville and Storden soils. They formed from medium textured to moderately fine textured, river-laid sediments (alluvium). Separate layers in the profile are not readily distinguishable. The native vegetation was grass and some trees.

COLO SILTY CLAY LOAM

A representative profile of Colo silty clay loam follows.

0 to 30 inches, black to very dark gray, firm silty clay loam.

30 to 50 inches +, very dark gray to olive gray, firm silty clay loam.

The thickness of the dark surface layer is variable. Generally, there is some sand in all layers. In some areas there are clay loam layers.

Colo silty clay loam (Cn).—This soil is moderately to highly fertile. It is productive and well suited to row crops. The larger areas along the Skunk River are used intensively for row crops, especially corn and soybeans. Areas along the smaller streams and areas that are wet and subject to flooding are used for pasture or as woodland.

Wetness is a problem in seasons when rainfall is above normal. The poor natural drainage has been improved by straightening and deepening the channel of the Skunk River, by digging road and field ditches, and, in a few areas, by installing tile. If satisfactory outlets can be obtained, tile drains are fairly effective. (Capability subclass IIw.)

Colo silty clay loam, channeled (Co).—This soil is so frequently flooded and is so cut up by old stream channels and by the present meandering stream that it is unsuitable for cultivation. Its best use is woodland or pasture. (Capability class V.)

COLO LOAM, LOAMY SUBSOIL VARIANT

A representative profile of Colo loam, loamy subsoil variant, follows.

0 to 24 inches, gray to very dark gray, slightly firm loam to clay loam.

24 to 60 inches, dark grayish-brown, slightly firm loam to clay loam.

This variant ordinarily contains more sand than Colo silty clay loam. In some areas, the subsoil is sandy clay loam. Lenses of sandy loam or loam occur in some places.

Colo loam, loamy subsoil variant (Cp).—This soil occurs with Colo silty clay loam, mainly in the northeastern part of the county on the bottoms along the Skunk River. It has slopes of 0 to 1 percent. It is less well drained than Huntsville silt loam, which it borders. The natural drainage is poor to somewhat poor. The water-holding capacity is good. The upper part of the profile is slightly acid to neutral.

Prior to the straightening and deepening of the Skunk River, this soil was undoubtedly flooded often. Many areas are still flooded occasionally. The drainage has been improved by road ditches and, in some areas, by shallow field drains and tile lines. Wherever there are good outlets, tile drains will probably be effective.

This soil is moderately fertile. It can be used intensively for row crops. When not flooded or extremely wet, it will, if well managed, produce high yields of corn, soybeans, oats, and meadow. Suggested rotations are corn-corn-oats and corn-soybeans-corn-oats-meadow. The oats in the first rotation should be seeded with a legume. The legume can be plowed under for green manure. (Capability subclass IIw.)

Colo-Judson-Nodaway complex

The soils of this complex occur in an intricate pattern, mainly along the smaller drainageways and creeks in the southeastern part of the county. The individual soils are described elsewhere in this report. Nodaway silt loam is the dominant soil in the complex, the Judson soil is the second most extensive, and Colo silty clay loam is the minor soil. In some areas, the Colo subsoil is silty clay.

The chief management problems are wetness and flooding. In the places where water concentrates, grassed waterways should be maintained to help prevent gully erosion.

Colo-Judson-Nodaway complex (Cr).—This complex is commonly used for permanent pasture. If cultivated, it is generally cropped the same as the surrounding soils because the areas are too small to manage separately. The larger areas are suitable for intensive cultivation if drained and protected from overflow. (Capability subclass IIw.)

Colo-Terril complex

The soils of this complex occur together in narrow areas on the bottom lands of small streams and drainageways in the northern two-thirds of the county. They are so closely associated that they were not mapped separately. The complex is about 50 percent Colo soils, about 30 to 40 percent Terril soils, and about 10 to 20 percent Huntsville soils. The individual soils are described elsewhere in this report.

Colo-Terril complex, 0 to 2 percent slopes (CsA).—Many areas of this unit are as much as two-thirds Colo soils. Because this unit occurs in narrow areas along small drainageways, it generally must be farmed in the same way as the surrounding soils or used for long-term pasture. Diversion terraces may be needed to help control water that runs off adjacent slopes. (Capability subclass IIw.)

Colo-Terril complex, 2 to 5 percent slopes (CsB).—Terril soils comprise as much as half of many areas of this unit. The flood hazard is less than on Colo-Terril complex, 0 to 2 percent slopes. Because of the greater proportion of the moderately well drained Terril soils, this unit has better natural drainage.

This unit must be farmed along with the surrounding soils or left in long-term pasture. In some places, diversion terraces may be needed to help control water that runs off adjacent slopes. (Capability subclass IIw.)

Cooper series

The Cooper series consists of dark-colored, imperfectly drained soils that occur on low terraces, or second bottoms, along the Des Moines and Raccoon Rivers. They are of minor extent. The soil material is alluvium.

COOPER SILT LOAM, ACID VARIANT

This variant is slightly acid in the upper part of the profile. It is moderately fertile and is fairly productive. Most of it is used intensively for row crops; some is used for oats and meadow. Because it is level and has slowly permeable lower layers, it is occasionally wet. Some areas are under water during high floods.

A representative profile of Cooper silt loam, acid variant, follows.

0 to 15 inches, very dark gray to black, heavy silt loam to slightly firm, light silty clay loam.
15 to 36 inches, very dark grayish-brown, firm silty clay loam or silt loam.
36 to 60 inches, dark grayish-brown, firm silty clay loam to very firm silty clay or clay.

The depth to the silty clay ranges from 24 to 42 inches.

Cooper silt loam, acid variant (Ct).—The profile of this soil is like the representative profile described. When not too wet, this soil is well suited to corn, soybeans, oats, and meadow. Drainage can be improved with shallow surface drains or, in some places, with tile. Tile should be placed above the silty clay layer. Tile drains may not work well.

Intensive row cropping will not cause deterioration of this soil, though the structure may need to be improved by growing grass-legume hay. One suitable rotation is corn-corn-oats. A legume for green manure should be seeded with the oats. (Capability subclass IIw.)

Crocker series

The soils of the Crocker series are sandy and somewhat excessively drained. They occur in small areas, mainly on the eastern side of the Des Moines River, north of the city of Des Moines. The slope range is 2 to 30 percent. The upper layers are loamy fine sand deposited by wind; the lower layers are glacial till. The Des Moines River bottom was the source of the fine sand. The native vegetation was mixed grass and trees.

The Crocker soils are subject to wind and water erosion. They are droughty and somewhat low in fertility, but the gently sloping areas are moderately productive under careful management. The upper part of the profile is medium acid.

These soils are used with adjacent soils for corn, oats, and meadow. The steeper areas are used for pasture.

CROCKER LOAMY FINE SAND

A representative profile of Crocker loamy fine sand follows.

0 to 8 inches, very dark grayish-brown, loose loamy fine sand.
8 to 11 inches, grayish-brown, loose loamy fine sand.
11 to 24 inches, brown, very friable fine sandy loam.
24 to 50 inches, yellowish-brown, slightly firm loam to light clay loam.

The sandy layers range in thickness from 12 to about 24 inches and in texture from sand to sandy loam. They are thinnest on the steep slopes and thickest on the gentle slopes. Calcareous loam glacial till is at depths of 3 to 5 feet.

Crocker loamy fine sand, 2 to 5 percent slopes (CuB).—The profile of this soil is like the representative profile. Corn probably should not be grown more often than 1 year in 3. A suggested rotation is corn-oats-meadow. This soil needs to be protected from wind and water erosion. This can be done by keeping the soil in meadow or leaving as much trash as possible on the surface if grain crops are grown. Long-term pasture is an alternative use if there is not a great need for cropland. (Capability subclass IIs.)

Crocker loamy fine sand, 5 to 9 percent slopes, moderately eroded (CuC2).—This soil presents serious problems of wind erosion, water erosion, and droughtiness. Tillage methods that leave crop residues on the surface will help control wind erosion. A suggested rotation is corn-oats-meadow. The corn should be planted on the contour. If there is no particular need for additional cropland, this soil can be used for long-term hay or pasture. (Capability subclass IIIs.)

Crocker loamy fine sand, 9 to 14 percent slopes, moderately eroded (CuD2).—The profile of this soil is like the representative profile, except that the thickness of the sandy layers is ordinarily nearer 12 inches than 24.

Long-term hay or pasture and woodland are suitable uses. Alfalfa will probably do well on this soil because the roots will reach through the sand and into the underlying loamy material, which has a high moisture-holding capacity. (Capability subclass IVs.)

Crocker loamy fine sand, 14 to 20 percent slopes, moderately eroded (CuE2).—The profile of this soil is like the representative profile, except that the thickness of the sandy layers is nearer 12 inches than 24. Included are spots in which the mantle of fine sand is less than 12 inches thick. Woodland and pasture are the most suitable uses for this soil. (Capability subclass VIs.)

Crocker loamy fine sand, 20 to 30 percent slopes (CuF).—The profile of this soil is like the representative profile, except that the sandy layers are commonly about 12 inches thick. Areas that have a sandy layer only 6 inches thick are included.

This soil is not suitable for cultivation. It should be used for pasture or as woodland. (Capability subclass VIIs.)

Dickinson series

The soils of the Dickinson series are well drained to somewhat excessively drained. They developed in sandy material. The slope range is 0 to 30 percent. The texture of the surface soil ranges from loam to sandy loam. The depth to calcareous material ranges from 24 to more than 60 inches. The native vegetation was prairie grass.

The parent material was coarse and stratified, probably as a result of being reworked and sorted by running water at the time it was deposited. In some areas, it has been further modified and sorted by wind.

DICKINSON FINE SANDY LOAM

Dickinson fine sandy loams occur mostly in the uplands in the northern part of the county. They also occur on a few high stream terraces. The dominant slope range is 2 to 5 percent.

These soils are somewhat excessively drained. They have a low moisture-holding capacity and are droughty. They are moderately low in fertility and are moderately low to very low in productivity, depending on slope. They are subject to wind and water erosion.

The nearly level areas are farmed along with the adjacent soils, which, if cultivated, are used for row crops, oats, and meadow. The steeper slopes are used for pasture.

A representative profile of Dickinson fine sandy loam follows.

- 0 to 10 inches, very dark grayish-brown, very friable fine sandy loam.
- 10 to 33 inches, dark-brown, very friable fine sandy loam.
- 33 to 60 inches, yellowish-brown, loose loamy sand.

The thickness of the surface layer decreases with increasing slope. The upper layers are slightly acid.

Dickinson fine sandy loam, 0 to 2 percent slopes (DaA).—The surface layer in this soil is slightly thicker than that in the representative profile of Dickinson fine sandy loam, and it is very dark brown in color rather than very dark grayish brown.

A suggested rotation for this soil is corn-oats-meadow. Alternative crops are alfalfa, winter rye, or wheat. Because of the hazard of wind erosion, crop residues should be left on the surface whenever possible. (Capability subclass IIIs.)

Dickinson fine sandy loam, 2 to 5 percent slopes (DaB).—This soil occurs on low knobs throughout the northern four-fifths of the county. Its profile is like the representative profile of Dickinson fine sandy loam.

A suggested rotation for this soil is corn-oats-meadow. Alternative crops are alfalfa, winter rye, and wheat. Crop residues should be left on the surface whenever possible to help prevent wind and water erosion. (Capability subclass IIIs.)

Dickinson fine sandy loam, 2 to 5 percent slopes, moderately eroded (DaB2).—The dark surface layer of this soil is generally less than 8 inches thick.

Probably this soil cannot be kept productive if row crops are grown more than 1 year in 3 or 4 years. A suggested rotation is corn-oats-meadow. Alternative crops are alfalfa, winter rye, or wheat. Crop residues left on the surface will help prevent wind and water erosion. (Capability subclass IIIs.)

Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded (DaC2).—The dark surface layer of this soil is generally less than 8 inches thick. Included are a few areas in which the surface layer is thick and relatively uneroded.

A rotation of corn-oats-meadow-meadow-meadow is suggested for this soil. Alternative crops are alfalfa, winter rye, or wheat. Crop residues should be left on the surface whenever possible to help prevent wind and water erosion. (Capability subclass IIIs.)

Dickinson fine sandy loam, 9 to 14 percent slopes, moderately eroded (DaD2).—The layers of sandy loam are thinner in this soil than in the representative profile, and the depth to the layer of loamy sand is less. Included are some areas in which the surface horizon is thick and relatively uneroded.

This soil is not suitable for cultivation. Permanent pasture is the best use for it. (Capability subclass VIs.)

Dickinson fine sandy loam, 14 to 20 percent slopes, moderately eroded (DaE2).—The layers of sandy loam are thinner in this soil than in the representative profile of Dickinson fine sandy loam, and the depth to the layer of loamy sand is less. Included are some areas in which the surface horizon is thick and relatively uneroded.

Long-term pasture is the most suitable use for this soil. Lime and phosphate needs should be determined by soil tests. The response to fertilization is uncertain because the soil is droughty. (Capability subclass VIIs.)

Dickinson fine sandy loam, 20 to 30 percent slopes, moderately eroded (DaF2).—The dark surface layer of this soil is thinner and lighter colored than that in the representative profile of Dickinson fine sandy loam. The most suitable use for this soil is permanent pasture. (Capability subclass VIIs.)

DICKINSON SOILS, SEVERELY ERODED

Dickinson soils, 9 to 14 percent slopes, severely eroded (DdD3).—The dark surface layer of this unit is thin. In a few areas, the subsoil is exposed. The depth to the layer of loamy sand is less than in the representative profile of Dickinson fine sandy loam. The surface layer is lighter colored than that in the representative profile because it contains less organic matter.

Long-term pasture is a suggested use for this unit. Probably lime and phosphate will be needed to improve the pasture. Because of droughtiness, the response to amendments is uncertain. (Capability subclass VIs.)

Dickinson soils, 14 to 20 percent slopes, severely eroded (DdE3).—The dark surface layer of this unit is normally less than 4 inches thick. It is much lighter colored than that in the representative profile of Dickinson fine sandy loam. In some areas, especially areas of strongly rounded slopes, the subsoil is exposed. The depth to the layer of loamy sand is several inches less than in the representative profile.

Long-term pasture is the most suitable use for this unit. (Capability subclass VIIs.)

DICKINSON LOAM

Dickinson loams are well drained to somewhat excessively drained. They are slightly droughty and are only moderately productive. Those south of the Raccoon River are more acid than those north of the river.

These soils are subject to moderate to severe erosion and, if they are farmed intensively, should be contoured or terraced. The gentler slopes are used for cultivated crops, and the steeper slopes are used for unimproved pasture.

A representative profile of Dickinson loam follows.

- 0 to 10 inches, very dark grayish-brown to dark-brown, friable loam.
- 10 to 28 inches, dark-brown, friable fine sandy loam.
- 28 to 50 inches, dark-brown to yellowish-brown loam; generally calcareous below a depth of 42 inches.

Dickinson loam, 2 to 5 percent slopes (DbB).—If this soil is contoured, a rotation of corn-corn-oats-meadow is suggested. If it is not contoured, a rotation of corn-oats-meadow is suggested. (Capability subclass IIs.)

Dickinson loam, 5 to 9 percent slopes, moderately eroded (DbC2).—The profile of this soil is like the representative profile of Dickinson loam, except that the dark surface layer is generally only 4 to 7 inches thick. This soil erodes easily and is slightly droughty; therefore, crop yields may not be high. If this soil is contoured, corn-oats-meadow-meadow-meadow is a suitable rotation. If it is terraced, a rotation of corn-corn-oats-meadow is suggested. Alternative uses are permanent hay and pasture. Alfalfa is fairly well suited. (Capability subclass IIIs.)

Dickinson loam, 9 to 14 percent slopes, moderately eroded (DbD2).—The profile of this soil is like the representative profile of Dickinson loam, except that the dark surface layer is only 4 to 7 inches thick. Permanent hay or pasture is the best use for this soil. Alfalfa is a suitable crop. (Capability subclass IVs.)

Dickinson loam, 14 to 20 percent slopes, moderately eroded (DbE2).—The profile of this soil is like the representative profile of Dickinson loam, except that the surface layer is only 4 to 7 inches thick. This soil is best suited to permanent pasture. (Capability subclass VIs.)

Dickinson loam, 20 to 30 percent slopes, moderately eroded (DbF2).—The profile of this soil is like the representative profile of Dickinson loam, except that the surface layer is only 4 to 7 inches thick. This soil is best suited to permanent pasture. (Capability subclass VIIs.)

DICKINSON SANDY LOAM, BENCH POSITION

Dickinson sandy loams, bench position, occur on glacial outwash terraces along the Skunk and Des Moines Rivers. They are somewhat excessively drained to excessively drained. The slope range is 0 to 9 percent.

These soils are subject to wind and water erosion. They are low in fertility and are not very productive, even under good management. The water-holding capacity is low.

Small areas of Buckner, Hagener, and Saylor soils are included.

A representative profile of Dickinson sandy loam, bench position, follows.

- 0 to 7 inches, very dark grayish-brown, very friable sandy loam.
- 7 to 30 inches, dark-brown, very friable sandy loam.
- 30 to 60 inches, brown to pale-brown loamy sand to sandy loam.

The surface soil and subsoil range in texture from very fine sandy loam to loamy sand. In some areas there are layers of coarse sand and fine gravel below a depth of 30 inches. The substratum contains a little more stratified sand and gravel than that of the Dickinson fine sandy loams. The upper layers are slightly acid to medium acid. Below depths of 3 to 4 feet, the reaction is neutral, but some spots are calcareous.

Dickinson sandy loam, bench position, 0 to 2 percent slopes (DcA).—For this soil, a cropping sequence of corn-oats-meadow is suggested to insure long-term productivity. Winter wheat or rye can also be grown. Because of the hazard of wind erosion, crop residues should be left on the surface whenever possible. If grain is not needed, or if the supply of fertilizer is limited, this soil can be used for alfalfa or long-term pasture. (Capability subclass IIIs.)

Dickinson sandy loam, bench position, 2 to 5 percent slopes (DcB).—A cropping sequence of corn-oats-meadow is suggested to maintain the productivity of this soil and to control erosion. Winter wheat or rye can also be grown. Crop residues should be left on the surface to help control wind erosion. This soil can also be used for alfalfa or long-term pasture. (Capability subclass IIIs.)

Dickinson sandy loam, bench position, 5 to 9 percent slopes (DcC).—If this soil is contoured, a rotation of corn-oats-meadow-meadow is suggested, but, because of the irregular slopes, contouring is not feasible in most areas. This soil can also be used for winter wheat, rye, alfalfa, or long-term pasture. Whenever possible, crop residues should be left on the surface to help control wind erosion. (Capability subclass IIIs.)

Dorchester series

The Dorchester series consists of light-colored soils on bottom lands. The soil material is recently deposited sediment. Many areas are subject to frequent and damaging floods. In some areas these soils border Huntsville and Nodaway soils.

These soils are potentially productive, but, to varying degrees, they need fertility improvement and flood protection. Generally, they are weakly to strongly calcareous (alkaline), but in a few areas they are neutral.

Some areas of Dorchester soils are in corn and soybeans, others are in pasture, and others are in unmanaged woodland used only for wildlife.

DORCHESTER SILT LOAM

Dorchester silt loams are somewhat similar in color and texture to Nodaway soils. They contain less organic matter than Huntsville soils. A representative profile of Dorchester silt loam follows.

0 to 50 inches, very dark gray to dark grayish-brown, friable silt loam; below a depth of 30 inches, a few pale-brown mottles; stratified lenses of fine sand are common.

Dorchester silt loam (De).—This soil is imperfectly drained. For places where the flood hazard is not extreme, a suggested use is corn for 2 years, followed by oats seeded with a legume for green manure. For inaccessible areas or for areas where flood hazard is high, pasture and woodland are alternative uses. It might be advantageous to apply nitrogen fertilizer to corn. (Capability class I; includes areas in class V.)

Dorchester silt loam, moderately shallow over sand (Df).—This soil is moderately well drained to excessively drained. It is underlain by sand at depths of 12 to 24 inches. The sand is ordinarily calcareous, but in some areas along the Raccoon River it is neutral to slightly acid.

Severe flood hazard and droughtiness cause the major management problems. In areas where the flood hazard is not extreme, corn for 2 years, followed by oats seeded with a legume for green manure, is a suggested rotation for this soil. The average yields will not be high. Pasture and woodland are alternative uses. (Capability subclass IIIs.)

Dorchester silt loam, deep over sand (Dg).—This soil is moderately well drained to excessively drained. It is underlain by sand at depths of 30 to 60 inches. The sand is ordinarily calcareous, but in some areas along the Raccoon River it is neutral to slightly acid.

The major management problems result from the severe flood hazard and the slight drought hazard. Corn for 2 years, followed by oats seeded with a legume for green manure, is suggested for areas where the flood hazard is not extreme. Woodland and pasture are alternative uses. (Capability class I; includes areas in class V.)

Downs series

The Downs series consists of well-drained, moderately dark colored soils that developed from Wisconsin loess. They occur in the uplands in the southeastern part of the county. They are associated with Fayette and Tama soils. Figure 8 shows the relationship of these soils. The slope range of the Downs soils is 0 to 30 percent. The upper layers of the profile are moderately acid. The native vegetation was first grass and later trees, so the Downs soils have characteristics of both prairie and forest soils.

Water erosion on the Downs soils is slight to very severe. Many areas have lost their original dark surface layer and are mapped as eroded phases.

These soils are moderately fertile. They are seldom, if ever, too wet for crops. Under good management, the gently sloping phases are highly productive of corn, oats, and meadow. Of the steeper areas, some are used for crops, but most are used for pasture.

DOWNS SILT LOAM

A representative profile of Downs silt loam follows.

0 to 7 inches, very dark grayish-brown, friable silt loam.

7 to 10 inches, dark grayish-brown, friable silt loam.

10 to 32 inches, brown, firm, medium silty clay loam.

32 to 50 inches +, mottled, yellowish-brown, friable silt loam.

The color and thickness of the upper two layers vary, depending on slope, erosion, and other factors. The thickness of the loess ranges from about 4 feet on side slopes to about 20 feet on the nearly level areas.

Downs silt loam, 0 to 2 percent slopes (DhA).—This soil somewhat resembles the Atterberry soils, with which it occurs. It has a darker colored and thicker surface layer than that in the representative profile of Downs silt loam.

A crop sequence no more intensive than corn-corn-oats-meadow is suggested. (Capability class I.)

Downs silt loam, 2 to 5 percent slopes (DhB).—In most places, the profile of this soil is like the representative profile of Downs silt loam. Included are a few small areas where, because there has been no accelerated erosion, the surface layer is thicker and darker colored than that in the representative profile.

If contoured, this soil is suited to a rotation of corn-corn-oats-meadow. If not contoured, it is suited to a rotation of corn-corn-oats-meadow-meadow. (Capability subclass IIe.)

Downs silt loam, 5 to 9 percent slopes, moderately eroded (DhC2).—The average thickness of the surface and subsurface layers of this soil is less than 8 inches.

If this soil is terraced, a rotation of corn-corn-oats-meadow is suggested. If it is contoured, a rotation of corn-corn-oats-meadow-meadow is suggested. If it is neither contoured nor terraced, a rotation of corn-oats-meadow-meadow-meadow is suitable. (Capability subclass IIIe.)

Downs silt loam, 9 to 14 percent slopes, moderately eroded (DhD2).—The surface and subsurface layers of this soil average less than 8 inches in thickness. Included are some areas, mostly in forest, that are not significantly eroded.

If this soil is not contoured and terraced, it will erode readily when cultivated. If it is terraced, a rotation of corn-corn-oats-meadow-meadow is suggested. An alternative use is pasture. (Capability subclass IIIe.)

Downs silt loam, 14 to 20 percent slopes, moderately eroded (DhE2).—The surface layers of this soil are somewhat thinner than those in the representative profile, and the total depth of the profile is less than that of the representative profile.

This soil is best suited to long-term hay, pasture, or woodland. (Capability subclass IVe.)

Downs silt loam, 20 to 30 percent slopes, moderately eroded (DhF2).—The profile of this soil is several inches shallower than the representative profile. Generally, the surface, subsurface, and subsoil layers are thinner than those in the representative profile, and the brown subsoil is not so high in clay. Included are some forested areas that are not significantly eroded and, therefore, have relatively thick surface and subsurface layers.

Woodland is the most suitable use for this soil. (Capability subclass VIIe.)

DOWNS SOILS, SEVERELY ERODED

Downs soils, 5 to 9 percent slopes, severely eroded (DkC3).—These soils have surface and subsurface layers that are much thinner than those in the representative profile of Downs silt loam. On strongly rounded slopes and where cultivation has been intensive, the brown subsoil is exposed.

If these soils are contoured, a rotation of corn-oats-meadow-meadow is suggested. If they are terraced, a rotation of corn-corn-oats-meadow-meadow is suitable. Alternative uses are hay and pasture. Heavy applications of fertilizer are needed to restore these eroded soils to maximum productivity. (Capability subclass IIIe.)

Downs soils, 9 to 14 percent slopes, severely eroded (DkD3).—The combined thickness of the surface and subsurface layers of these soils is generally less than 4 inches. On strongly rounded slopes that have been intensively cultivated, the brown subsoil is exposed.

These soils are not suitable for intensive cultivation. A rotation of corn-oats-meadow-meadow is suggested for terraced areas. Alternative uses are hay, pasture, and woodland. Heavy applications of fertilizer are needed to restore these soils to maximum long-time productivity. (Capability subclass IVe.)

Downs soils, 14 to 20 percent slopes, severely eroded (DkE3).—The thickness of the surface and subsurface layers of these soils averages less than 4 inches. In cultivated fields and especially on abruptly rounded slopes, the brown subsoil is exposed. These soils are best suited to long-term pasture and woodland. (Capability subclass VIe.)

Farrar series

The Farrar series consists of somewhat excessively drained sandy soils. These soils occur mainly in the northeastern part of the county, east of the Skunk River, and are associated mainly with the Hagener, Dickinson, and Clarion soils. They developed under prairie vegetation. They have a slope range of 2 to 30 percent.

The fine sandy material in the upper layers of these soils was blown by wind from the adjacent river bottoms. The loam in the lower layers was deposited by the Cary glacier. The glacial material is friable. It is commonly calcareous below depths of 3 to 4 feet.

These soils are subject to wind and water erosion. They are slightly acid. The fertility is low. The gently sloping phases are used for corn, oats, and meadow, and they are moderately productive under good management. Tillage practices that leave crop residues on the surface help to prevent wind erosion. The steeper phases are used for pasture.

FARRAR FINE SANDY LOAM

A representative profile of Farrar fine sandy loam follows.

0 to 6 inches, very dark brown, very friable fine sandy loam.

6 to 20 inches, very dark brown to dark brown, very friable fine sandy loam.

20 to 35 inches, dark yellowish-brown, friable loam.

35 to 60 inches +, yellowish-brown, friable loam; calcareous.

The combined thickness of the sandy upper layers ranges from 6 to about 30 inches. The texture ranges from loamy fine sand to fine sandy loam.

Farrar fine sandy loam, 2 to 5 percent slopes (FaB).—If this soil is not contoured, a crop sequence of corn-oats-meadow is suggested. A sequence of corn-corn-oats-meadow is suitable if the fields are contoured. This soil is more subject to water erosion than the Clarion soils, with which it occurs. As it is also subject to wind erosion, crop residues should be left on the surface whenever possible. (Capability subclass IIs.)

Farrar fine sandy loam, 5 to 9 percent slopes (FaC).—If this soil is terraced, a crop sequence of corn-corn-oats-meadow is suggested. If it is contoured but not terraced, a sequence of corn-oats-meadow-meadow is suggested. Crop residues should be left on the surface to help control wind erosion. (Capability subclass IIIs.)

Farrar fine sandy loam, 5 to 9 percent slopes, moderately eroded (FaC2).—The dark surface layer of this soil is thinner than that in the representative profile. The combined thickness of the sandy layers ranges from 6 to about 15 inches.

If this soil is terraced, a crop sequence of corn-corn-oats-meadow is suggested. If it is contoured, a sequence of corn-oats-meadow-meadow is suggested. Crop residues should be left on the surface to help control wind erosion. (Capability subclass IIIs.)

Farrar fine sandy loam, 9 to 14 percent slopes, moderately eroded (FaD2).—The dark surface layer of this soil is somewhat shallower than that in the representative profile. However, there are some included areas that are relatively uneroded and have a thicker surface layer. The combined thickness of the sandy layers ranges from 6 to about 15 inches.

This soil is not suitable for intensive cultivation. Permanent hay or pasture is probably its best use. If it is cultivated, crop residues should be left on the surface to help control wind erosion. (Capability subclass IVs.)

Farrar fine sandy loam, 14 to 20 percent slopes, moderately eroded (FaE2).—This soil generally has a somewhat thinner dark surface layer than that of the representative profile. There are, however, some included areas where the surface layer is thicker because it is not eroded significantly. The total thickness of the sandy loam layers is about 6 to 15 inches. The depth to calcareous material ranges from about 18 to 27 inches.

Long-term pasture is the most suitable use for this soil. (Capability subclass VIs.)

Farrar fine sandy loam, 20 to 30 percent slopes, moderately eroded (FaF2).—The surface and subsurface layers of this soil are generally less than 15 inches thick. In most places the dark surface layer is 4 to 8 inches thick, but included are a few areas where the surface layer is thicker. This soil is generally leached to depths of 18 to 27 inches.

Long-term pasture or permanent pasture is the most suitable use for this soil. (Capability subclass VIIs.)

Fayette series

The Fayette series consists of well-drained, light-colored soils that developed from loess. The thickness of the loess ranges from 3 feet on the lower side slopes to more than 20 feet on the broad, level upland divides. The Fayette soils occur in the southeastern part of the county, mostly in the uplands, but to some extent on benches, or second bottoms. They are associated with Downs, Stronghurst, and Tama soils (fig. 8). The slope range is 0 to 40 percent. The native vegetation was trees.

Generally, the nearly level phases have a grayer and thicker subsurface layer than other phases. They have a slightly mottled subsoil, which is somewhat like that of the Stronghurst soils. The steeper phases have somewhat less clay in the subsoil than the gently sloping phases. In the severely eroded phases, the plow layer consists of yellowish-brown material from the subsoil.

The Fayette soils are moderately fertile. They are medium acid in the upper part of the profile and need lime. Under good management, the gently sloping phases are highly productive of corn, oats, and meadow—the chief crops grown. About a third of the gently sloping areas are forested. The steeper slopes are used for unimproved pasture and woodland. Erosion is slight to severe, depending on the slopes.

FAYETTE SILT LOAM

A representative profile of Fayette silt loam follows.

0 to 4 inches, dark grayish-brown, friable silt loam.
4 to 10 inches, grayish-brown, friable silt loam.
10 to 35 inches, yellowish-brown, slightly firm silty clay loam.
35 to 60 inches +, mottled yellowish-brown and reddish-brown, friable silt loam.

Fayette silt loam, 0 to 2 percent slopes (FbA).—This soil developed on the broad, forested ridgetops. It has thicker surface and subsurface layers than those described in the representative profile. It is slightly mottled in the subsoil. It has better natural drainage than the Stronghurst soils, however. A rotation of corn-corn-oats-meadow or corn-oats-meadow is suitable. (Capability class I.)

Fayette silt loam, 2 to 5 percent slopes (FbB).—The profile of this soil is like the representative profile, except that in some areas some of the dark surface soil and grayer subsurface layer has been removed by accelerated erosion. Included are some forested areas in which there has been little or no accelerated erosion.

If this soil is contoured, a rotation of corn-corn-oats-meadow is suitable. If it is not contoured, a rotation of corn-corn-oats-meadow-meadow is suggested. (Capability subclass IIe.)

Fayette silt loam, 2 to 5 percent slopes, moderately eroded (FbB2).—Most of the original dark surface layer and some of the subsurface layer of this soil have been removed by accelerated erosion. The depth to the yellowish-brown subsoil ranges from 4 to 8 inches.

A rotation of corn-corn-oats-meadow is suitable if this soil is contoured. A rotation of corn-corn-oats-meadow-meadow is suggested if the soil is not contoured. (Capability subclass IIe.)

Fayette silt loam, 5 to 9 percent slopes, moderately eroded (FbC2).—The depth to the yellowish-brown subsoil is generally only 4 to 8 inches. If this soil is terraced, a rotation of corn-corn-oats-meadow is suitable. If it is contoured, a rotation of corn-oats-meadow-meadow is suggested. (Capability subclass IIIe.)

Fayette silt loam, 9 to 14 percent slopes, moderately eroded (FbD2).—In this soil, the depth to the yellowish-brown subsoil generally is only 4 to 8 inches. Included are some forested areas where the surface layer is slightly darker colored and thicker than that in the representative profile.

If this soil is terraced to control erosion, a rotation of corn-corn-oats-meadow-meadow is suggested. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Fayette silt loam, 14 to 20 percent slopes, moderately eroded (FbE2).—In this soil, the depth to the yellowish-brown subsoil is generally 4 to 8 inches. Included are some forested areas where the surface and subsurface layers are thicker than those in the representative profile.

Long-term pasture and woodland are suitable uses for this soil. (Capability subclass IVe.)

Fayette silt loam, 20 to 30 percent slopes, moderately eroded (FbF2).—Although the surface and subsurface layers generally are not so thick as those in the representative profile, roughly 30 to 40 percent of this soil is relatively uneroded.

Woodland is the most suitable use for this soil. (Capability subclass VIIe.)

Fayette silt loam, 30 to 40 percent slopes, moderately eroded (FbG2).—In most places, the surface layer of this soil is slightly thinner than that in the profile described.

This soil is best suited to woodland or pasture. (Capability subclass VIIe.)

Fayette silt loam, bench position, 2 to 5 percent slopes (FcB).—This soil is found below the uplands, along streams. It developed from loess over terrace deposits, while the Fayette soils in the uplands developed from loess over Kansan till. It receives some runoff water from the slopes above; hence, it may be more productive in dry years than the Fayette soils of similar slope in the uplands.

If this soil is contoured, a rotation of corn-corn-oats-meadow is suitable. If it is not contoured, a rotation of corn-corn-oats-meadow-meadow is suggested. (Capability subclass IIe.)

FAYETTE SOILS, SEVERELY ERODED

Fayette soils, 5 to 9 percent slopes, severely eroded (FdC3).—The plow layer is composed mostly of the original yellowish-brown subsoil.

If this unit is contoured, a rotation of corn-corn-oats-meadow-meadow is suggested. If it is terraced, a rotation of corn-oats-meadow is suggested. Lime and fertilizer are needed. (Capability subclass IIIe.)

Fayette soils, 9 to 14 percent slopes, severely eroded (FdD3).—In most of this unit, the yellowish-brown, former subsoil is exposed.

A corn-oats-meadow-meadow rotation is suitable for these soils if they are terraced or stripcropped. (Capability subclass IVe.)

Fayette soils, 14 to 20 percent slopes, severely eroded (FdE3).—In this unit, the yellowish-brown, former subsoil is exposed. Pasture and woodland are the most suitable uses. (Capability subclass VIe.)

Gara series

The Gara series consists of light-colored, well-drained soils that developed from Kansan glacial till of clay loam texture. They occur in the southern part of Polk County, where the Kansan till is not very thick and the shale bedrock commonly lies at depths of 4 to 6 feet. Figure 9 shows the position of the Gara soils on the landscape.

The slope range is 5 to 40 percent. The native vegetation was originally prairie grass, but in recent centuries trees have invaded. Therefore, these soils have characteristics of both forest and prairie soils.

These soils are moderately fertile. The upper layers are medium acid. The subsoil is slowly to very slowly permeable. If these soils are cultivated without regard to soil conservation, they are subject to severe or very severe erosion. Some Gara soils have lost their original surface soil through erosion.

The slopes of 5 to 14 percent commonly are used for corn, oats, and meadow, but they are also used for permanent pasture. The steeper slopes are used mostly for permanent pasture or woodland.

GARA LOAM

A representative profile of Gara loam follows.

0 to 5 inches, very dark gray, friable loam.
5 to 8 inches, dark grayish-brown, friable loam.
8 to 30 inches, yellowish-brown, firm to very firm clay loam.
30 to 48 inches +, mottled yellowish-brown and reddish-yellow, firm clay loam.

The thickness and color of the surface layer vary. In some areas, especially in Bloomfield Township, the material below depths of 3 or 4 feet is loam. Stones, pebbles, and some sand pockets are present in some small areas. There are also some spots of clay gumbotil.

Gara loam, 5 to 9 percent slopes, moderately eroded (GaC2).—Most of this soil is somewhat eroded, and the surface and subsurface horizons combined are less than 8 inches thick. Several areas are included that are relatively uneroded and have a thick surface layer. Also included are some soils in Bloomfield Township that have loam or sandy loam below the subsoil, rather than clay loam.

If this soil is contoured, a crop sequence of corn-oats-meadow-meadow is suggested. If it is terraced, a suggested sequence is corn-corn-oats-meadow-meadow. Even without these conservation practices, this soil can be kept productive for long periods by using a crop sequence consisting of 1 year of corn, 1 year of oats, and 4 years of meadow; or 1 year of a small grain and 3 or 4 years of meadow. If grain and hay are not needed, this soil can be used for long-term pasture. (Capability subclass IIIe.)

Gara loam, 9 to 14 percent slopes, moderately eroded (GaD2).—The combined thickness of the upper two layers of this soil is generally only 4 to 8 inches. Several areas that are forested and have thicker surface and subsurface layers are included. Some areas in Bloomfield Township are underlain, below a depth of 30 inches, by loam and sandy loam rather than the more common clay loam.

This soil is not suitable for intensive cultivation. If it is terraced, it can be used for a rotation of corn-oats-meadow. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Gara loam, 14 to 20 percent slopes, moderately eroded (GaE2).—In most areas, the combined thickness of the upper two layers of this soil is only 4 to 8 inches. Included are some relatively uneroded, forested areas that have thicker surface layers. In a few areas in Bloomfield Township, the soil is underlain, below a depth of 30 inches, by loam and sandy loam rather than the more common clay loam. This soil is best suited to long-term pasture or woodland. (Capability subclass IVe.)

GARA SOILS, ERODED

Gara soils, 9 to 14 percent slopes, severely eroded (GbD3).—This unit has thinner surface and subsurface layers than the representative profile of Gara loam. The yellowish-brown former subsoil is exposed in many places, especially on sharply rounded slopes or in areas that have been farmed intensively.

This unit is best suited to long-term pasture or woodland. If hay is needed, a crop sequence such as a small grain followed by several years of meadow is suggested. (Capability subclass IVe.)

Gara soils, 14 to 20 percent slopes, severely eroded (GbE3).—The combined thickness of the surface and subsurface layers of this unit is less than 4 inches. In most areas that have been farmed intensively and that have sharply rounded slopes, the yellowish-brown former subsoil is exposed. This unit is best suited to long-term pasture or woodland. (Capability subclass VIe.)

Gara soils, 20 to 40 percent slopes, slightly to severely eroded (GbF2).—In most areas of this unit, the surface and subsurface layers are a few inches thinner than those in the representative profile of Gara loam. In some areas, the yellowish-brown former subsoil is exposed. The underlying Kansan till is ordinarily thinner than that underlying the Gara soils that have milder slopes. Shale bedrock is within 6 feet of the surface in many areas. In Bloomfield Township, there are a few areas that are underlain by loam or sandy loam.

This unit is suited to woodland or permanent bluegrass pasture. If it is used for pasture, a good vegetative cover should be maintained to help control erosion. (Capability subclass VIIe.)

Glencoe series

The Glencoe series consists of dark-colored soils that occur in small, shallow, basinlike depressions in the uplands in the northern part of the county. They are locally called "pothole" soils. They are adjacent to Webster and Nicollet soils and, in many places, like the Okoboji soils, they are surrounded by narrow rims of Harpster soils (fig. 7). They formed from glacial drift or local alluvium. The native vegetation was wet-prairie grass.

The Glencoe soils are naturally very wet and are often ponded. They have a slowly to very slowly permeable subsoil. They need artificial drainage, but, because the soils occur in depressions, satisfactory outlets commonly necessitate deep placement of tile lines. The tile lines may not draw well, and surface intakes may be needed to remove surface water. In some areas, shallow surface ditches are used in addition to tile lines.

The Glencoe soils are slightly acid, but in a few places they are calcareous in the upper layers. They are similar to the Okoboji soils but are higher in clay throughout the profile.

The Glencoe soils are highly fertile, but unless they are well drained artificially, they generally give low yields. Alfalfa seldom survives the winter. In most places, these soils are cropped along with the surrounding soils.

GLENCOE SILTY CLAY LOAM

A representative profile of Glencoe silty clay loam follows.

- 0 to 20 inches, black, slightly firm to firm silty clay loam.
- 20 to 45 inches, dark olive-gray to olive-gray, firm to very firm silty clay or firm silty clay loam.

The black upper layer ranges from 20 to 35 inches in thickness and from friable silt loam to firm silty clay in texture. The subsoil ranges in thickness from 10 to 30 inches.

Glencoe silty clay loam (Gc).—This soil is somewhat similar to the associated Webster soils. The areas are too small to farm separately. There are no management suggestions other than to improve drainage where feasible. (Capability subclass IIIw.)

Gosport series

The Gosport series consists of light-colored soils that, like the Bauer and Runnells soils, formed from preglacial shale of Pennsylvanian age. These soils are naturally well drained, although in very wet seasons some areas may be seepy. They are found on the lower parts of slopes, below the soils derived from loess, such as the Fayette, and those derived from Kansan till, such as the Lindley and Gara. Gosport soils occur in the southern part of the county, along the dissected uplands bordering the Des Moines River and its tributary creeks. They formed under forest and have naturally thin surface layers. The slope range is 5 to 40 percent.

These soils are very erodible because of their slopes and their very slowly permeable subsoil. They are medium acid to strongly acid. They are low in fertility and are used chiefly for woodland or unimproved bluegrass pasture. Some slopes of 5 to 15 percent are used for corn, oats, and meadow, but yields of corn are not very high, even under good management.

GOSPORT SILT LOAM

A representative profile of Gosport silt loam follows.

- 0 to 6 inches, grayish-brown, friable silt loam.
- 6 to 15 inches, yellowish-brown, very firm to firm silty clay; light brownish-gray mottles.
- 15 inches +, yellowish-brown, plastic silty clay shale that commonly extends to depths of several feet; numerous hard shale fragments.

The shaly material is variable in color, layering, and texture. The surface layer ranges from 0 to about 8 inches in thickness.

Gosport silt loam, 5 to 9 percent slopes, moderately eroded (GdC2).—This soil is best suited to woodland but, if carefully managed and fertilized, might be used for long-term pasture. (Capability subclass IVe.)

Gosport silt loam, 9 to 14 percent slopes, moderately eroded (GdD2).—This soil is best suited to woodland or pasture. (Capability subclass VIe.)

Gosport silt loam, 14 to 20 percent slopes, moderately eroded (GdE2).—This soil is best suited to woodland or pasture. (Capability subclass VIIe.)

Gosport silt loam, 20 to 40 percent slopes, moderately eroded (GdF2).—This soil is generally only 6 to 12 inches deep over shale. It is best suited to woodland. (Capability subclass VIIe.)

GOSPORT SOILS, SEVERELY ERODED

Gosport soils, 14 to 20 percent slopes, severely eroded (GeE3).—The surface layer of this unit is thinner than that in the representative profile of Gosport silt loam. It is generally less than 4 inches thick, and, in many areas, the yellowish-brown subsoil is exposed. This unit is best suited to woodland or pasture. (Capability subclass VIIe.)

Gravity series

The Gravity series consists of dark-colored, imperfectly drained soils that developed from local alluvium washed from adjacent slopes. This material continued to accumulate while the soil profile was forming—a possible cause of the thick, dark-colored surface layer.

The slope range is 2 to 4 percent. The native vegetation was prairie grass.

Gravity soils occur on foot slopes in the southern part of the county, most commonly below areas of Shelby and Gara soils. They receive runoff and seepage water. Gully erosion is likely in areas where water concentrates.

These soils have a grayer subsoil and are less well drained than the Olmitz soils. They are more clayey than the Judson, Olmitz, and Terril soils, though they are similar to them in position and origin.

Gravity soils are slightly acid to medium acid in the upper part of the profile. They are moderately to highly fertile. They may need artificial drainage if they are used for corn and alfalfa. Under good management, they are highly productive of corn, oats, and alfalfa. They are now used along with the adjacent soils—for pasture where the adjacent soils are strongly sloping, and for corn and oats where adjoining bottom lands are farmed to those crops.

GRAVITY SILTY CLAY LOAM

A representative profile of Gravity silty clay loam follows.

0 to 16 inches, very dark grayish-brown to black, slightly firm silty clay loam.
16 to 36 inches, very dark grayish-brown to dark olive-gray, firm silty clay loam mottled with olive gray and brownish yellow.
36 to 50 inches +, slightly firm to somewhat friable silty clay loam mottled with olive gray and brownish yellow.

In a few areas there is on the surface a 4- to 8-inch recent deposit of grayish-brown, friable loam or silt loam. The top layer ranges in color from black to grayish brown and in thickness from 15 to 25 inches. In some areas the texture is clay loam; in others it is gritty silty clay loam. In a few areas there is a thin, grayish-brown subsurface layer, and in these the soil is somewhat like Cantril or Blockton soils.

Gravity silty clay loam, 2 to 4 percent slopes (GfB).—If this soil can be farmed separately from the adjoining upland soils, it can be used intensively for row crops. Where water concentrates, grassed waterways are needed to prevent gully erosion. Diversion terraces may be needed to protect this soil from runoff from adjacent slopes. Tile drainage may be needed if the soil is cultivated. (Capability subclass IIw.)

Hagener series

The Hagener series consists of sandy soils that are excessively drained and very droughty. They occur primarily in the uplands east of the Skunk River. There are a few areas on the natural terraces of the Skunk and Des Moines Rivers and a few scattered areas away from the rivers. The slope range is 0 to 20 percent. The natural vegetation was primarily prairie grass. Along the terraces of the Des Moines River are a few areas where Hagener and Buckner soils are intermixed. These areas were mapped as the Buckner-Hagener complex.

The parent material was mainly fine sand. It was blown from the river bottoms or from the Late Wisconsin glacial outwash plains. Little organic matter has accumulated, either because the wind has removed some of the surface soil or deposited sand on the surface or because the soils supported only poor stands of native grasses to supply organic matter.

The Hagener soils are low in water-holding capacity. They are slightly acid to medium acid in the upper part of the profile. They are low in fertility. Even under good management, they are not productive of row crops, grain, hay, or pasture. Some of the smaller, gently sloping areas are cropped, along with adjacent soils, to row or grain crops. The larger and steeper areas are used mostly for pasture.

These soils are subject to wind and water erosion. Terraces to control erosion are not practicable because these soils are so sandy that terrace ridges are not stable and the channels tend to fill with sand. If these soils are used for row crops, they should be cultivated and stripcropped on the contour.

HAGENER LOAMY FINE SAND

A representative profile of Hagener loamy fine sand follows.

0 to 10 inches, very dark grayish-brown, loose loamy fine sand.
10 to 36 inches, brown to dark grayish-brown, loose loamy fine sand.
36 to 60 inches +, yellowish-brown, loose loamy fine sand.

In a few areas, at depths of 4 to 8 feet, there are thin, strong-brown, clayey, iron-rich bands. In some areas a very dark brown layer—possibly a buried surface layer—is in the subsoil. These soils, though dominantly loamy fine sand, are sand throughout in some places. Most commonly, the underlying material is fine sand to depths of many feet, but, as in the Farrar soils, some areas are underlain with friable loam till at depths of 4 to 5 feet, and a few with coarse sand.

Hagener loamy fine sand, 0 to 2 percent slopes (HaA).—A crop sequence of corn-oats-meadow is suggested for this soil if grain is needed and if the soil is protected from wind erosion. Alternative crops are rye, other winter grain, and alfalfa. Yields are very low in dry years. (Capability subclass IIIs.)

Hagener loamy fine sand, 0 to 2 percent slopes, moderately eroded (HaA2).—The profile of this soil is like the representative profile of Hagener loamy fine sand, except that the dark surface layer is less than 8 inches thick. This shallowness of the surface soil is ordinarily due to wind action.

If this soil is needed for grain, a suggested crop sequence is corn-oats-meadow. Suitable precautions are needed to control wind erosion. Rye and permanent alfalfa are alternative crops. (Capability subclass IIIs.)

Hagener loamy fine sand, 2 to 5 percent slopes (HaB).—A crop sequence of corn-oats-meadow is suggested for this soil. Alternative crops are continuous alfalfa (reseeded when necessary) and winter rye. Cultivation should be on the contour, and crop residues should be left on the surface. (Capability subclass IIIs.)

Hagener loamy fine sand, 2 to 5 percent slopes, moderately eroded (HaB2).—Except that the dark surface

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layer is generally less than 8 inches thick, the profile of this soil is similar to the representative profile of Hagener loamy fine sand. Included are some areas where the wind has deposited rather than removed soil material.

If this soil is needed for grain, a crop sequence of corn-oats-meadow is suggested. Cultivation should be on the contour, and crop residues should be left on the surface. Winter small grains and permanent alfalfa (reseeded when necessary) are suitable alternative crops. (Capability subclass IIIs.)

Hagener loamy fine sand, 5 to 9 percent slopes (HaC).—If this soil is contoured, a crop sequence of corn-oats-meadow is suggested. Alfalfa or a winter small grain, such as rye, are alternative crops. Tillage practices that leave crop residues on the surface will help reduce wind erosion. (Capability subclass IIIs.)

Hagener loamy fine sand, 5 to 9 percent slopes, moderately eroded (HaC2).—Except that the dark surface layer is less than 8 inches thick, the profile of this soil is like the representative profile. In some areas, the shallowness of the topsoil is due primarily to wind erosion, in others, primarily to water erosion. In some places the wind has deposited fresh soil material that has not accumulated much organic matter.

If this soil is contoured, a corn-oats-meadow rotation is suggested. Alfalfa or a winter small grain, such as rye, is suggested as an alternative crop. (Capability subclass IIIs.)

Hagener loamy fine sand, 9 to 14 percent slopes, moderately eroded (HaD2).—The dark surface layer of this soil is more than 4 but less than 8 inches thick. The shallowness is due, in part, to wind or water erosion, but before there was any erosion the surface layer was thinner than that in the representative profile. Included are some areas where the surface soil is more than 8 inches thick.

Pasture is the most suitable use for this soil. (Capability subclass VIs.)

Hagener loamy fine sand, 9 to 14 percent slopes, severely eroded (HaD3).—Except that the dark surface layer is generally less than 4 inches thick, the profile of this soil is like the representative profile. Pasture is the most suitable use for this soil. (Capability subclass VIs.)

Hagener loamy fine sand, 14 to 20 percent slopes, eroded (HaE2).—The dark surface layer of this soil ranges in thickness from 0 to about 10 inches, but generally it is more than 4 but less than 8 inches thick.

Because of strong slopes and extreme droughtiness, pasture is the most suitable use for this soil. (Capability subclass VIIs.)

Harpster series

The Harpster series consists of poorly drained, nearly level soils that developed from calcareous glacial drift of loam texture. These soils are found, generally in small areas, in the uplands in the northern four-fifths of the county. They commonly form rims around depressions in which Glencoe (fig. 7) and Okoboji soils occur. In plowed fields that have become dry on the surface, the Harpster soils appear as prominent, gray areas. The native vegetation was wet-prairie grass.

These soils are low in fertility. They do not supply enough potassium and phosphorus for corn and alfalfa. They are high in calcium carbonate. Most areas need artificial drainage. Since the soils are moderately permeable, tile drains are usually effective.

Because Harpster soils generally occur in small areas, they are cropped along with the Webster and Nicollet soils to corn, soybeans, oats, and meadow.

HARPSTER LOAM

Harpster loam is strongly calcareous throughout. The natural drainage ranges from somewhat poor to poor. In some areas the boundaries between this soil and the calcareous variants of Webster or the Marshan soils are gradual. A few small areas of Harpster loam that are too small to show on the soil map are included with adjacent soils. A representative profile of Harpster loam follows.

0 to 12 inches, dark-gray, friable loam.
12 to 30 inches, olive-gray, slightly firm loam to clay loam.
30 to 50 inches +, pale-olive, slightly firm loam.

The color of the surface soil ranges from gray to very dark gray or almost black. In some areas, the texture of the various layers is somewhat sandy.

Harpster loam (Hb).—Although Harpster loam is normally cropped along with the adjacent soils, it needs heavier applications of phosphate and potash, particularly potash, than the adjacent soils. (Capability subclass IIw.)

Hayden series

The Hayden series consists of well-drained, light-colored soils that developed from Cary glacial till. The till consists of calcareous, friable loam. In some areas there are sand and gravel pockets and lenses. These soils occur mainly on the dissected uplands adjacent to the Des Moines and Skunk Rivers in the northern four-fifths of the county. They have a slope range of 0 to 40 percent. Like the Fayette and Lindley soils, they formed under trees.

These soils have good water-holding capacity. They are moderately fertile. The upper layers are medium acid. Erosion is a serious hazard.

The steeper areas are used mostly for pasture, but some are used for woodland. Other areas are used for corn, oats, and meadow, and also for pasture and woodland. Under good management, these areas are moderately productive of corn, oats, and meadow.

HAYDEN LOAM

The following profile is representative of Hayden loam.

0 to 2 inches, very dark grayish-brown, friable loam.
2 to 8 inches, brown to pale-brown, very friable loam.
8 to 40 inches, yellowish-brown, slightly firm clay loam.
40 to 60 inches +, brown to light yellowish-brown, calcareous, friable loam.

The thickness of the dark-colored surface layer ranges from 0 to 5 inches. The texture of the subsoil ranges from heavy loam to medium clay loam. The depth to calcareous material ranges from 27 to 50 inches and is generally least on the steeper, strongly convex slopes. The nearly level phases have a weakly mottled, grayish-brown subsoil, especially where these soils border the poorly drained Ames soil.

Hayden loam, 0 to 2 percent slopes (HcA).—This soil has a thicker, grayer subsurface layer than the representative profile of Hayden loam. Its subsoil is also grayer and is slightly mottled.

There is no erosion problem. Some areas are slightly wet and may need artificial drainage. A crop sequence of corn-corn-oats-meadow is suggested. (Capability class I.)

Hayden loam, 2 to 5 percent slopes (HcB).—The dark surface soil of this unit is ordinarily somewhat thicker than that in the representative profile. If this soil is contoured, a rotation of corn-corn-oats-meadow is suggested. If it is not contoured, a rotation of corn-corn-oats-meadow-meadow is suggested for keeping the soil productive. (Capability subclass IIe.)

Hayden loam, 2 to 5 percent slopes, moderately eroded (HcB2).—The combined thickness of the upper two layers of this soil is only 4 to 8 inches.

Contour cultivation and a crop sequence of corn-corn-oats-meadow are suggested. A rotation of corn-corn-oats-meadow-meadow is suitable if this soil is not contoured. Adequate fertilization is important in improving and maintaining this soil. (Capability subclass IIe.)

Hayden loam, 5 to 9 percent slopes, moderately eroded (HcC2).—This soil includes some areas where the surface and subsurface layers are thicker than those of the representative profile.

If this soil is terraced, it probably can be kept productive for a long time by using a crop sequence of corn-corn-oats-meadow and applying nitrogen for the second year of corn. If it is not contoured or terraced, a sequence of corn-oats-meadow-meadow-meadow is suggested for maintaining productivity and minimizing erosion. (Capability subclass IIIe.)

Hayden loam, 9 to 14 percent slopes, moderately eroded (HcD2).—This soil includes some areas where the surface and subsurface layers are thicker than those in the representative profile.

If this soil is terraced, a crop sequence of corn-corn-oats-meadow-meadow is suggested. Long-term pasture is an alternative use. (Capability subclass IIIe.)

Hayden loam, 14 to 20 percent slopes, moderately eroded (HcE2).—This soil is best suited to long-term hay or pasture, or to woodland. (Capability subclass IVe.)

Hayden loam, 20 to 30 percent slopes, moderately eroded (HcF2).—The profile of this soil is not so distinctly defined as the representative profile. The parent material is normally at depths of 2 to 3 feet. The depth of leaching ranges from about 27 to 36 inches, which is less than in the more gently sloping Hayden soils. This soil is best suited to pasture or woodland. (Capability subclass VIIe.)

Hayden loam, 30 to 40 percent slopes, moderately eroded (HcG2).—The profile of this soil has thinner surface and subsoil layers than the Hayden profile described. The parent material is normally at depths of 2 to 3 feet. The depth to calcareous till ranges from about 27 to 36 inches, which is less than in the Hayden soils on gentler slopes. The most suitable use for this soil is woodland or pasture. (Capability subclass VIIe.)

Huntsville series

The Huntsville series consists of moderately dark-colored soils of the bottom lands. Their slope range is 0 to 2 percent. They occur along the original channel of the Skunk River and on the bottom lands along the smaller creeks and streams—in some places, close to the streams. Huntsville soils that are considerably cut up by meanders and oxbows have been mapped as channeled phases. The channeled areas are often wet and ponded.

HUNTSVILLE SILT LOAM

Huntsville silt loams are moderately well drained to imperfectly drained. They formed from silty alluvium. Small amounts of sediment probably were deposited each time the streams overflowed. The overflow hazard varies from area to area. Some areas are seldom flooded because they are protected by dikes or road ditches. Other areas are flooded frequently. These soils border Nodaway, Dorchester, and Colo soils.

Huntsville silt loams are moderately to highly fertile. The upper layers are slightly acid. If these soils are protected from flooding and otherwise well managed, their potential productivity is high. Their use is largely determined by the frequency and severity of flooding.

Trees, shrubs, or prairie grass grew on these soils. A little organic matter has accumulated, but, because the parent material was deposited gradually, the other processes of soil formation have not been active. A representative profile of Huntsville silt loam follows.

0 to 8 inches, very dark gray, friable silt loam.
8 to 33 inches, very dark grayish-brown, friable silt loam.
33 to 50 inches +, very dark grayish-brown, friable silt loam; coarse, reddish-yellow mottles are common.

The profile varies somewhat in color. The texture is a gritty silt loam bordering on silty clay loam. In some areas there are pockets and lenses of sand. Also, in some areas, the subsoil is friable silty clay loam. Generally, Huntsville silt loams are slightly acid to neutral, but in a few areas the subsoil is calcareous.

Huntsville silt loam (Hf).—This soil is practically free of old oxbow and meander channels. If protected from overflow, it is suited to intensive cropping to corn or soybeans. A suitable rotation is corn for 2 years, followed by oats seeded with a legume for green manure. Areas that are subject to severe flooding are best suited to woodland or pasture. (Capability class I; includes some areas that are subject to flooding and are in class V.)

Huntsville silt loam, channeled (Hg).—This soil is cut by oxbows and meanders. Generally, the profile is like the representative profile described, but in the oxbows the soil material is like Alluvial land in color and texture. Because of its channeled surface, this soil is of limited use for corn, soybeans, or other cultivated crops. Most areas are best suited to pasture or woodland. (Capability class V.)

HUNTSVILLE SANDY LOAM

Huntsville sandy loam (Hd).—Except for the sandy loam surface layer and a somewhat sandy subsoil, this soil resembles Huntsville silt loam. It is slightly droughty. It can be used and managed in about the same way as Huntsville silt loam, but it is lower in productivity and fertility. If protected from serious flooding, it can be used intensively for corn and soybeans. A suitable rotation is corn for 2 years, followed by oats seeded to a legume for green manure. Because of the overflow hazard, many areas are better suited to pasture or woodland than to cultivated crops. (Capability subclass IIs.)

Huntsville sandy loam, channeled (He).—This soil is sandier throughout than Huntsville silt loam. It is subject to more severe flooding than Huntsville silt loam or Huntsville sandy loam. Its use for corn, soybeans, and other crops is severely limited because it is so cut up by oxbows and stream channels. Most areas are best suited to woodland or pasture. (Capability class V.)

Ida series

The Ida series consists of well-drained soils that developed from silty loess. Their slope range is 5 to 9 percent. They occur only in a few upland areas in the northern part of the county, generally near the base of slopes below Clarion soils.

The Ida soils have good water-holding capacity. Like the Storden soils, they are very deficient in available phosphorus for corn, alfalfa, and other crops. They are ordinarily farmed like the adjacent soils, which are generally sloping.

The soils of the Ida series formed from Wisconsin loess, most of which apparently was laid down before the glacial till from which the Clarion soils formed. As evidence, one can see in a deep road cut along United States Highway No. 65 (in the northeast quarter section of Franklin Township) the glacial till overlying the loess. Deep in the loess are logs that were buried an estimated 14,000 years ago. These logs are of considerable aid to glacial geologists and soil scientists in determining the time of various glacial events in Iowa.

IDA SILT LOAM

In the extreme western part of Iowa, Ida silt loam is extensive, but in Polk County it is more of scientific than of practical interest. A representative profile of Ida silt loam follows.

- 0 to 6 inches, calcareous, dark grayish-brown, very friable silt loam.
- 6 to 50 inches +, calcareous, yellowish-brown, very friable silt loam.

Ida silt loam, 5 to 9 percent slopes, eroded (IaC2).—A cropping sequence of corn-oats-meadow-meadow is suggested for this soil if cultivation is on the contour. If this soil is terraced, a corn-corn-oats-meadow rotation is suitable. This soil is very low in available phosphorus. The amounts of phosphorus to be applied should be determined by soil test. (Capability subclass IIIe.)

Judson series

The Judson series is composed of dark-colored, moderately well drained soils that generally occur on foot slopes or alluvial fans in the southeastern part of the county. Commonly, these soils occupy concave slopes between the bottom lands where Chaseburg and Colo soils occur and the uplands where Tama and Downs soils occur. There are a few inclusions of imperfectly drained to poorly drained soils, most of which are where natural waterways cross the Judson soils.

The Judson soils formed from local alluvium, which was washed down slowly over a period of centuries from slopes above. The natural vegetation was chiefly prairie grass, although trees also grew on these soils. The slope range is 2 to 9 percent.

These soils have good water-holding capacity. They receive some runoff and some soil material from adjacent slopes. Spots where runoff water concentrates are subject to severe gullying. The hazard of sheet erosion is slight to severe, depending on slope.

These soils are slightly acid to medium acid in the upper layers. They are moderately to highly fertile. Under good management, they are highly productive of corn, oats, and hay. They are used along with the adjacent soils for corn, oats, meadow, and pasture.

In Polk County, Judson soils are mapped as separate units and also as part of the Colo-Judson-Nodaway complex.

JUDSON SILT LOAM

In most areas of Judson silt loam, the profile contains more sand than is ordinarily found in a silt loam, but not enough to make its textural class loam or clay loam. A representative profile of Judson silt loam follows.

- 0 to 21 inches, very dark brown, friable silt loam.
- 21 to 50 inches +, dark-brown to dark grayish-brown, friable silt loam; a few yellowish-brown mottles below depths of 30 inches.

The thickness of the upper layer ranges from about 15 to 25 inches. The lower layer ranges in consistence and texture from friable silt loam to slightly firm silty clay loam. The finer texture is more common on the longer, smoother, and possibly older alluvial fans. The reaction ranges from slightly acid in the upper part of the profile to neutral in the lower part.

Judson silt loam, 2 to 5 percent slopes (JaB).—In some areas of this soil, natural drainage is somewhat poorer than in the representative profile described, and, in other areas, it is moderately good. The subsoil is dominantly dark grayish brown. Yellowish-brown mottles are common within 18 to 24 inches of the surface.

The larger areas are suitable for intensive cultivation, but this soil is usually cropped the same as adjacent soils. If this soil is cultivated, it may need tile to improve drainage or diversion terraces to help control runoff from adjacent slopes. Where runoff water concentrates, waterways should be kept in grass to help prevent gully erosion. (Capability subclass IIe.)

Judson silt loam, 5 to 9 percent slopes (JaC).—This soil is suitable for intensive cultivation in the larger areas, but it is usually cropped the same as adjacent soils. If it is cultivated, it may need tile to improve drainage or diversion terraces to help protect it from runoff from adjacent slopes. It should be cultivated on the contour to help control erosion. Where runoff water concentrates, waterways should be kept in grass to help prevent gullying. (Capability subclass IIIe.)

Kato series

The soils of the Kato series are dark colored and imperfectly drained. They formed from gritty silt loam or loam over sand and gravel. Most of the parent material was laid down by glacial melt water. These soils occur on nearly level glacial outwash terraces, chiefly along the Skunk and Des Moines Rivers. The native vegetation was prairie grass.

The Kato soils are moderately to highly fertile. They are slightly acid to medium acid in the upper layers. They are moderately to highly productive.

Two phases of Kato loam are mapped in Polk County. One is underlain by sand and gravel at depths of 24 to 30 inches, and the other, at depths of 36 to 60 inches.

KATO LOAM, MODERATELY DEEP OVER SAND AND GRAVEL

This is an inextensive soil. Because of the coarse sand and fine gravel at depths of 24 to 30 inches, it is somewhat droughty in dry seasons. It may need artificial drainage in some areas. It is moderately fertile. Under good management, it is moderately productive of corn, soybeans, and hay. The principal management problem is maintenance of fertility.

A representative profile of Kato loam, moderately deep over sand and gravel, follows.

- 0 to 8 inches, very dark gray, friable loam.
- 8 to 27 inches, dark grayish-brown, friable to slightly firm loam; faint brownish-yellow mottles.
- 27 to 48 inches +, mottled yellowish-brown and reddish-yellow gravelly loamy sand substratum; generally calcareous.

The substratum generally extends to depths of several feet. Its texture ranges from gravel to loamy sand. The depth to carbonates ranges from 2 to 5 feet.

Kato loam, moderately deep over sand and gravel, 1 to 3 percent slopes (KaA).—This soil can be used for a crop sequence of corn-corn-oats-meadow if the fertility is maintained. It is also suited to pasture. (Capability subclass IIs.)

KATO LOAM, DEEP OVER SAND AND GRAVEL

A representative profile of Kato loam, deep over sand and gravel, follows.

- 0 to 14 inches, very dark gray, friable loam.
- 14 to 38 inches, very dark grayish-brown, slightly firm loam; dark-gray and yellowish-brown mottles are common below a depth of 20 inches.
- 38 to 50 inches +, dark grayish-brown and reddish-yellow sand and gravel.

The texture of the surface soil and subsoil varies from loam to gritty slit loam. In some areas the texture of the subsoil is gritty silty clay loam or clay loam.

Kato loam, deep over sand and gravel, 1 to 3 percent slopes (KbA).—This soil is moderately to highly fertile. It is slightly wet in some areas, especially in those bordering the Marshan and other poorly drained soils. It has a somewhat lower water-holding capacity than the Nicollet soils but otherwise resembles them. Erosion is not a problem.

Under good management, this soil is highly productive of corn, soybeans, oats, and hay—the main crops grown. It is suited to a crop sequence in which corn is grown 2 years out of 3. If it is adequately fertilized, it can be kept productive for a long time. An alternative sequence is corn-corn-oats-meadow. (Capability class I.)

Ladoga series

The Ladoga series consists of moderately dark colored soils that developed from Wisconsin loess. Presumably the loess was calcareous when deposited; it is now neutral in reaction. Centuries ago, prairie grass grew on these soils, but trees later invaded. These soils, therefore, have some features of both prairie and forest soils. The slope range is 2 to 30 percent. Drainage is good in most places, but in some of the gently sloping areas it is moderately good to imperfect.

Ladoga soils occur in the southwestern part of the county, which is rolling to hilly. The boundary between the Ladoga soils and the Sharpsburg soils is gradual. Ladoga soils are similar to Downs soils but have slightly more clay in the subsoil.

The upper layers of these soils are medium acid to slightly acid. Erosion is a hazard, and the hazard increases in severity with increasing steepness of slope.

The gently and moderately sloping soils of this series are used for corn, oats, and meadow. Under good management, they are highly productive. The steeper phases are used mostly for pasture, but some areas are in woodland.

LADOGA SILT LOAM

A representative profile of Ladoga silt loam follows.

- 0 to 6 inches, very dark grayish-brown, friable silt loam.
- 6 to 9 inches, grayish-brown to dark grayish-brown, very friable silt loam.
- 9 to 36 inches, yellowish-brown, firm silty clay loam.
- 36 to 50 inches +, mixed brown, yellowish-brown, and brownish-gray, friable silt loam.

The thickness and color of the surface layer vary. The subsoil is somewhat less clayey on the steeper slopes than on the gentler slopes. The loess is 8 to 10 feet thick on the level areas, but it is only 3 to 4 feet thick on some of the steeper slopes.

Ladoga silt loam, 2 to 5 percent slopes (LaB).—The profile of this soil is like the representative profile of

Ladoga silt loam, except that the surface and subsurface layers are thicker in some places.

If this soil is contoured, a rotation of corn-corn-oats-meadow is suitable. If it is not contoured, a rotation of corn-oats-meadow-meadow is suggested. (Capability subclass IIe.)

Ladoga silt loam, 5 to 9 percent slopes, moderately eroded (LaC2).—A rotation of corn-oats-meadow-meadow is suggested if this soil is contoured. For fields that are terraced, corn-corn-oats-meadow is a suitable rotation. (Capability subclass IIIe.)

Ladoga silt loam, 9 to 14 percent slopes, moderately eroded (LaD2).—In some areas the combined thickness of the two upper layers of this soil is only 4 to 7 inches.

Corn-oats-meadow-meadow is a suitable rotation if this soil is stripcropped. For terraced fields, a rotation of corn-corn-oats-meadow-meadow is suggested. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Ladoga silt loam, 14 to 20 percent slopes, moderately eroded (LaE2).—The surface and subsurface layers of this soil are only 4 to 6 inches thick. This soil is best suited to hay, pasture, or woodland. (Capability subclass IVe.)

Ladoga silt loam, 20 to 30 percent slopes, moderately eroded (LaF2).—This soil has a profile that has thinner surface and subsurface layers than the representative profile of Ladoga silt loam. The depth to the parent material is 6 to 12 inches less than in the representative profile. This soil is best suited to woodland or pasture. (Capability subclass VIIe.)

LADOGA SOILS, SEVERELY ERODED

Ladoga soils, 5 to 9 percent slopes, severely eroded (LbC3).—The surface and subsurface layers of this unit are thinner than those in the representative profile of Ladoga silt loam. The combined thickness of the two surface layers is normally less than 4 inches. In some areas, mostly on slopes that have been cultivated intensively, the yellowish-brown subsoil is exposed. A rotation of corn-corn-oats-meadow is suitable for fields that are terraced if second-year corn is heavily fertilized. For fields that are contoured, a crop sequence of corn-oats-meadow-meadow is suggested. (Capability subclass IIIe.)

Lakeville series

The soils of the Lakeville series are sandy and gravelly and very droughty. They occur in small areas in the northern four-fifths of the county. The slopes range from 2 to 40 percent and are ordinarily short. The native vegetation was mainly prairie grass.

The parent material was deposited by the Late Wisconsin glacier, and it is variable from area to area and within any one area. The upper part includes sandy loam, gravelly loam, and some loam. The substratum ranges in texture from sand to gravel; it is generally calcareous and is commonly at very shallow depths.

These soils are low in fertility and productivity. They are excessively drained. Wind erosion is a problem on the sandier areas, and the hazard of water erosion increases in severity as the slopes increase in gradient. The more gently sloping areas are farmed along with Clarion loam and other adjacent soils. The steeper areas are used for pasture.

LAKEVILLE SANDY LOAM

Sandy loam is the dominant type in the Lakeville series. Included with the sandy loams are spots of gravelly loam and coarse loam. Some areas of Storden and Dickinson soils are included. Generally, the Lakeville soils contain more gravel than the Dickinson soils and are less acid. Very small areas of Lakeville sandy loam are shown on the soil map by sand and gravel symbols. A representative profile of Lakeville sandy loam follows.

- 0 to 6 inches, very dark grayish-brown, very friable sandy loam.
- 6 to 22 inches, brown, very friable, sandy loam containing considerable gravel.
- 22 to 60 inches +, pale-brown, calcareous, loose gravel and sand.

Lakeville sandy loam, 2 to 5 percent slopes (LcB).—The dark surface layer of this soil is about 8 inches thick. A sequence of corn-oats-meadow is suggested. An alternative crop is permanent alfalfa. Many areas are so small that they must be managed with the adjoining soils. Yields are likely to be low in most years. Crop residues should be left on the surface to reduce wind erosion. (Capability subclass IIIs.)

Lakeville sandy loam, 5 to 9 percent slopes, moderately eroded (LcC2).—The profile of this soil is about like the representative profile of Lakeville sandy loam, though the dark-colored surface layer is normally less than 6 inches thick and is lacking in some areas.

If this soil is cultivated on the contour, a crop sequence of corn-oats-meadow-meadow is suitable. A rotation of corn-oats-meadow is suitable for fields that are terraced. Yields are likely to be low in most years. An alternative crop is continuous alfalfa (reseeded when necessary). Crop residues should be left on the surface to reduce wind erosion. (Capability subclass IIIs.)

Lakeville sandy loam, 9 to 14 percent slopes, moderately eroded (LcD2).—The profile of this soil is similar to the representative profile of Lakeville sandy loam, except that the dark surface layer is generally less than 6 inches thick. In a few areas the subsoil is exposed. The best use for this soil is pasture. (Capability subclass VIs.)

Lakeville sandy loam, 14 to 20 percent slopes, moderately eroded (LcE2).—The profile of this soil is like the representative profile of Lakeville sandy loam, except that the dark-colored surface layer is less than 6 inches thick. The best use for this soil is pasture. Grazing should be restricted. (Capability subclass VIIs.)

Lakeville sandy loam, 20 to 40 percent slopes, moderately eroded (LcF2).—The profile of this soil is like the representative profile of Lakeville sandy loam, except that the dark-colored surface layer is less than 6 inches thick. The best use for this soil is pasture. Grazing should be restricted. (Capability subclass VIIs.)

Lamont series

The soils of the Lamont series are sandy and droughty. They formed under trees, a fact which accounts for the thinness of the surface layer. The parent material was wind-deposited fine sand and a very small amount of silt. Most of these materials were blown from the Des Moines River bottoms. The Lamont soils occur mainly in hilly areas on the eastern side of the Des Moines River, northwest of the city of Des Moines. Their slope range is 2 to 30 percent.

These soils are somewhat excessively drained and are very low in water-holding capacity. They are low in fertility. They are subject to wind and water erosion. Some of the gently sloping areas are used for corn, oats, and meadow although, even under good management, yields are low. The more strongly sloping areas are used for pasture or woodland.

LAMONT FINE SANDY LOAM

A representative profile of Lamont fine sandy loam follows.

- 0 to 4 inches, very dark grayish-brown, very friable fine sandy loam.
- 4 to 8 inches, grayish-brown, very friable fine sandy loam to loamy fine sand.
- 8 to 27 inches, yellowish-brown, friable fine sandy loam.
- 27 to 45 inches +, yellowish-brown, very friable to loose fine sandy loam to loamy fine sand.

The texture of the surface soil ranges from fine sandy loam to loamy fine sand. The texture of the subsoil ranges from fine sandy loam to loam. The sand substratum is leached of carbonates to a depth of more than 4 feet.

A few areas of loam are included with the fine sandy loams.

Lamont fine sandy loam, 2 to 5 percent slopes (LdB).—The profile of this soil is like the representative profile of Lamont fine sandy loam, except that the surface layer is about 6 inches thick.

A crop sequence such as corn-oats-meadow is suggested to maintain productivity. Crop residues should be left on the surface to help prevent wind erosion. Alternative crops are continuous alfalfa and winter grains. (Capability subclass IIs.)

Lamont fine sandy loam, 5 to 9 percent slopes (LdC).—The profile of this soil is about like the representative profile described for Lamont fine sandy loam. If this soil is contoured or stripcropped, a rotation of corn-oats-meadow-meadow is suggested. An alternative crop is a winter grain, such as rye or wheat. Crop residues should be left on the surface to help prevent wind erosion. If this soil is not needed for crops, it can be used for long-term pasture or as woodland. (Capability subclass IIIs.)

Lamont fine sandy loam, 9 to 14 percent slopes (LdD).—The profile of this soil is similar to the representative profile of Lamont fine sandy loam. Long-term pasture or woodland is the best use for this soil. (Capability subclass VIs.)

Lamont fine sandy loam, 14 to 20 percent slopes (LdE).—The profile of this soil is similar to the representative profile of Lamont fine sandy loam. Suitable uses for this soil are pasture and woodland. (Capability subclass VIIs.)

Lamont fine sandy loam, 20 to 30 percent slopes (LdF).—The profile of this soil is similar to the representative profile of Lamont fine sandy loam. Woodland is the most suitable use for this soil. (Capability subclass VIIs.)

Lester series

The soils of the Lester series are moderately dark-colored, well-drained soils that formed from Cary glacial till of loam texture. They occur in the northern four-fifths of the county, in the uplands adjacent to the Des Moines and Skunk Rivers. In most areas they are adjacent to LeSueur, Clarion, or Hayden soils. The slope range is 0 to 40 percent. Centuries ago, the native vegetation was prairie grass; later trees encroached. Consequently, these soils have features of both prairie and forest soils.

These soils have good water-holding capacity and are moderately fertile. The upper layers of the profile are medium acid. Under good management, the gently sloping areas are highly productive of corn, oats, and meadow, which are the chief crops grown. The more strongly sloping areas are used for pasture and woodland.

LESTER LOAM

In some areas, Lester loams occur close to Crocker and Lamont soils. In these areas the texture of the surface soil is sandy loam. Spots of sandy loam are included in some of the loam map units.

A representative profile of Lester loam follows.

- 0 to 6 inches, very dark grayish-brown, friable loam.
- 6 to 9 inches, dark grayish-brown, friable loam.
- 9 to 36 inches, dark yellowish-brown, firm loam to light clay loam.
- 36 to 48 inches +, mottled yellowish-brown and light brownish-gray, friable loam; generally calcareous below depths of 40 inches.

The surface soil ranges in color from very dark brown to very dark gray, and in thickness from 4 to 9 inches. In some areas sandy loam and loam are mixed. The subsurface layer is 2 to 6 inches thick. The depth to calcareous till ranges from 30 to 50 inches. The subsoil is light clay loam in the nearly level areas, and loam on the steeper areas. In the nearly level areas it is grayer and more weakly mottled and is somewhat like the subsoil of the LeSueur soils. The depth to carbonates is less on the steeper slopes.

Lester loam, 0 to 2 percent slopes (LeA).—The profile of this soil resembles the representative profile, except that the dark-colored surface layer is a few inches thicker. Some areas are wet at times and might benefit from tile drainage.

With a crop sequence of corn for 2 years followed by oats for green manure, productivity can be maintained if enough fertilizer is used, including plenty of nitrogen for the second year of corn. An alternative crop sequence is corn-soybeans-corn-oats-meadow. (Capability class I.)

Lester loam, 2 to 5 percent slopes (LeB).—This soil is similar to the Lester loam described in the representative profile.

If this soil is contoured, a rotation of corn-soybeans-corn-oats-meadow is suggested. If it is not contoured, corn-corn-oats-meadow-meadow is a suitable rotation. (Capability subclass IIe.)

Lester loam, 2 to 5 percent slopes, moderately eroded (LeB2).—The combined thickness of the upper two layers of this soil is only 5 to 8 inches. In some areas the yellowish-brown subsoil is exposed.

If this soil is contoured, a rotation of corn-soybeans-corn-oats-meadow is suggested. If it is not contoured, corn-corn-oats-meadow-meadow is a suitable rotation. (Capability subclass IIe.)

Lester loam, 5 to 9 percent slopes, moderately eroded (LeC2).—The combined thickness of the upper two layers of this soil is only 4 to 8 inches.

A rotation of corn-corn-oats-meadow-meadow is suitable if this soil is contoured. If it is not contoured, a rotation of corn-oats-meadow-meadow-meadow is suggested. Corn-corn-oats-meadow is a suitable rotation if the soil is terraced and heavily fertilized. (Capability subclass IIIe.)

Lester loam, 9 to 14 percent slopes, moderately eroded (LeD2).—The profile of this soil is similar to the representative profile of Lester loam.

If this soil is terraced, a rotation of corn-corn-oats-meadow-meadow is suitable. An alternative use is pasture. (Capability subclass IIIe.)

Lester loam, 14 to 20 percent slopes, moderately eroded (LeE2).—The surface layer of this soil is between 3 and 6 inches thick. There are included areas that have thicker topsoils and are not eroded. The average depth to calcareous material is between 30 and 36 inches.

The most suitable uses for this soil are long-term hay, pasture, and woodland. (Capability subclass IVe.)

Lester loam, 20 to 40 percent slopes (LeF).—The surface layer of this soil is only 3 to 6 inches thick. Areas are included where the surface layer is thicker and where little or no accelerated erosion has taken place. There is less clay in the subsoil than in the subsoil in the representative profile. The average depth to calcareous material is between 30 and 36 inches.

This soil is best suited to woodland. If it is used for pasture, grazing should be limited so that enough vegetation remains on the soil to help prevent erosion. (Capability subclass VIIe.)

LESTER SOILS, SEVERELY ERODED

Lester soils, 5 to 9 percent slopes, severely eroded (LfC3).—The combined thickness of the upper two layers of this unit is less than 6 inches. In a number of small areas, the subsoil is exposed.

An important step in improving and conserving these eroded soils is a good fertilization program. If this unit is contoured, a rotation of corn-oats-meadow-meadow is suitable. If the soils are terraced, a rotation of corn-oats-meadow is suggested. (Capability subclass IIIe.)

Lester soils, 9 to 14 percent slopes, severely eroded (LfD3).—The yellowish-brown subsoil of this unit is exposed in a number of small patches, mostly on sharply rounded slopes that have been cultivated intensively. The depth of leaching is less than in the profile described. It averages between 30 and 36 inches.

This unit is suitable for only limited cultivation. Its best use is probably permanent hay or pasture. (Capability subclass IVe.)

Lester-Colo complex

This complex consists mainly of Lester loam, 14 to 40 percent slopes, and Colo silty clay loam, 0 to 2 percent slopes. The Colo soil occurs on narrow bottom lands between steep slopes of Lester soil. Small areas of Hayden loam, Terril loam, and Huntsville silt loam are included.

The steep areas and the narrow bottom lands are so closely intermixed that most areas of this complex are used for pasture or woodland. Preventing erosion is the main management problem.

Lester-Colo complex, 0 to 20 percent slopes (LgE).—This complex is suited to hay, pasture, or woodland. (Capability subclass IVe.)

Lester-Colo complex, 0 to 40 percent slopes (LgF).—This complex is best suited to woodland. If it is used for pasture, grazing should be limited so that a good vegetative cover can be maintained to help prevent erosion. (Capability subclass VIIe.)

LeSueur series

The LeSueur series consists of moderately dark colored, imperfectly drained soils that developed in Cary glacial till of loam texture. These soils occur in the uplands in the northern four-fifths of the county, near the Skunk and Des Moines Rivers. They are associated with Lester, Nicollet, Webster, and Hayden soils. Centuries ago, the LeSueur soils were covered by prairie grass; later, trees encroached. Consequently, these soils have characteristics of both prairie and forest soils.

These soils are moderately fertile. The upper layers are medium acid. Where the adjacent soils are steep, these soils are used for pasture, but in most areas they are cultivated. Under good management, they are moderately to highly productive of corn, soybeans, oats, and meadow. Some areas are slightly wet and may need tile drainage.

LeSUEUR LOAM

A representative profile of LeSueur loam follows.

- 0 to 8 inches, very dark gray, friable loam.
- 8 to 11 inches, dark-gray, friable loam.
- 11 to 33 inches, dark grayish-brown, firm, light clay loam; strong-brown mottles are common.
- 33 to 48 inches +, mottled light brownish-gray and yellowish-brown, friable loam; generally calcareous below a depth of 40 inches.

The surface layer ranges from 5 to 10 inches in thickness and from very dark brown to very dark gray in color. The subsurface layer ranges from very dark gray to dark gray in color and from 2 to 6 inches in thickness. The depth to carbonates ranges from 2½ to 4 feet.

LeSueur loam, 1 to 3 percent slopes (LhA).—The profile of this soil is similar to the representative profile of LeSueur loam.

A crop sequence of corn-corn-oats (green manure) is suitable for this soil if enough fertilizer is used, including plenty of nitrogen for the second year of corn. An alternative sequence is corn-soybeans-corn-oats-meadow. (Capability class I.)

Lindley series

The soils of the Lindley series are well drained and light colored and have clayey subsoils. They occur in the hilly uplands, mainly in the southeastern part of the county. The slope range is 9 to 40 percent.

These soils formed under forest. Partly because of that, they have a thin surface layer. The parent material was Kansan glacial till.

The Lindley soils are low in fertility. The upper layers are moderately acid. The water-holding capacity is good. Some areas are cropped to corn, oats, and meadow, but yields are not high, even under good management. The steeper areas are used chiefly for pasture or woodland. The erosion hazard is severe to extreme because the subsoil is fine textured and slowly permeable and the vegetation in cultivated areas is usually poor.

LINDLEY LOAM

A representative profile of Lindley loam follows.

- 0 to 4 inches, dark grayish-brown, friable loam.
- 4 to 8 inches, grayish-brown, friable loam.
- 8 to 36 inches, yellowish-brown, very firm gritty silty clay mottled with brown, reddish brown, and brownish yellow.
- 36 to 50 inches, mottled yellowish-brown and reddish-yellow, firm clay loam.

These soils have considerable variation in the texture and color of the subsoil. On slopes of 9 to about 15 percent, the subsoil is reddish and finer textured than that in the representative profile described. It contains, in the upper part, small stones and pebbles that were left after geologic erosion of one of the former soils. The Lindley soils in these places were, like the Adair soils, partly formed several thousand years before the Wisconsin loess and the Cary drift were deposited. The soils were buried by the loess and later reexposed by geologic erosion. Thus, they have been weathering for a much longer period than the Hayden or Fayette soils, and this fact accounts, at least in part, for the fine texture of the subsoil. This reddish subsoil has been called ferrettotil by glacial geologists. In a few areas gumbotil-like material is present. In the area of Fayette and Lindley soils in the southeastern part of the county, one can see in deep road cuts how the reddish subsoil occurs at the surface, then continues beneath the loess.

On slopes of 25 to 40 percent, the color of the subsoil is normally yellowish brown and its texture is clay loam rather than silty clay. In these places the Lindley soils resemble the Hayden soils. Presumably, the older Lindley soils, which had reddish subsoils, were removed from these steeper slopes by geologic erosion, along with the overlying loess; then the processes of soil formation began again and the Lindley soils with yellowish-brown, firm clay loam subsoils developed. The Kansan till from which the Lindley soils developed is thin. In many places it is only 4 to 8 feet thick over the shale bedrock.

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Lindley loam, 9 to 14 percent slopes, moderately eroded (LkD2).—The profile of this soil is similar to the representative profile of Lindley loam.

If this soil is needed for crops, it can be used for a small grain followed by several years of meadow. If it is contour stripcropped and well fertilized, corn can be grown once in 5 or 6 years, but long-term hay, pasture, or woodland are better uses. (Capability subclass IVe.)

Lindley loam, 14 to 20 percent slopes, moderately eroded (LkE2).—The profile of this soil is similar to the representative profile of Lindley loam, except that the subsoil is generally clay loam rather than gritty silty clay. Long-term pasture or woodland are suitable uses. (Capability subclass VIe.)

LINDLEY SOILS, ERODED

Lindley soils, 9 to 14 percent slopes, severely eroded (LmD3).—The average thickness of the surface layer of this unit is less than 4 inches. In some small spots, the subsoil is exposed. Long-term pasture and woodland are suitable uses for this unit. (Capability subclass VIe.)

Lindley soils, 14 to 20 percent slopes, severely eroded (LmE3).—The average thickness of the surface layer of this unit is less than 4 inches. In some areas, the subsoil is exposed. The subsoil is usually clay loam rather than silty clay. Woodland and pasture are the most suitable uses for this unit. (Capability subclass VIIe.)

Lindley soils, 20 to 40 percent slopes, moderately eroded (LmF2).—Woodland and pasture are the most suitable uses for this unit. (Capability subclass VIIe.)

Marshan series

The Marshan series consists of dark-colored, poorly drained soils that are underlain by sand and gravel. The slope range is 0 to 2 percent. These soils occur mainly on the glacial outwash terraces along the Skunk and Des Moines Rivers. They formed from glacial outwash that was deposited when the Late Wisconsin glaciers were melting. The native vegetation was prairie grass and some sedges.

The upper layers of the profile are slightly acid to neutral; the lower part of the subsoil and the substratum are generally calcareous. These soils are moderately to highly fertile and, under good management, are highly productive of corn, soybeans, and oats—the main crops grown.

Most areas are artificially drained, but some areas need drainage improvement, especially those that are in slight depressions. The sand and gravel in the substratum make it hard to install tile drains; the banks are likely to cave in.

MARSHAN SILTY CLAY LOAM, DEEP OVER SAND AND GRAVEL

A representative profile of Marshan silty clay loam, deep over sand and gravel, follows.

- 0 to 16 inches, black, slightly firm silty clay loam.
- 16 to 32 inches, dark grayish-brown and olive-gray, firm silty clay loam.

32 to 45 inches, olive-gray, slightly firm to firm silty clay loam; generally calcareous.
45 to 60 inches +, olive-gray, stratified sand and gravel.

The surface layer is generally slightly acid in reaction, though a few areas are calcareous. In some places the texture of the subsoil is clay loam or loam. In a few areas it borders on silty clay.

Marshan silty clay loam, deep over sand and gravel (Mb).—The profile of this soil is similar to the representative profile described, except that the depth to the coarse-textured substratum varies from 30 inches to more than 60 inches.

If artificially drained and adequately fertilized, this soil can be cropped intensively. Generally, nitrogen should be applied for the second year of corn. A suggested rotation is corn for 2 years, followed by oats seeded with a legume for green manure. Legume-grass meadows will help maintain the granular structure and good tilth of the plow layer. Areas that cannot be artificially drained are suitable for pasture. (Capability subclass IIw.)

MARSHAN SILTY CLAY LOAM, MODERATELY DEEP OVER SAND AND GRAVEL

Marshan silty clay loam, moderately deep over sand and gravel (Ma).—In this soil the sand and gravel occur 24 to 36 inches below the surface. The subsoil is coarser textured and less clayey and plastic than that in the representative profile. The texture of the subsoil is light clay loam or loam.

This soil is somewhat more droughty than the deep phase and is less productive in very dry seasons. Nevertheless, it can be cropped intensively if artificially drained and adequately fertilized. A suggested crop sequence is corn for 2 years, followed by oats seeded with a legume for green manure. Areas that cannot be drained artificially are suitable for pasture. Legume-grass mixtures in the rotation will help preserve the granular structure of the plow layer. (Capability subclass IIw.)

Muck

Muck is very poorly drained. It occurs in shallow depressions in the northern part of the county. It is high in organic matter. Two phases are mapped—the very shallow phase, which has a 6- to 18-inch surface layer, and the moderately shallow phase, which has an 18- to 42-inch surface layer.

Many areas of Muck are too wet for cropping and some are ponded at times. Artificial drainage is needed. Because Muck is in depressions, it may be necessary to place the tile at considerable depth in order to obtain satisfactory outlets. Muck is very productive in some years, but average yields of grain crops are rather low. Legumes are likely to be winter-killed, and oats are likely to lodge. In some seasons, corn and soybeans do moderately well.

The reaction varies from slightly acid to slightly calcareous. Fertilizer needs should be determined by soil tests.

MUCK

The following profile is representative of Muck, moderately shallow.

0 to 27 inches, black muck; loose and very friable.
27 to 48 inches, dark olive-gray, firm to slightly firm silty clay loam.

The lower, or mineral, layer ranges in texture from friable silty clay loam to firm silty clay.

Muck, moderately shallow (Md).—This unit is not well suited to small grains or hay. If it is artificially drained, it is moderately well suited to intensive cropping to corn, soybeans, and potatoes. Drainage can be improved by tile or surface drains if outlets are available. Crops are likely to be damaged by early frosts. (Capability subclass IIIw.)

Muck, very shallow (Mc).—This unit is not well suited to small grains or hay. If artificially drained, it is suited to intensive cropping to corn and possibly potatoes. Drainage can be improved by tile or surface drains if outlets are available. Crops are likely to be damaged by early frosts. (Capability subclass IIIw.)

Muscatine series

The soils of the Muscatine series, like those of the Tama series, developed from thick loess of Late Wisconsin age. They have a dark-colored surface layer. The native vegetation was prairie grass. The slope range is 1 to 3 percent. Drainage is imperfect to moderately good.

Muscatine soils occur on uplands in the southeastern part of Polk County. Figure 8 shows their position on the landscape in relation to other soils.

These soils have a good water-holding capacity. The upper layers of the profile are slightly acid to medium acid. Fertility is moderate to high. Under good management, these soils are highly productive of corn, soybeans, oats, and meadow—the main crops grown. There is only a slight erosion hazard.

In most areas the Muscatine soils can be farmed without tile drainage, although in some areas tile may improve yields.

MUSCATINE SILT LOAM

A representative profile of Muscatine silt loam follows.

0 to 16 inches, very dark brown, friable silt loam.
16 to 35 inches, very dark gray to variegated brown and yellowish-brown, slightly firm silty clay loam.
35 to 60 inches +, variegated yellowish-brown and strong-brown, friable silt loam.

Compared with many other soils, the Muscatine soils are fairly uniform. They have some variation in characteristics, however. Drainage is moderately good on slopes of 2 or 3 percent, where this soil borders Tama soils. In nearly level areas, drainage is imperfect. Where the Muscatine soils grade toward the Atterberry soils, the surface layer is very dark gray. Ordinarily, the parent material is leached of carbonates, though presumably it was calcareous when deposited.

Muscatine silt loam, 1 to 3 percent slopes (MeA).—This soil can be cropped intensively and still be kept productive if it is adequately fertilized. If corn is grown 2 years out of 3, extra nitrogen is needed. A suitable crop sequence for less intensive use is corn-corn-oats-meadow. If extra nitrogen fertilizer is not available for the second year of corn, a sequence of corn-oats-meadow can be used. (Capability class I.)

Nicollet series

The Nicollet series consists of dark-colored soils that developed from friable, calcareous loam till deposited by the Cary glacier. These soils formed under prairie vegetation. They are moderately well drained to imperfectly drained.

Nicollet soils occur on uplands in the northern four-fifths of the county, generally adjacent to or between the well-drained Clarion and the poorly drained Webster soils (fig. 7).

These soils have good water-holding capacity. They are similar to the Muscatine soils, but, because they contain more sand, they have slightly lower water-holding capacity and potassium-supplying capacity than the Muscatine soils. The upper layers of the profile are slightly acid. There is only a slight erosion hazard.

Nicollet soils are moderately to highly fertile and, under good management, are highly productive of corn, soybeans, oats, and meadow—the main crops grown. Some of the nearly level areas that border Webster soils may need tile drainage for the best growth of corn and alfalfa.

NICOLLET LOAM

A representative profile of Nicollet loam follows.

- 0 to 14 inches, very dark brown, slightly firm loam.
- 14 to 32 inches, very dark grayish-brown, slightly firm clay loam.
- 32 to 50 inches +, mottled yellowish-brown and strong-brown, friable loam.

The surface layer includes sandy loam, loam, clay loam, and silt loam, but it is dominantly loam bordering on clay loam. The color of the subsoil ranges from the dark brown of the Clarion to the olive gray of the Webster soils. The depth to calcareous material ranges from 30 to 45 inches. There are a few pockets or lenses of sand.

Nicollet loam, 1 to 3 percent slopes (NaA).—This soil can be cropped intensively. It can be used for corn or soybeans 2 years out of 3 and still be kept productive if plenty of extra nitrogen is applied for corn and if the fertilization program is otherwise adequate. An alternative, less intensive, sequence is corn-corn-oats-meadow. This sequence also requires extra nitrogen for the second year of corn. (Capability class I.)

Nodaway series

The Nodaway series consists of moderately well drained to imperfectly drained, slightly acid, light-colored soils formed from recently deposited, medium-textured alluvium. The slope range is 0 to 2 percent. These soils occupy bottom lands along the rivers and creeks. They are subject to flooding, and each flood deposits fresh sediment.

These soils are moderately fertile. Under good management, if they are not too frequently or severely flooded, they are highly productive of corn and soybeans. Use of individual areas depends on the overflow hazard. Many areas need protection from flooding. In some areas, small levees or dikes have been built.

NODAWAY SILT LOAM

A representative profile of Nodaway silt loam follows.

- 0 to 40 inches, dark grayish-brown, friable silt loam.
- 40 to 60 inches, black, slightly firm silty clay loam.

The texture ranges from loam to friable silty clay loam, though gritty silt loam is dominant. Lenses and layers of fine sand and silty clay, both dark gray and light gray, are common.

The black layer is a buried soil. In most places it is similar to Colo silty clay loam, but in a few places it is similar to Wabash silt loam. In a few places there is no black layer. Inclusions of Dorchester and Huntsville soils occur in a few areas.

Nodaway silt loam (Nb).—Many areas of this soil are narrow strips along streams and cannot be managed separately. The areas that can be farmed separately from the uplands and can be protected from floods are suitable for intensive cropping. A suggested rotation is corn for 2 years, followed by oats seeded with a legume for green manure. Nitrogen fertilizer probably will increase corn yields. (Capability class I.)

Okoboji series

The soils of the Okoboji series are very poorly drained, dark-colored soils. They occupy potholes and depressions in the uplands in the northern four-fifths of the county. Probably most of these areas were sloughs, ponds, or shallow lakes before tile systems, drainage ditches, and graded roads were constructed. The Okoboji soils, like the Glencoe soils, are commonly rimmed with Harpster soils. The parent material is local alluvium. The native vegetation was wet-prairie grass.

The Okoboji soils need artificial drainage for some crops, particularly for corn and soybeans. Most areas become ponded in wet periods unless they have artificial surface drainage.

OKOBOJI SILT LOAM

A representative profile of Okoboji silt loam follows.

- 0 to 25 inches, black, friable silt loam.
- 25 to 35 inches, grayish-brown, slightly firm silt loam.
- 35 to 45 inches, mottled grayish-brown and olive-gray, slightly firm silty clay loam.

The surface texture ranges from mucky silt loam to slightly firm silty clay loam. The thickness of the surface layer ranges from 15 to 30 inches. The depth to carbonates ranges from 0 to about 48 inches. The upper layers of the profile are neutral to slightly alkaline. In a few areas the surface layer is slightly calcareous.

Okoboji silt loam (Oa).—This soil occurs mostly in small areas that cannot be cropped separately from the surrounding soils. It can be used and managed in about the same way as the Nicollet and Webster soils, with which it is associated on the landscape. If it can be adequately drained, it is suited to an intensive crop sequence, such as corn for 2 years, followed by oats seeded with a legume for green manure. It is poorly suited to legume meadows because winterkilling is common. (Capability subclass IIIw.)

Olmitz series

The Olmitz series consists of dark-colored soils that occur at the base of slopes and on fans, mainly in the steeper sections of the southeastern part of the county. Generally these soils lie below the side slopes occupied by the Gara and Shelby soils. The slope range is 0 to 9 percent.

OLMITZ LOAM

The parent material of the Olmitz loams is chiefly local alluvium washed from adjacent, higher lying slopes. Presumably, the alluvium was laid down slowly over many centuries. In some areas, however, sediment a foot or more thick has recently been deposited. The Olmitz loams formed mainly under prairie grass. Trees have encroached in a few scattered areas.

Generally, the Olmitz loams are moderately well drained, but some of the lower lying areas are somewhat poorly drained and may need artificial drainage. Most areas receive runoff water from higher lying slopes. Where this water accumulates, gullies form. The upper layers of the profile are slightly acid to moderately acid. The lower layers are neutral to alkaline.

Under good management, these soils produce high yields of corn, oats, hay, and other crops. The individual areas are small and are used in the same way as the adjacent soils. Cultivated areas need diversion terraces to protect them from runoff from the bordering slopes. They may also need grassed waterways to prevent gullying.

A representative profile of Olmitz loam follows.

- 0 to 20 inches, very dark brown, friable loam.
- 20 to 30 inches, dark grayish-brown, slightly firm loam.
- 30 to 50 inches +, grayish-brown, friable loam.

The surface layer ranges in color from very dark grayish brown to very dark brown. It ranges in thickness from 9 to 20 inches. Friable silty clay loam is found, in some areas, in the surface soil and the subsoil.

Olmitz loam, 2 to 5 percent slopes (ObB).—This soil is somewhat poorly drained. It is suitable for fairly intensive cultivation. Row crops can be grown 2 years out of 3. Tile drains may be needed for cultivated areas. (Capability subclass IIe.)

Olmitz loam, 5 to 9 percent slopes (ObC).—This soil is similar to the representative profile of Olmitz loam. It is well suited to cultivation. However, if it is cropped intensively, it has a slight erosion hazard. (Capability subclass IIIe.)

OLMITZ SANDY LOAM

The profile of Olmitz sandy loam is sandier throughout than the representative profile of Olmitz loam.

Olmitz sandy loam, 0 to 2 percent slopes (OcA).—This soil has a lighter colored and thinner surface layer than the Olmitz loams and a less well developed subsoil. It may be wet late in spring because of runoff from upland slopes. It is low in fertility and has a lower moisture-holding capacity than Olmitz loams.

Most of this soil occurs in small areas and is commonly cropped along with the adjacent soils. A rotation of corn-oats-meadow is suggested for the larger areas. Yields are likely to be low in dry periods. Cultivated areas may need tile drains and diversion terraces. (Capability subclass IIs.)

Olmitz sandy loam, 2 to 5 percent slopes (OcB).—This soil is similar to Olmitz sandy loam, 0 to 2 percent slopes, and requires similar management. (Capability subclass IIs.)

Peat

This very poorly drained organic soil occurs in depressions in Cary glacial till in the northern four-fifths of the county. It consists of an accumulation of partly decomposed swamp plants. The stems and roots are recognizable. The Peat in Polk County is normally high in lime.

Areas that are artificially drained are used for corn, potatoes, and some truck crops. The undrained areas are used for pasture or are idle.

PEAT

A representative profile of Peat follows.

- 0 to 30 inches, black to very dark brown, very loose peat.
- 30 to 50 inches +, dark olive-gray to olive, firm silty clay loam.

The peat layer is 18 to 48 inches thick. The lower layer ranges from silt loam to silty clay in texture. The reaction ranges from neutral to alkaline.

Peat (Pa).—This soil is not well suited to small grains or hay. It is suited to continuous corn or to truck crops if adequately fertilized and drained. Yields are likely to be low in extremely wet years. If tile drains are used, the tile should be placed below the peat layer. Pasture is a suitable use for areas that cannot be drained artificially. (Capability subclass IIIw.)

Riverwash

This land type consists of freshly deposited sand or sandy loam unaffected by soil development processes. It occurs along rivers and creeks and is flooded in every period of high water. Except for some willows, it has no plant cover.

The areas along the Des Moines River are calcareous, but those along other rivers and creeks in this county ordinarily are not calcareous.

Riverwash (Ra).—This is the only Riverwash unit mapped in Polk County. It is not a true soil. (Capability subclass VIIs.)

Rolfe series

The Rolfe series consists of poorly drained, dark-colored soils that occupy potholes and shallow depressions. These soils occur mainly in the uplands in the northern four-fifths of the county. There are a few areas on the glacial terraces of the Des Moines River; these are mapped as a bench-position phase. The Rolfe soils in the uplands formed from local alluvium washed in past centuries from the adjacent slopes. The bench-position soils formed from glacial outwash that was deposited on the natural terraces. The native vegetation was wet-prairie grass.

The upper layers of the profile are medium acid, and the lower layers are slightly acid to neutral. The water-holding capacity is good. These soils are wet in many seasons unless artificially drained. Tile drains do not function well, because of the slowly permeable subsoil. Surface drains may be needed.

The Rolfe soils are somewhat low in fertility. Even under good management, they are only moderately productive of corn and soybeans, which are the main crops grown.

The Rolfe soils are generally similar to the Glencoe and Okoboji soils in landscape position and to the Blockton and Ames soils in arrangement, color, and texture of the upper layers of the profile. The Ames soils, however, were influenced somewhat by forest vegetation. The Rolfe soils have a more prominent gray subsurface layer and a more friable, more permeable substratum than the Blockton soils.

ROLFE LOAM

A representative profile of Rolfe loam follows.

0 to 6 inches, black to very dark gray, friable loam.
6 to 12 inches, dark-gray to gray, friable loam.
12 to 33 inches, dark-gray, firm to very firm clay loam bordering on a gritty silty clay; yellowish brown and olive gray in the lower part.
33 to 48 inches, firm to slightly firm loam; thin lenses of sand and fine gravel are common.

The surface layer ranges up to 15 inches in thickness. The subsurface layer varies in color and thickness. The genesis of this profile seems to be related to the permeable sandy lenses in the lower part. These lenses, it is thought, allowed water to drain through the profile, causing it to become slightly acid to medium acid, after which some of its clay, under the slight acidity, moved from the upper layers into the subsoil. In the bench-position phase, the sand-and-gravel substratum is commonly thicker and more nearly continuous than in the upland phase.

Rolfe loam (Rb).—This soil generally occurs in small areas. Ordinarily it cannot be managed separately from the Webster, Nicollet, and Clarion soils with which it is associated on the landscape. If it is fertilized, it can be used for intensive row cropping, but it will yield less than the surrounding soils. Surface and tile drainage are needed in most areas. Surface intakes may also be needed. (Capability subclass IIIw.)

Rolfe loam, bench position (Rc).—This soil ordinarily has layers of stratified sand and gravel within 3 to 6 feet of the surface. In addition to the problems of wetness and possible difficulties with tile drainage due to the "tight," slowly to very slowly permeable subsoil, there is also a slight flood hazard.

This soil can be used for crop sequences in which row crops are grown half of the time or even 2 years out of 3. Yields will be lower than on the adjoining Marshan and Kato soils. (Capability subclass IIIw.)

Runnells series

The Runnells series consists of well-drained, moderately dark colored soils. These soils developed from loess underlain, in most places, by shale. They occur in hilly areas in the southeastern part of the county. They are commonly associated on the landscape with the Lindley, Downs, and Gosport soils. Their slope range is 5 to 40 percent. Like the Downs soils, the Runnells soils formed under mixed prairie-forest vegetation. Nevertheless, in some areas, they have features of a soil developed wholly under forest.

Weathered shale generally lies at depths of 18 to 30 inches. In many areas a gritty silty clay layer, a few inches thick, is found between the shale and the loess. This layer is thought to be a remnant of Kansan glacial till, which must have covered the shale before the loess was deposited. It is somewhat like the subsoil of the Lindley soils. The shale is somewhat like the substratum of the Gosport and Bauer soils.

These soils are medium acid throughout. They have good water-holding capacity. Because of the steep slopes and the very slowly permeable substratum, they have a rather serious erosion hazard. They are moderately low in fertility. The moderately steep slopes are used for corn, oats, and meadow and, under good management, are moderately productive. The steeper slopes are used for pasture or woodland.

RUNNELLS SILT LOAM

A representative profile of Runnells silt loam follows.

0 to 12 inches, very dark gray to very dark grayish-brown, friable silt loam.
12 to 20 inches, yellowish-brown, slightly firm silty clay loam.
20 to 32 inches, yellowish-brown, mottled with reddish brown, very firm, gritty silty clay (till); gravelly material is common in the upper part.
32 to 50 inches +, yellowish-brown, very firm silty clay (shale).

The thickness of the surface layer ranges from 4 to 12 inches. The thickness of the loess ranges from 12 to 36 inches. In many areas there is a 10- to 15-inch layer of reddish-brown, weathered glacial till between the loess and the shale. The loess rests directly on the shale in other areas.

Runnells silt loam, 5 to 9 percent slopes, moderately eroded (RdC2).—If this soil is contoured, a crop sequence of corn-oats-meadow-meadow can be used. This will keep erosion losses to a reasonable minimum. Terracing may not be feasible, because of the impermeable shale subsoil. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Runnells silt loam, 9 to 14 percent slopes, moderately eroded (RdD2).—This soil is suitable for only limited cultivation. It is better suited to permanent hay or pasture than to cultivated crops. (Capability subclass IVe.)

Runnells silt loam, 14 to 20 percent slopes, moderately eroded (RdE2).—The surface layer of this soil is a little thinner than that in the representative profile of Runnells silt loam. However, included are some uneroded tree-covered areas in which the surface layer is 8 to 12 inches thick. The most suitable uses for this soil are pasture and woodland. (Capability subclass VIe.)

Runnells silt loam, 20 to 40 percent slopes, moderately eroded (RdF2).—The surface layer of this soil is slightly thinner than that in the representative profile of Runnells silt loam. However, some areas of uneroded soils that have thicker surface layers have been included. The layer of loess from which these soils developed is about 18 to 21 inches thick.

This soil is very susceptible to gullying. Woodland is the most suitable use for it. (Capability subclass VIIe.)

RUNNELLS SOILS, SEVERELY ERODED

Runnells soils, 9 to 14 percent slopes, severely eroded (ReD3).—The surface layer averages less than 4 inches thick. Many small patches of the yellowish-brown silty clay loam subsoil are exposed. There are numerous small gullies, which are crossable with farm machinery. Long-term hay and pasture are the most suitable uses for these soils. (Capability subclass IVe.)

Sarpy series

The Sarpy series consists of sandy, extremely droughty soils on bottom lands. These soils occur on the flood plain near the banks of the Des Moines River, with Dorchester soils and Riverwash. They have slopes of 2 percent or less. The flood hazard is serious.

River sand, in some places reworked by wind, was the parent material. Each flood deposits more sand. Trees, shrubs, and prairies grasses are the native vegetation.

The Sarpy soils are low in water-holding capacity. They are low in fertility and are not productive of corn and other row crops. Areas that are not frequently flooded are used for grain crops or meadow. Other areas are used for pasture or woodland or are idle.

SARPY LOAMY SAND

A representative profile of Sarpy loamy sand follows.

0 to 6 inches, grayish-brown, loose, calcareous loamy sand.
6 to 40 inches +, pale-brown to light-gray, loose, calcareous loamy sand or sand.

Generally the texture ranges from sand to loamy sand, but there are some areas of sandy loam. A few areas are neutral in reaction.

Sarpy loamy sand (Sa).—This soil generally occupies small areas. It is commonly cropped along with the surrounding soils, although it is poorly suited to cultivation because it is so droughty. It is best suited to hay or pasture. (Capability subclass IIIs.)

Saylor series

The Saylor series consists of dark-colored sandy soils that are moderately well drained to imperfectly drained. These soils have slopes of 0 to 2 percent. They occur on glacial outwash and stream terraces, mainly along the Des Moines River. They are commonly associated with Dickinson sandy loam, bench position. The parent material was sandy glacial outwash or sandy alluvium. The native vegetation was chiefly prairie grass.

The upper layers of the profile are medium acid, and the lower layers are neutral. The water-holding capacity is low. However, these soils are ordinarily less droughty than Dickinson sandy loam, bench position, as the lower substratum can supply some water to plants. Some areas may need to be drained. This must be done with caution because excessive tiling might cause the soils to become more droughty.

The Saylor soils are moderately low in fertility. Even under good management, yields of corn will be somewhat low because of moisture shortage. Water erosion is not a hazard, but wind erosion may be a hazard occasionally.

SAYLOR FINE SANDY LOAM

A representative profile of Saylor fine sandy loam follows.

0 to 16 inches, very dark gray to very dark brown, friable fine sandy loam.
16 to 30 inches, very dark grayish-brown, friable fine sandy loam to sandy loam; fine mottles of strong brown.
30 to 45 inches +, mottled strong-brown and brown, very friable sandy loam.

Textures in the surface layer include sandy loam, fine sandy loam, and loam. The subsoil layer ranges in color from mottled dark brown to highly mottled dark grayish brown and gray. The lowest layer in the profile ranges in texture from loamy sand to sandy loam. It is commonly stratified and includes some fine gravel.

Saylor fine sandy loam, 0 to 2 percent slopes (SbA).—Suggested crop sequences for this soil are corn-corn-oats-meadow or corn-oats-meadow. For good yields of second-year corn, extra nitrogen is required. Tillage practices that leave crop residues on the surface will help to prevent wind erosion. If this soil is not needed for crops or if it is considered too droughty to be suitable for crops, it can be used for pasture. (Capability subclass IIs.)

Sharpsburg series

The Sharpsburg series consists of dark-colored, moderately well drained soils that developed from loess. These soils have slopes of 0 to 20 percent. They occur in the southwestern part of the county. The gently sloping areas are mainly on the upland divides; the more strongly sloping, on the side slopes of the divides. Figure 9 shows the position of the Sharpsburg soils on the landscape.

Most of these soils occur where the Wisconsin loess was deposited on Kansan glacial till. In a few areas, mapped as bench-position phases, the loess was deposited on old alluvial terraces. The native vegetation was grass.

Sharpsburg soils are moderately to moderately slowly permeable and have good water-holding capacity. They are moderately to highly fertile. The upper layers are slightly acid to medium acid. The gently sloping phases are used intensively for corn, soybeans, oats, and meadow. Under good management, high yields are obtained. The steeper phases are also cropped, but they are used less often for row crops and more often for meadow; some areas are used for permanent pasture. Erosion is a severe hazard on the steeper phases. Sometimes there is seepage in areas where the Sharpsburg soils border the Adair and Clarinda soils.

SHARPSBURG SILT LOAM

A representative profile of Sharpsburg silt loam follows.

0 to 12 inches, very dark brown, friable silt loam.
12 to 30 inches, dark-brown, firm silty clay loam mottled with yellowish brown and strong brown in the lower part.
30 to 50 inches +, mottled light yellowish-brown and strong-brown, friable silt loam.

The thickness and color of the surface layer vary with gradient of slope and degree of erosion. The depth to mottling is commonly less in the strongly sloping phases—presumably a result of geologic erosion. The more nearly level areas have a dark grayish-brown subsoil. The underlying loess is about 8 to 10 feet thick on the more nearly level divides. On the side slopes it may be only 3 to 4 feet thick.

Sharpsburg silt loam, 0 to 2 percent slopes (ScA).—The profile of this soil is similar to the representative profile of Sharpsburg silt loam, but about half the acreage of this soil is somewhat poorly to moderately well drained. Mottling in the subsoil indicates that these areas may be somewhat wet early in spring.

If heavily fertilized, this soil can be used for a crop sequence of corn-soybeans-corn-oats-meadow and still be kept productive. The fertilization program should include extra nitrogen for the corn planted after soybeans. A less intensive sequence is corn-corn-oats-meadow. (Capability class I.)

Sharpsburg silt loam, 2 to 5 percent slopes (ScB).—Generally, this soil is like the representative soil described, but in some areas the dark surface layer is only 8 to 10 inches thick. If this soil is contoured and heavily fertilized, a rotation of corn-soybeans-corn-oats-meadow is suggested. If it is not contoured, corn-corn-oats-meadow-meadow is a suitable rotation. An alternative, less intensive sequence is corn-oats-meadow. Cultivation should be on the contour, and terraces should be constructed where feasible. (Capability subclass IIe.)

Sharpsburg silt loam, 5 to 9 percent slopes (ScC).—The profile of this soil is like the representative profile of Sharpsburg silt loam, except that the dark-colored surface layer is commonly only 6 to 9 inches thick.

If this soil is contoured, it can be used for a crop sequence of corn-corn-oats-meadow-meadow and still be kept at maximum productivity. If terraced and heavily fertilized, this soil is suitable for a rotation of corn-corn-oats-meadow. (Capability subclass IIIe.)

Sharpsburg silt loam, 5 to 9 percent slopes, moderately eroded (ScC2).—The dark surface layer of this soil is only about 4 to 8 inches thick.

If this soil is contoured, a crop sequence of corn-corn-oats-meadow-meadow will give maximum production and keep erosion losses at a minimum. If the soil is terraced and heavily fertilized, a rotation of corn-corn-oats-meadow is suitable. (Capability subclass IIIe.)

Sharpsburg silt loam, 9 to 14 percent slopes, moderately eroded (ScD2).—The dark surface layer of this soil is generally only 4 to 8 inches thick, but in some areas it is thicker.

If this soil is stripcropped on the contour, a crop sequence of corn-oats-meadow-meadow will give maximum production and hold erosion losses to a reasonable minimum. If the soil is terraced, a rotation of corn-corn-oats-meadow-meadow or corn-oats-meadow is suggested. (Capability subclass IIIe.)

Sharpsburg silt loam, 14 to 20 percent slopes, moderately eroded (ScE2).—The dark surface layer of this soil is 4 to 8 inches thick. The most suitable use for this soil is long-term pasture or hay. (Capability subclass IVe.)

SHARPSBURG SOILS, SEVERELY ERODED

Sharpsburg soils, 9 to 14 percent slopes, severely eroded (SdD3).—The dark-colored surface layer of this soil is, on the average, less than 4 inches thick. The yellowish-brown subsoil is exposed in some small patches.

If this soil is stripcropped on the contour, a rotation of corn-oats-meadow-meadow is suggested. If the soil is terraced, corn-oats-meadow is a suitable rotation. (Capability subclass IVe.)

Shelby series

The Shelby series consists of moderately well drained soils developed from Kansan glacial till of clay loam texture. These soils occur in the southern part of the county. The slope range is 5 to 30 percent. Figure 9 shows how the Shelby soils occur on the landscape.

These soils erode readily when cultivated because of the slope and the slowly permeable subsoil. Erosion has removed the original surface layer from many areas. Some slopes of 5 to 15 percent are used for corn, oats, and meadow, but the slopes of more than 15 percent are used mostly for permanent pasture. The Shelby soils are moderately fertile and moderate to low in productivity.

Small areas of Olmitz soils are included with Shelby soils because the narrow, concave slopes on the sides of valleys cannot be delineated readily on the soil map.

SHELBY LOAM

A representative profile of Shelby loam follows.

- 0 to 7 inches, very dark grayish-brown, friable loam.
- 7 to 14 inches, dark-brown, firm loam.
- 14 to 30 inches, brown to yellowish-brown, firm clay loam.
- 30 to 50 inches +, yellowish-brown, mottled with strong brown and light brownish gray, slightly firm clay loam to heavy loam.

The Shelby soils are among the more variable soils of the county. The upper layers of the profile are slightly acid to medium acid. Those below 3 feet are generally slightly acid but in some areas are calcareous. Where the Shelby soils border the Adair soils, the subsoil texture is gritty silty clay. Many areas include some narrow bands of Adair soils, commonly between Sharpsburg and Shelby soils. In a few areas, the subsoil is loam. Also, in a few areas, there is shale in the lower part of the profile. The soils in these areas are similar to the Bauer and Gosport soils. In a few areas, pockets and lenses of sand and gravel occur. There are also a few stones and pebbles.

Shelby loam, 5 to 9 percent slopes, moderately eroded (SeC2).—If this soil is contoured, a rotation of corn-oats-meadow-meadow-meadow is suggested. If this soil is terraced, a rotation of corn-corn-oats-meadow is suitable, if extra nitrogen is applied for the second year of corn. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Shelby loam, 9 to 14 percent slopes, moderately eroded (SeD2).—If stripcropped on the contour, this soil can be used for a crop sequence of corn-oats-meadow-meadow. This sequence will help to keep the soil productive and to minimize erosion. If the soil is terraced, a rotation of corn-corn-oats-meadow-meadow is suggested. (Capability subclass IIIe.)

Shelby loam, 14 to 20 percent slopes, moderately eroded (SeE2).—The dark surface layer of this soil is generally 4 to 7 inches thick. A few areas are included where the surface layer is 8 to 10 inches thick. In some areas the depth to the shale bedrock is less than that of the Shelby soils on milder slopes. This soil is best suited to permanent hay or pasture. (Capability subclass IVe.)

SHELBY SOILS, SEVERELY ERODED

Shelby soils, 14 to 20 percent slopes, severely eroded (SfE3).—The profile of this soil is like the representative profile of Shelby loam, except that the surface layer averages less than 4 inches in thickness. In many small areas, the yellowish-brown subsoil is exposed. Some areas have numerous shallow gullies. In some areas these soils are shallower than the Shelby soils on milder slopes. The most suitable use is pasture. (Capability subclass VIe.)

Shelby soils, 20 to 30 percent slopes, severely eroded (SfF3).—The surface layer generally is less than 4 inches thick. In some areas the profile is fairly thin over shale bedrock. The yellowish-brown subsoil is exposed in many small spots. In some areas there are numerous small gullies. The most suitable use is pasture. (Capability subclass VIIe.)

Storden series

The Storden series consists of dark-colored, well-drained, calcareous soils that developed from Cary glacial till of loam texture. These soils occur on the uplands in the northern four-fifths of the county. They have slopes of 3 to 40 percent. The slopes are short, irregular, and generally steep. Many small areas are included with Clarion soils. Where Storden soils border Lakeville soils, there are some gravelly and sandy inclusions. Figure 7 shows how Storden soils occur on the landscape.

The glacial-till parent material is friable, calcareous loam. The Storden soils have not developed a true subsoil, mainly because of geological erosion, and are, therefore, like the parent material in texture and reaction. The native vegetation was prairie grass. Some areas near streams had a scattering of trees.

These soils have an erosion hazard that increases in severity with steepness of slope. Many areas can be contoured and terraced, but the topography is irregular and there are areas in which these conservation practices are hard to apply.

The water-holding capacity is good, but runoff is rapid. Because these soils are calcareous, they are very low in available phosphorus. The milder slopes are used for corn, oats, and meadow. Under good management, including proper fertilization, moderate to high yields are obtained. The steeper areas are used for pasture and, to some extent, for woodland.

STORDEN LOAM

A representative profile of Storden loam follows.

- 0 to 6 inches, very dark grayish-brown, friable loam.
- 6 to 50 inches +, light yellowish-brown, friable, calcareous loam.

The thickness of the dark surface layer ranges from 4 to 12 inches. Although the profile is normally calcareous throughout, it is leached to depths of 6 to 12 inches in some areas where this soil borders the Clarion soils. Sand and gravel pockets are common.

Storden loam, 3 to 9 percent slopes (SgC).—The profile of this soil is like the representative profile of Storden loam. This soil occurs mostly on small knobs and ridges, in association with the gently sloping Clarion and Nicollet soils.

If this soil is contoured, a rotation of corn-oats-meadow-meadow is suitable. If the soil is terraced, a rotation of corn-corn-oats-meadow is suggested. Extra nitrogen should be applied for the second year of corn. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Storden loam, 20 to 40 percent slopes, moderately eroded (SgF2).—The surface layer of this soil is only 2 to 6 inches thick. This soil is subject to gullying and to severe sheet erosion. It is best suited to pasture. (Capability subclass VIIe.)

STORDEN SOILS, SEVERELY ERODED

Storden soils, 5 to 9 percent slopes, severely eroded (ShC3).—This unit is like the Storden loam described except that its dark-colored surface layer is generally less than 4 inches thick. It occupies small knobs and ridges, in association with gently sloping Clarion and Nicollet soils.

If this unit is contoured, corn-oats-meadow-meadow is a suitable rotation. If this unit is terraced, a rotation of corn-corn-oats-meadow is suggested. Alternative uses are hay and pasture. (Capability subclass IIIe.)

Storden soils, 9 to 14 percent slopes, severely eroded (ShD3).—The profile of this unit is like the representative profile of Storden loam, except that the surface layer is only 2 to 6 inches thick.

This unit is best suited to pasture or hay. If it is terraced, a rotation of corn-oats-meadow is suitable. (Capability subclass IIIe.)

Storden soils, 14 to 20 percent slopes, severely eroded (ShE3).—The profile of this unit is like the representative profile, except that the dark surface layer is only 2 to 6 inches thick. Included are some areas where all of the original surface layer has been lost through erosion.

This unit is best suited to permanent hay or pasture. (Capability subclass IVe.)

Storden-Colo complex

This complex occurs along drainageways in the northern four-fifths of the county. It consists mainly of Colo silty clay loam on narrow bottom lands surrounded by steep Storden soils. Smaller acreages of moderately steep Clarion and Terril soils are included. Each of these soils is described elsewhere in this report. The slopes range from 0 to 40 percent but, because of the predominance of Storden soils, are mostly between 14 and 40 percent.

This complex is used mostly for pasture. Scattered trees grow in some areas. The major management problems are preventing erosion of the steep Storden soils and protecting the Colo soils from wetness and flooding.

Storden-Colo complex, 0 to 20 percent slopes (SkE).—In this unit the Storden, Clarion, and Terril soils are only slightly eroded. Their profiles are similar to those described under each series. The Storden soils are dominant. These soils are best suited to pasture. (Capability subclass IVe.)

Storden-Colo complex, 0 to 40 percent slopes (SkF).—The Storden soils are dominant in this unit. The dark-colored surface layer of the sloping areas ranges from 6 to 10 inches in thickness.

This complex is best suited to pasture. Grazing on the steeper slopes should be limited, to keep the ground covered with sufficient vegetation to prevent erosion. (Capability subclass VIIe.)

Storden-Lakeville complex

This complex occurs in the northern four-fifths of the county, mostly in the knob-and-kettle morainic area in the central part of Jefferson Township. It consists of about equal amounts of Storden and Lakeville soils. In some individual areas, smaller acreages of Dickinson and Hagener soils are included. All of these soils are described elsewhere in this report.

These soils have low water-holding capacity. They are low in fertility and are subject to severe erosion. The productivity is low. The slope range is 5 to 20 percent.

Storden-Lakeville complex, 5 to 9 percent slopes, moderately eroded (SmC2).—The dark-colored surface layer of this unit is variable, but ordinarily it is 4 to 8 inches thick. In some areas, little or none of the original surface soil remains.

Some of this unit is in fields of Clarion soils and is cropped along with them. If this unit is contoured, a suggested rotation is corn-oats-meadow-meadow. If the unit is terraced, a rotation of corn-oats-meadow is suggested. Pasture is possibly the best use. (Capability subclass IIIs.)

Storden-Lakeville complex, 9 to 14 percent slopes, moderately eroded (SmD2).—The soils of this unit are best suited to pasture. (Capability subclass IVs.)

Storden-Lakeville complex, 14 to 20 percent slopes, moderately eroded (SmE2).—This unit is best suited to long-term pasture. (Capability subclass VIs.)

Stronghurst series

The Stronghurst series consists of imperfectly drained, light-colored soils that developed from loess of Wisconsin age. These soils have slopes of 0 to 2 percent. They occur mainly on the uplands in the southeastern part of the county. A few areas that are on natural terraces along some of the streams are mapped as Stronghurst silt loam, bench position. On the natural terraces, the loess was deposited over old alluvium. In other parts of the uplands, it was deposited over Kansan till. The native vegetation was trees, as was that of the associated Fayette soils.

These soils are moderately low in fertility. The upper layers are medium acid. The water-holding capacity is good. Mottling in the subsoil is evidence of the imperfect natural drainage.

These soils are used mainly for corn, oats, and meadow. Under good management, they are moderately productive. Erosion and wetness are slight hazards. If artifiicial drainage is needed, tile drains will probably function well.

STRONGHURST SILT LOAM

A representative profile of Stronghurst silt loam follows.

0 to 3 inches, dark grayish-brown, friable silt loam.
3 to 10 inches, dark-gray, friable silt loam.
10 to 33 inches, dark-brown and very dark grayish-brown, firm silty clay loam mottled with yellowish brown.
33 to 50 inches +, mottled dark yellowish-brown and yellowish-brown, friable silt loam.

The dark surface layer is 3 to 6 inches thick. The subsoil layer ranges from dark brown with few mottles to very dark grayish brown with numerous yellowish-brown mottles. A few areas in slight depressions have poor natural drainage.

Stronghurst silt loam (Sn).—This soil occurs in the uplands. A crop sequence of corn-oats-meadow or corn-corn-oats-meadow should give maximum production and help to hold erosion losses to a reasonable minimum. Extra nitrogen is needed for the second year of corn. (Capability class I.)

Stronghurst silt loam, bench position (So).—This soil occurs on loess-covered stream terraces. It is underlain at a depth of 5 feet by medium-textured alluvium. A crop sequence of corn-corn-oats-meadow should give maximum long-time production, provided extra nitrogen is applied for the second year of corn. (Capability class I.)

Tama series

The Tama series consists of dark-colored, well-drained soils that developed from loess. These soils have slopes of 0 to 14 percent. They occur in the hilly area in the southeastern part of the county and are associated with Muscatine, Downs, and Fayette soils (fig. 8). The native vegetation was grass.

The Tama soils have good water-holding capacity and are moderately to highly fertile. The upper layers of the profile are medium acid. Many of the stronger slopes have lost much of the original dark-colored surface layer through erosion. The nearly level and gently sloping areas are used for corn, oats, and meadow. Under good management, high yields are obtained. The stronger slopes are used less often for corn and oats, seldom for soybeans, and more commonly for meadow and permanent pasture. Controlling erosion is a problem. The severity of the erosion hazard increases with increasing slope.

TAMA SILT LOAM

A representative profile of Tama silt loam follows.

0 to 10 inches, very dark brown, friable silt loam.
10 to 33 inches, dark-brown to brown, slightly firm silty clay loam; a few strong-brown mottles in the lower part.
33 to 50 inches +, mottled yellowish-brown and light brownish-gray, friable silt loam.

The surface layer is 12 to 14 inches thick in the nearly level areas bordering Muscatine soils. Where it is eroded, it is thinner. It is also thinner and somewhat grayer in areas bordering the Downs soils. The depth to the substratum, ordinarily the weathered Kansan till, is greatest in the nearly level areas. It is commonly 10 or more feet, but may be only 3 to 5 feet in the strongly sloping areas.

Tama silt loam, 0 to 2 percent slopes (TaA).—This soil has a slightly thicker surface layer than the representative profile of Tama silt loam.

A rotation of corn-soybeans-corn-oats-meadow is suitable for this soil if it is heavily fertilized. An alternative, less intensive sequence, is corn-corn-oats-meadow. (Capability class I.)

Tama silt loam, 2 to 5 percent slopes (TaB).—The profile of this soil is like the representative profile of Tama silt loam.

If this soil is contoured or terraced and heavily fertilized, it is suitable for a crop sequence of corn-soybeans-corn-oats-meadow. If the soil is not contoured, a rotation of corn-corn-oats-meadow is suggested. (Capability subclass IIe.)

Tama silt loam, 2 to 5 percent slopes, moderately eroded (TaB2).—The dark-colored surface layer of this soil is only about 4 to 8 inches thick. If this soil is contoured or terraced and heavily fertilized, a crop sequence of corn-soybeans-corn-oats-meadow is suggested. Without these practices, a rotation of corn-corn-oats-meadow is suitable. (Capability subclass IIe.)

Tama silt loam, 5 to 9 percent slopes (TaC).—In this soil, the dark-colored surface layer is a few inches thinner than in the representative profile of Tama silt loam.

If this soil is contoured, a crop sequence of corn-corn-oats-meadow-meadow is suggested. If it is terraced and heavily fertilized, corn-corn-oats-meadow is a suggested rotation. (Capability subclass IIIe.)

Tama silt loam, 5 to 9 percent slopes, moderately eroded (TaC2).—The dark-colored surface layer of this soil is only 4 to 8 inches thick.

If this soil is contoured, corn-corn-oats-meadow-meadow is a suggested rotation. If this soil is terraced and large amounts of fertilizer are used, a rotation of corn-corn-oats-meadow is suitable. (Capability subclass IIIe.)

Tama silt loam, 9 to 14 percent slopes, moderately eroded (TaD2).—The dark-colored surface layer of this soil is ordinarily only 4 to 8 inches thick. Included, however, are a few areas with a dark-colored surface layer as thick as that in the representative profile. If this soil is stripcropped on the contour, a crop sequence of corn-oats-meadow-meadow or corn-corn-oats-meadow-meadow-meadow is suggested for obtaining maximum production and keeping erosion to a reasonable minimum. A rotation of corn-corn-oats-meadow-meadow is suggested if the soil is terraced and if extra nitrogen is used for the second year of corn. If contouring is the only conservation practice, a rotation of corn-oats-meadow-meadow-meadow is suggested. (Capability subclass IIIe.)

TAMA SOILS, SEVERELY ERODED

Tama soils, 9 to 14 percent slopes, severely eroded (TbD3).—The profile of this unit differs from the representative profile of Tama silt loam in having a dark-colored surface layer that is less than 4 inches thick. The dark yellowish-brown silty clay loam subsoil is exposed in some small patches. Many areas have mottled gray and brown subsoils, apparently inherited from the parent material.

If this unit is stripcropped on the contour, a crop sequence in which corn is grown only 1 year out of 4 is suggested. If it is terraced, corn-corn-oats-meadow-meadow is a suitable rotation. An alternative use, if this unit is not needed for crops, is long-term pasture. (Capability subclass IIIe.)

Terril series

The Terril series consists of dark-colored soils that developed from local alluvium. Most of the parent material washed from adjacent slopes in past centuries. The native vegetation was mainly prairie grass, but there were, and still are, trees in some areas. The slope range is 0 to 9 percent.

Terril soils occur in the northern four-fifths of Polk County, below steep Clarion soils, on foot slopes or fans along the Skunk and Des Moines Rivers. A few areas are mapped as part of the Colo-Terril complex or as inclusions in the Storden-Colo complex.

Terril soils are normally well drained to moderately well drained, but are somewhat poorly drained in the nearly level areas. They have good water-holding capacity and are highly fertile. The upper layers of the profile are slightly acid. These soils are highly productive of row crops and grain crops, as well as of meadow and pasture. Erosion is a problem on the steeper slopes. The gentle slopes sometimes receive some runoff and sediment from the adjacent higher lying soils. Where water concentrates, gully erosion is a problem. The larger individual areas are used intensively for row crops and grain crops, but small areas adjacent to steeper areas are used for pasture.

TERRIL LOAM

A representative profile of Terril loam follows.

0 to 16 inches, very dark brown, friable loam.
16 to 30 inches, very dark grayish-brown, friable loam.
30 to 60 inches +, dark grayish-brown, friable loam mottled with yellowish brown.

The surface layer ranges from very dark brown to very dark grayish brown in color and from 15 to 25 inches in thickness. Generally the texture is loam throughout the profile, but it ranges from sandy loam, where these soils border the Ankeny soils, to clay loam, where they border the Colo soils.

Terril loam, 0 to 2 percent slopes (TcA).—This soil has a thicker and darker colored surface layer than the representative profile of Terril loam. Some areas tend to be somewhat poorly drained and may benefit from tiling. Diversion terraces are needed in some places to divert water that runs off the adjacent slopes. Waterways should be sodded to help control gullying.

This soil commonly occurs in small areas and is cropped along with the surrounding soils. It is suitable for intensive cropping, however. Corn for 2 years, followed by oats seeded with a legume for green manure, is a suitable rotation if extra nitrogen is applied for the second year of corn. An alternative rotation is corn-corn-oats-meadow. (Capability class I.)

Terril loam, 2 to 5 percent slopes (TcB).—Diversion terraces are needed to protect this soil from water that runs off the bordering slopes. Waterways should be sodded to help control gullying. Tile drainage may be needed in some areas.

This soil is very productive, and the large areas of it are suitable for intensive cultivation. Commonly, however, it occurs in small areas that must be cropped with the adjacent soils. Corn grown for 2 years and followed by oats seeded to a legume for green manure is a suitable rotation. An alternative rotation is corn-corn-oats-meadow. (Capability subclass IIe.)

Terril loam, 5 to 9 percent slopes (TcC).—This soil is similar to the Terril loam described, except that the subsoil is dark brown. It has moderately good natural drainage.

A crop sequence of corn-corn-oats-meadow is suggested if this soil is contoured. Diversion terraces may be needed to protect this soil from runoff from bordering slopes. If the soil is not contoured or protected by terraces, a crop sequence of corn-oats-meadow or corn-corn-oats-meadow-meadow is suggested. Waterways should be kept in sod to help control gullying. (Capability subclass IIIe.)

Wabash series

The Wabash series consists of dark-colored, poorly to very poorly drained soils that have very slow permeability. They occur in small areas on the bottom lands of the Skunk River and some of the smaller creeks in other parts of the county. Wabash soils are also mapped as part of the Wabash-Gravity-Nodaway complex. The slope range is 0 to 1 percent. The parent material is slack-water alluvium. The native vegetation was wet-prairie grass and some trees.

These soils are often too wet for crops. Because of the clayey subsoil, tile lines are not very practicable for improving drainage. A few areas are drained by surface ditches. Some of the lower lying areas receive runoff and floodwaters, which add to the wetness problem.

These soils are used for corn and soybeans in years that are not too wet. Another use is pasture.

WABASH SILTY CLAY

A representative profile of Wabash silty clay follows.

0 to 14 inches, black, firm to very firm silty clay.
14 to 33 inches, dark-gray, very firm silty clay.
33 to 50 inches, dark-gray, very firm silty clay mottled with olive gray.

The surface layer ranges from friable silty clay loam to very firm silty clay. The subsoil ranges from firm silty clay bordering on silty clay loam to very firm clay. The substratum ranges from slightly firm silty clay to clay. The upper layers of the profile are slightly acid to medium acid. The subsoil and substratum are slightly acid to neutral.

Wabash silty clay (Wb).—The profile of this soil is like the representative profile of Wabash silty clay. If drainage can be improved and floods prevented, this soil is suitable for intensive cultivation. Corn grown for 2 years and followed by oats seeded with a legume for green manure is a suitable rotation. The clayey surface layer is often too wet or too dry to be tilled easily. (Capability subclass IIIw.)

WABASH SILT LOAM

Except for the texture of the upper layers, the profile of this soil is like that of Wabash silty clay. The silt loam is 15 to 40 inches thick. It is probably material that has been recently deposited over the older silty clay.

Wabash silt loam (Wa).—If drained and protected from overflow, this soil is suitable for intensive cultivation. A suggested rotation consists of corn for 2 years, followed by oats seeded to a legume for green manure. (Capability subclass IIIw.)

Wabash-Gravity-Nodaway complex

The soils of this complex occur in intricate association along the smaller drainageways in the southwestern part of the county. Most areas of the complex are narrow bands surrounded by steep soils. Nodaway silt loam is dominant; Wabash silty clay is next in extent; and Gravity silty clay loam is the least extensive. Each soil is described elsewhere in this report.

The chief limitations of this complex are wetness and flooding.

Wabash-Gravity-Nodaway complex (Wc).—The larger areas of this complex are suitable for intensive cultivation if they can be drained and protected from overflow. The smaller areas are cropped along with the adjacent soils. Generally, this complex is best suited to pasture. (Capability subclass IIw.)

Waukegan series

The Waukegan series consists of dark-colored, well drained to somewhat excessively drained soils that are underlain by coarse sand and fine gravel. These soils have a slope range of 0 to 9 percent. They occur on stream terraces along the Skunk, Des Moines, and Raccoon Rivers and along some of the smaller creeks. The parent material is loamy glacial outwash of Late Wisconsin age over sand and gravel. The depth to sand and gravel ranges from 18 to 60 inches or more. The natural vegetation was mainly prairie.

The level and gently sloping areas are used mostly for row crops, oats, and meadow. The stronger slopes are used for pasture, because they have a severe erosion hazard.

WAUKEGAN LOAM, MODERATELY DEEP OVER SAND AND GRAVEL

These soils are somewhat excessively drained and tend to be droughty. They are moderately fertile, but their productivity is limited by low moisture-holding capacity.

A representative profile of Waukegan loam, moderately deep over sand and gravel, follows.

- 0 to 11 inches, very dark brown, friable loam.
- 11 to 25 inches, brown, friable loam.
- 25 inches +, brown gravelly coarse sand to fine gravel; extends to depth of several feet.

The texture of the surface layer ranges from sandy loam to gritty silt loam, though loam is dominant. The texture of the subsoil ranges from light loam to gritty light silty clay loam. The depth to coarse sand and gravel ranges from 18 to 35 inches, but 24 inches is the common depth. In some areas, these soils are calcareous at a depth of 2 feet, and in others they are noncalcareous to a depth of more than 4 feet.

Waukegan loam, moderately deep over sand and gravel, 0 to 2 percent slopes (WdA).—This soil has a moderate to severe drought hazard. It is moderately fertile, but because of the low moisture-holding capacity, yields are limited, even in years of normal rainfall. Erosion is not a problem. This soil is particularly well suited to irrigation. Corn-corn-oats-meadow is a suitable rotation. (Capability subclass IIs.)

Waukegan loam, moderately deep over sand and gravel, 2 to 5 percent slopes (WdB).—This soil has a moderate to severe drought hazard. It is slightly erodible. It is moderately fertile, but, because of the low moisture-holding capacity, yields are limited, even in years of normal rainfall. If it is contoured, a suggested crop sequence is corn-oats-meadow. For areas that are not contoured, a rotation of corn-oats-meadow-meadow is suggested. More intensive rotations may result in loss of some of the loamy material. An alternative use is pasture. (Capability subclass IIs.)

Waukegan loam, moderately deep over sand and gravel, 5 to 9 percent slopes (WdC).—The profile of this soil is somewhat shallower than the representative profile of Waukegan loam, moderately deep over sand and gravel. The surface horizon is not so dark as that in the representative profile.

This soil has a moderate to severe drought hazard. It is medium to low in fertility. Yields are limited, even in normal years, by the low moisture-holding capacity.

If this soil is stripcropped, a rotation of corn-oats-meadow-meadow is suitable. If the soil is contoured only, a sequence of corn-oats-meadow-meadow-meadow is suggested. An alternative crop is alfalfa. (Capability subclass IIIs.)

WAUKEGAN LOAM, DEEP OVER SAND AND GRAVEL

These soils have moderately good water-holding capacity, although they are less drought resistant than the Tama soils. However, it is unlikely that crops will be damaged by drought except in extremely dry years. Under good management, the nearly level areas are highly productive of corn, soybeans, oats, and meadow, which are the chief crops. The smaller and steeper areas are used for pasture.

A representative profile of Waukegan loam, deep over sand and gravel, follows.

- 0 to 12 inches, very dark brown, friable loam.
- 12 to 42 inches, dark-brown to yellowish-brown, friable loam.
- 42 to 60 inches +, coarse sand or gravel.

The surface layer is 10 to 15 inches thick. It ranges from silt loam to loam texture. The subsoil ranges from heavy loam to light silty clay loam. These layers usually contain some sand-sized particles. The depth to the sand and gravel substratum ranges from 36 to 60 inches. It is most commonly 40 to 45 inches. The upper part of the substratum is ordinarily neutral, and the lower part, calcareous.

Waukegan loam, deep over sand and gravel, 0 to 2 percent slopes (WeA).—This soil has a 12- to 15-inch dark surface layer. Much of this soil is moderately well drained. It is somewhat similar to the Kato soils that are deep over sand and gravel. A crop sequence in which row crops are grown 2 years out of 3 is suitable; for example, corn for 2 years followed by oats seeded with a legume for green manure. A less intensive rotation is corn-corn-oats-meadow. (Capability class I.)

Waukegan loam, deep over sand and gravel, 2 to 5 percent slopes (WeB).—The profile of this soil is like the representative profile of Waukegan loam, deep over sand and gravel. If this soil is contoured, a rotation of corn-corn-oats-meadow is suitable. If the soil is terraced, a rotation of corn-soybeans-corn-oats-meadow is suggested. If it is neither contoured nor terraced, a rotation of corn-oats-meadow is suggested. (Capability subclass IIe.)

Waukegan loam, deep over sand and gravel, 5 to 9 percent slopes (WeC).—The profile of this soil is like the representative profile of Waukegan loam, deep over sand and gravel, except that the surface layer is 8 to 12 inches thick. For areas that are contoured, a crop sequence of corn-oats-meadow-meadow is suggested. However, supporting practices may not be feasible in many areas because of the short, irregular slopes. For these areas, a crop sequence of corn-oats-meadow-meadow-meadow is suggested. An alternative use is pasture. (Capability subclass IIIe.)

Webster series

The Webster series consists of dark-colored, poorly drained soils that developed from Cary glacial till. These soils occur in the uplands in the northern four-fifths of the county in association with Nicollet, Clarion, Glencoe, Harpster, Ames (fig. 7), and Lester soils. The slope range is 0 to 1 percent.

The till is friable to slightly firm, calcareous loam. In many areas, a 1- to 3-foot layer of glacial outwash material that consists of friable loam containing some lenses of sand and sandy loam overlies the loam till. The native vegetation was prairie grass. Sedges and wet-prairie grass were native to the lower lying areas.

The upper layers of the Webster soils are slightly acid to slightly alkaline in reaction. The water-holding capacity is good, and the subsoil is moderately to slowly permeable. Tile lines are needed to improve drainage. Ordinarily, outlets are accessible. These soils are moderately to highly fertile. Under good management, high yields of corn, soybeans, oats, and alfalfa are obtained.

WEBSTER SILTY CLAY LOAM

A representative profile of Webster silty clay loam follows.

- 0 to 15 inches, black, slightly firm to firm gritty silty clay loam.
- 15 to 30 inches, dark grayish-brown and olive-gray, firm silty clay loam.
- 30 to 60 inches +, olive-gray, calcareous, slightly firm glacial loam.

The surface layer ranges in thickness from 12 to 18 inches. The surface soil and subsoil range in texture from slightly firm clay loam to firm, gritty silty clay loam. Where the Webster soils are adjacent to the Lester soils, the Ames soils, or other forest-influenced soils, the subsoil is firm clay loam or light gritty silty clay. The depth to calcareous material ranges from 24 to 40 inches. Some areas are also slightly calcareous in the surface layer, but most such areas are included with Webster silty clay loam, calcareous variant.

Webster silty clay loam (Wf).—This soil is used intensively for corn and soybeans. An occasional grass-legume crop will help to maintain a granular structure in the surface soil. Because of the gritty silty clay loam texture of the surface layer, fall plowing is commonly practiced so that freezing and thawing will break down the cloddy structure into a finer granular structure. Although many areas are adequately tiled, the tile systems and outlets need frequent attention and care. If the soil is adequately fertilized, a suitable rotation is corn for 2 years followed by oats seeded with a legume for green manure. An alternative rotation is corn-soybeans-corn-oats-meadow. (Capability subclass IIw.)

Webster silty clay loam, calcareous variant (Wg).—This soil is similar in profile characteristics and origin to Webster silty clay loam, except that, as its name implies, it is slightly calcareous in all layers, including the surface layer. Fragments of snail shells are common on the surface. This soil has good water-holding capacity. It is poorly drained. Artificial drainage is needed.

This soil is not so strongly calcareous in the surface layer as the associated Harpster soils. It is usually low in available phosphorus and potassium for corn and alfalfa, but less so than the Harpster soils. Soil tests are advisable to determine fertility status.

If well managed, this soil is suitable for intensive use for row crops. Yields of corn, soybeans, oats, and alfalfa are almost as high as on the normal Webster silty clay loam. If enough fertilizer is used, a rotation of corn for 2 years followed by oats seeded to green manure is suitable. An alternative rotation is corn-soybeans-corn-oats-meadow. (Capability subclass IIw.)

Soil Management

This soil survey report can be used as a guide by the farmers of Polk County in selecting management practices that will maintain or increase the productivity of their soils. General recommendations, such as those in this report, must often be modified to give the best results on any specific farm. High yields of good-quality crops are desired by all farmers, but such yields depend upon many things, including climate, kind of soil, topography, and past and present soil management.

In agronomic work it is not possible to conduct trials on each soil in every field in a county or state. Consequently, there is need for some means whereby information obtained through trials in one locality can be utilized on like soils in other localities. Knowing what kinds of soils are in each locality makes it possible to apply in one area information obtained by experimental trials or by the experience of farmers in another area.

This soil survey report is not intended to be a source of all information needed for the successful operation of a farm in Polk County. Further detailed information on such subjects as crop varieties, soil conservation practices, and livestock management can be obtained from the personnel of the Soil Conservation Service, the County Extension Director, the State Agricultural Experiment Station, and from similar sources.

Soil Characteristics that Affect Management

Good soil management requires the consideration of many soil treatments and practices that will help to control erosion and improve or maintain productivity. Before choosing a management system for a farm, the

TABLE 3.—*Summary of major*

Soil	Slope range	Parent material, or substratum	Position on landscape	Native vegetation
	Percent			
Adair clay loam	5 to 14	Kansan glacial till	Uplands (lower slopes, coves, and heads of drainageways) in southeastern part of county.	Prairie
Alluvial land	0 to 1	Medium-textured, fresh stream deposits.	First bottoms of large streams	Prairie, shrubs, and hardwoods.
Ames loam	0 to 2	Cary glacial till	Uplands in northern four-fifths of county and flats near Skunk and Des Moines Rivers.	Forest
Ankeny sandy loam	0 to 5	Slopewash from sandy uplands	Foot slopes, mostly on east side of Skunk River.	Prairie
Atterberry silt loam	1 to 3	Thick, windblown silt (loess)	Uplands or river glacial terraces	Prairie-forest transition
Bauer silt loam	5 to 40	Shale bedrock	Uplands	Prairie
Blockton silt loam	0 to 5	Slopewash (old alluvium)	Foot slopes in southeastern part of county.	Prairie
Buckner loamy sand	0 to 9	Sandy glacial outwash	Terraces of Skunk and Des Moines Rivers.	Prairie
Cantril silt loam	0 to 5	Slopewash (local alluvium)	Foot slopes in southern part of county and along drainageways.	Prairie-forest transition
Chaseburg silt loam	0 to 5	Slopewash from Fayette and Downs soils.	Foot slopes	Forest or prairie
Chelsea loamy fine sand	5 to 30	Wind-deposited sands	Uplands, near streams	Forest
Clarinda silty clay loam	5 to 9	Gray clay (gumbotil)	Uplands, mostly in coves in southern part of county.	Prairie
Clarion loam	0 to 30	Cary glacial loam till	Uplands in northern four-fifths of county.	Prairie
Clarion silt loam	2 to 20	Cary glacial loam till and some wind-deposited silt.	Uplands	Prairie
Clearfield silty clay loam	5 to 14	Thick, windblown silt (loess)	Uplands, mostly in coves	Prairie
Colo silty clay loam	0 to 1	Alluvium (stream deposits)	Bottom lands, mostly along Skunk River.	Prairie
Colo loam, loamy subsoil variant.	0 to 1	Alluvium (stream deposits)	Bottom lands, mostly along Skunk River.	Prairie
Cooper silt loam, acid variant	0 to 1	Alluvium	Second bottoms along Des Moines and Raccoon Rivers.	Prairie
Crocker loamy fine sand	2 to 30	Wind-deposited sand over Cary glacial till.	Uplands, near streams	Prairie-forest transition
Dickinson fine sandy loam	0 to 30	Sandy material	Uplands, mostly in northern part of county.	Prairie
Dickinson loam	2 to 30	Sandy material	Uplands, mostly in northern part of county.	Prairie
Dickinson sandy loam, bench position.	0 to 9	Sandy material	Glacial outwash and stream terraces.	Prairie
Dorchester silt loam	0 to 2	Fresh stream deposits	First bottoms, along Des Moines River.	Shrubs and trees
Dorchester silt loam, moderately shallow over sand.	0 to 2	Fresh stream deposits over sand	First bottoms	Shrubs and trees
Dorchester silt loam, deep over sand.	0 to 1	Fresh stream deposits over sand	First bottoms	Shrubs and trees
Downs silt loam	0 to 30	Thick, windblown silt (loess)	Uplands, near streams	Prairie-forest transition
Farrar fine sandy loam	2 to 30	Windblown sandy loam over Cary glacial loam till.	Uplands, in northeastern part of county, east of Skunk River.	Prairie
Fayette silt loam	0 to 40	Thick, windblown silt (loess)	Uplands along streams; some on terraces.	Forest
Gara loam	5 to 40	Kansan glacial till	Uplands in southern part of county near streams.	Prairie-forest transition
Glencoe silty clay loam	0 to 1	Slopewash and Cary glacial till	"Potholes" in uplands in northern part of county.	Prairie
Gosport silt loam	5 to 40	Shale bedrock	Uplands, mostly along streams, in southern part of county.	Forest
Gravity silty clay loam	2 to 4	Local alluvium	Foot slopes between uplands and bottom lands in southern part of county.	Prairie
Hagener loamy fine sand	0 to 20	Windblown sands	Uplands on east side of Skunk River; some on terraces.	Prairie

characteristics of soil types

Dominant natural drainage [1]	Surface layer (A horizon, uneroded)	Subsoil (B horizon, if present)	Permeability of subsoil [2]
Intermediate	Very dark grayish-brown clay loam	Mottled dark grayish-brown and very dark gray silty clay or clay loam.	Very slow.
Good to poor	Variable	Variable	Variable.
Poor	Very dark grayish-brown loam; light brownish-gray subsurface layer.	Light olive-brown silty clay	Very slow.
Good	Very dark grayish-brown sandy loam	Dark-brown and brown sandy loam	Rapid.
Intermediate	Very dark gray silt loam; grayish subsurface layer.	Dark grayish-brown silty clay loam	Moderate.
Good	Very dark grayish-brown silt loam	Thin, brown silt loam, if present	Very slow to moderate.
Poor	Black silt loam; grayish subsurface layer.	Very dark gray silty clay	Very slow.
Good	Dark grayish-brown, loamy coarse sand.	Dark-brown, loamy coarse sand	Very rapid.
Intermediate	Very dark grayish-brown silt loam; grayish-brown subsurface layer.	Mottled dark grayish-brown silty clay loam.	Slow.
Intermediate	Grayish-brown silt loam mottled in lower part.	No B horizon	Moderate.
Good	Very dark brown loamy fine sand; dark-gray subsurface layer.	Yellowish-brown loamy fine sand	Very rapid.
Poor	Very dark gray silty clay loam	Mottled dark-gray or olive-gray silty clay.	Very slow.
Good	Very dark brown loam	Dark-brown loam	Moderate.
Good	Very dark brown silt loam	Dark-brown silt loam or loam	Moderate.
Intermediate	Very dark gray silty clay loam to silt loam.	Mottled dark grayish-brown silty clay loam.	Slow.
Poor	Black to very dark gray silty clay loam.	Very dark grayish-brown and very dark gray silty clay loam.	Slow to moderate.
Poor	Very dark gray loam to clay loam	Very dark grayish-brown and very dark gray clay loam.	Slow to moderate.
Intermediate	Very dark gray silt loam	Mottled dark grayish-brown silty clay loam to silty clay.	Slow to very slow.
Good	Very dark grayish-brown loamy fine sand; dark grayish-brown subsurface layer.	Brown loam	Rapid.
Good	Very dark grayish-brown, fine sandy loam.	Dark-brown fine sandy loam	Rapid to very rapid.
Good	Very dark grayish-brown loam	Dark-brown fine sandy loam	Rapid.
Good	Very dark grayish-brown sandy loam	Dark-brown sandy loam	Rapid.
Intermediate	Very dark gray silt loam; calcareous	No B horizon	Moderate.
Good	Very dark gray silt loam; calcareous	Dark grayish-brown sand at depths of 12 to 24 inches.	Rapid.
Good	Very dark gray silt loam; calcareous	Dark grayish-brown sand at depths of 30 to 60 inches.	Moderate.
Good	Very dark grayish-brown silt loam; grayish-brown subsurface layer.	Brown silty clay loam	Moderate.
Good	Very dark brown fine sandy loam	Dark yellowish-brown and dark-brown fine sandy loam in upper part; loam in lower part.	Moderate to rapid.
Good	Dark grayish-brown silt loam; grayish-brown subsurface layer.	Yellowish-brown silty clay loam	Moderate.
Good	Very dark gray loam; dark grayish-brown subsurface layer.	Yellowish-brown clay loam or silty clay.	Slow to very slow.
Very poor	Black silty clay loam	Olive-gray silty clay	Slow to very slow.
Good	Grayish-brown silt loam	Yellowish-brown silty clay or silty clay loam; shale at depth of about 15 inches.	Very slow.
Intermediate	Black to very dark grayish-brown silty clay loam.	Mottled very dark grayish-brown silty clay loam.	Slow to moderate.
Good	Very dark grayish-brown loamy fine sand.	Dark grayish-brown to brown loamy fine sand.	Very rapid.

TABLE 3.—*Summary of major*

Soil	Slope range	Parent material, or substratum	Position on landscape	Native vegetation
	Percent			
Harpster loam	0 to 2	Cary glacial loam till	Rims around former ponds, and sloughs in northern four-fifths of county.	Prairie
Hayden loam	0 to 40	Cary glacial loam till	Uplands along streams in northern four-fifths of county.	Forest
Huntsville sandy loam	0 to 2	Recent stream deposits; somewhat sandy.	First bottoms	Shrubs and trees
Huntsville silt loam	0 to 2	Recent stream deposits	First bottoms	Trees, shrubs, or prairie grasses.
Ida silt loam	5 to 9	Windblown silt (loess)	Uplands in northern part of county.	Prairie
Judson silt loam	2 to 9	Local alluvium	Foot slopes and alluvial fans between uplands and bottom lands in southeastern part of county.	Prairie
Kato loam, moderately deep over sand and gravel.	1 to 3	Glacial outwash	Second bottoms or terraces	Prairie
Kato loam, deep over sand and gravel.	1 to 3	Glacial outwash	Second bottoms	Prairie
Ladoga silt loam	2 to 30	Thick, windblown silt (loess)	Uplands near streams in southwestern part of county.	Prairie-forest transition
Lakeville sandy loam	2 to 40	Sandy or gravelly, calcareous Cary glacial till.	Uplands in northern four-fifths of county.	Prairie
Lamont fine sandy loam	2 to 30	Wind-deposited fine sand and silt.	Uplands, mostly on east side of Des Moines River.	Forest
Lester loam	0 to 40	Cary glacial loam till	Uplands adjacent to Des Moines and Skunk Rivers in northern four-fifths of county.	Prairie-forest transition
LeSueur loam	1 to 3	Cary glacial loam till	Uplands near Skunk and Des Moines Rivers in northern four-fifths of county.	Prairie-forest transition
Lindley loam	9 to 40	Kansan glacial till	Uplands in southeastern part of county.	Forest
Marshan silty clay loam, deep over sand and gravel.	0 to 2	Glacial loamy outwash over sand and gravel.	Second bottoms, or terraces	Prairie
Marshan silty clay loam, moderately deep over sand and gravel.	0 to 2	Glacial loamy outwash over sand and gravel.	Outwash terraces along Skunk and Des Moines Rivers.	Prairie
Muck, moderately shallow	0 to 1	Plant residues over moderately fine textured material.	Depressions in northern four-fifths of county.	Prairie
Muck, very shallow	0 to 1	Plant residues over moderately fine textured mineral material.	Depressions in northern four-fifths of county.	Prairie
Muscatine silt loam	1 to 3	Thick, windblown silt (loess)	Upland ridgetops in southeastern part of county.	Prairie
Nicollet loam	1 to 3	Cary glacial loam till	Uplands in northern four-fifths of county.	Prairie
Nodaway silt loam	0 to 2	Recent loamy stream deposits	First bottoms n southern part of county.	Shrubs and trees
Okoboji silt loam	0 to 1	Local alluvium	Uplands in depressions in northern four-fifths of county.	Prairie
Olmitz loam	2 to 9	Local alluvium	Base of slopes and fans between uplands and bottom lands in southeastern part of county.	Prairie
Olmitz sandy loam	0 to 5	Sandy local alluvium	Base of slopes and fans between uplands and bottom lands in southern part of county.	Prairie
Peat	0 to 1	Raw organic matter accumulations and mineral soil.	Depressions in northern four-fifths of county.	Prairie
Riverwash	([3])	Fresh stream deposits; mixed sand and loam.	Low first bottoms	Shrubs and willows
Rolfe loam	0 to 1	Slopewash or Cary glacial loam till; some glacial outwash.	Shallow depressions and glacial terraces along Des Moines River.	Prairie
Runnells silt loam	5 to 40	Windblown silt (loess) over shale.	Uplands in southeastern part of county.	Prairie-forest transition
Sarpy loamy sand	0 to 2	Freshly deposited, coarse, sandy river alluvium.	Low first bottoms of Des Moines River.	Trees, shrubs, and grass
Saylor fine sandy loam	0 to 2	Sandy glacial outwash	Second bottoms, or glacial outwash terraces.	Prairie
Sharpsburg silt loam	0 to 20	Thick, windblown silt (loess)	Upland ridges in southwestern part of county.	Prairie

characteristics of soil types—Continued

Dominant natural drainage[1]	Surface layer (A horizon, uneroded)	Subsoil (B horizon, if present)	Permeability of subsoil[2]
Poor	Dark-gray loam	Olive-gray and grayish-brown loam to clay loam.	Moderate.
Good	Very dark grayish-brown loam; brown subsurface layer.	Yellowish-brown clay loam	Moderate.
Intermediate	Very dark grayish-brown sandy loam	No B horizon	Rapid.
Intermediate	Very dark gray silt loam	Mottled very dark grayish-brown silt loam or loam.	Moderate.
Good	Dark grayish-brown silt loam	No B horizon	Moderate.
Good to intermediate	Very dark brown to very dark grayish-brown silt loam.	Dark grayish-brown and dark-brown silt loam.	Moderate.
Intermediate	Very dark gray loam	Dark grayish-brown loam	Moderate to rapid.
Intermediate	Very dark gray loam	Mottled very dark grayish-brown silt loam or loam.	Moderate.
Good	Very dark grayish-brown silt loam; grayish-brown subsurface layer.	Yellowish-brown silty clay loam	Moderate.
Good	Very dark grayish-brown sandy loam	Brown and yellowish-brown sandy loam.	Rapid.
Good	Very dark brown or very dark grayish-brown fine sandy loam; grayish-brown subsurface layer.	Yellowish-brown fine sandy loam or loam.	Rapid.
Good	Very dark grayish-brown loam	Dark-brown and dark yellowish-brown loam and clay loam.	Moderate.
Intermediate	Very dark gray loam; dark-gray and very dark grayish-brown subsurface layer.	Mottled dark grayish-brown clay loam.	Slow to moderate.
Good	Dark grayish-brown loam	Yellowish-brown or reddish clay loam or gritty silty clay.	Slow to moderate.
Poor	Black silty clay loam	Very dark grayish-brown and olive-gray silty clay loam or clay loam.	Moderate to rapid.
Poor	Black silty clay loam	Very dark grayish-brown and olive-gray clay loam or loam.	Rapid.
Very poor	Black muck	Dark olive-gray silty clay loam	Moderate.
Very poor	Black muck	Dark olive-gray silty clay loam	Moderate.
Intermediate	Very dark brown silt loam	Very dark grayish-brown silty clay loam.	Moderate.
Intermediate	Very dark brown loam to silt loam	Mottled very dark grayish-brown loam to clay loam.	Moderate.
Good to intermediate	Dark grayish-brown silt loam	No B horizon	Moderate.
Very poor	Black silt loam to mucky silt loam	Mottled grayish-brown and olive-brown silt loam.	Moderate.
Intermediate	Very dark brown loam	Dark grayish-brown loam	Moderate.
Intermediate	Dark grayish-brown sandy loam	Grayish-brown sandy loam	Rapid.
Very poor	Black to very dark brown peat	Olive-gray silty clay loam	Moderate.
Variable	Variable—sand, silt loam, and sandy loam.	Variable	Very rapid.
Poor	Black loam; dark-gray or gray subsurface layer.	Dark-gray and dark grayish-brown clay loam to silty clay.	Slow to very slow.
Good	Very dark gray silt loam; grayish-brown subsurface layer.	Yellowish-brown silty clay loam	Moderate to slow.
Good	Grayish-brown loamy sand; calcareous.	No B horizon	Very rapid.
Intermediate	Very dark gray fine sandy loam	Mottled very dark grayish-brown and brown fine sandy loam.	Rapid.
Good	Very dark brown silt loam to silty clay loam.	Dark brown silty clay loam	Moderate.

TABLE 3.—*Summary of major*

Soil	Slope range	Parent material, or substratum	Position on landscape	Native vegetation
	Percent			
Shelby loam	5 to 30	Kansan glacial till	Uplands in southern part of county.	Prairie
Storden loam	3 to 40	Cary glacial till	Uplands in northern four-fifths of county.	Prairie
Stronghurst silt loam	0 to 2	Thick, windblown silt (loess)	Upland ridgetops and terraces in southeastern part of county.	Forest
Tama silt loam	0 to 14	Thick, windblown silt (loess)	Uplands in southeastern part of county.	Prairie
Terril loam	0 to 9	Slopewash from Clarion or Storden soils.	Foot slopes and fans along Skunk and Des Moines Rivers.	Prairie
Wabash silty clay	0 to 1	Slack-water clayey alluvium	Bottom lands	Prairie and trees
Wabash silt loam	0 to 1	Slack-water clayey alluvium	Bottom lands	Prairie and trees
Waukegan loam, moderately deep over sand and gravel.	0 to 9	Loamy Cary glacial outwash over sand and gravel.	Stream terraces along Skunk, Des Moines, and Raccoon Rivers.	Prairie
Waukegan loam, deep over sand and gravel.	0 to 9	Loamy glacial outwash over sand and gravel.	Stream terraces along Skunk, Des Moines, and Raccoon Rivers.	Prairie
Webster silty clay loam	0 to 1	Cary loam till and loam outwash.	Level uplands in northern four-fifths of county.	Prairie

[1] Good = well drained, moderately well drained, somewhat excessively drained, and excessively drained; intermediate = imperfectly drained; poor = poorly drained and very poorly drained.

[2] Permeability is here defined as the estimated rate at which water can move or flow through the subsoil layer. Sloping soils that have very slow permeability are highly susceptible to erosion and cannot be tiled if wet; soils that have slow permeability may or may not be drainable with tile depending on local conditions. In this table, "very slow" and "slow" indicate that less than 1 inch of water can flow through per hour; "medium," that the rate of flow is 1 to 10 inches per hour; "rapid" and "very rapid," that the rate is more than 10 inches per hour.

[3] Variable.

characteristics of soil types—Continued

Dominant natural drainage [1]	Surface layer (A horizon, uneroded)	Subsoil (B horizon, if present)	Permeability of subsoil [2]
Good	Very dark grayish-brown loam	Brown loam to clay loam	Moderate to slow.
Good	Very dark grayish-brown loam	No B horizon	Moderate.
Intermediate	Dark grayish-brown silt loam; dark-gray subsurface layer.	Mottled brown and dark grayish-brown silty clay loam.	Slow.
Good	Very dark brown silt loam	Dark-brown silty clay loam	Moderate.
Good	Very dark brown loam	Very dark grayish-brown and dark-brown loam.	Moderate.
Poor	Black silty clay to silty clay loam	Dark-gray silty clay	Very slow.
Poor	Black silt loam	Dark-gray silty clay	Very slow.
Good	Very dark brown loam	Brown loam	Rapid.
Good	Very dark brown loam to silt loam	Dark-brown to yellowish-brown loam to silty clay loam.	Moderate to rapid.
Poor	Black silty clay loam	Olive-gray and dark grayish-brown silty clay loam and clay loam.	Slow to moderate.

characteristics of the soils and the potential productivity of the soils should be known. Some of the characteristics to be considered in soil management are discussed in the following paragraphs.

Drainage and permeability.—Drainage and permeability are defined in the section, Soil Survey Methods and Definitions.

Drainage affects crop yields. Wet soils do not produce high yields of corn, soybeans, alfalfa, and small grains. Corn and alfalfa need a deep root zone for best growth. If the soils are wet, plants do not root deeply, nutrients are not readily available, weeds are difficult to control, and planting and cultivation are often delayed.

Poorly drained soils need to be artificially drained. Tile drains work well in soils that are moderately permeable or moderately to slowly permeable. They do not work well in very slowly permeable soils, which should be drained by open ditches or surface drains.

Permeability affects the rate of runoff and erosion. Soils that are slowly permeable absorb water more slowly and have faster runoff than soils that are rapidly permeable.

Moisture-holding capacity.—Permeability, runoff rate, relief, and natural drainage are factors that affect the moisture-holding capacity of a soil. Soil texture probably has the greatest effect. Silt loam and silty clay loam hold the most water available for plants. Clay, silty clay, clay loam, and loam hold somewhat less but normally hold adequate amounts for plant growth. Sand and loamy sand hold somewhat less moisture. The texture of all soil layers within the root zone should be considered in evaluating moisture-holding capacity.

Texture.—Soil texture affects the amount of water the soil will hold, the permeability of the soil, and the ease with which the soil can be cultivated and can be penetrated by plant roots. Consequently, texture must be considered in determining whether irrigation is needed, what method of irrigation to use, what system of drainage to install, and what crops to grow.

Organic-matter content.—The content of organic matter is normally related to soil color. Ordinarily, the darker the color, the greater the content of organic matter, and the greater the content of organic matter, the greater the supply of nitrogen. Light-colored soils generally need more nitrogen fertilizer than dark-colored soils.

Slope.—The slope of the soil is a most important characteristic in determining the need for erosion control. The steeper the slope, the more rapid the runoff and the greater the erosion hazard. Soils of more than 2 percent slope are generally subject to erosion if cultivated. Erosion losses are greater when the soils are not covered with vegetation. Steep slopes also limit the use of farm machinery.

Management Practices

Crop rotation.—A suitable crop rotation is basic to good management. No one rotation is best suited to all farms or soils. A rotation used on a large farm where adequate capital is available may not be suitable for a smaller farm. On erodible, sloping soils a different rotation may be necessary than on level soils where erosion is not a problem.

Moreover, the crop rotation selected should depend on accompanying practices. For example, if no nitrogen fertilizer or manure is used, it is very important that a good legume is included in the rotation to supply the nitrogen needed for grain. If terraces and contour cultivation are used as erosion control practices, meadow need not be used so long in the rotation.

Suggested rotations or uses and erosion control practices for all soils can be found in the section, Descriptions of Soils, and in table 4. High yields of suitable row crops can be obtained from productive soils if the suggested rotations and special practices are used. The rotation of crops and accompanying practices will reduce erosion losses to a reasonable minimum and maintain a satisfactory level of organic matter, provided the soils are fertilized according to the needs indicated by soil tests. The yields will, of course, vary from one soil to another. The rotations suggested are not necessarily the ones that will produce the highest yields per acre.

In choosing a suitable crop rotation for a farm or a field, one must consider the characteristics of the soils, their fertility and productivity, the present erosion control practices, the needs of livestock on the farm, and the current economic situation.

Erosion control.—Most farmers recognize the need for and the importance of controlling erosion. Erosion removes the soil material that contains the largest amounts of organic matter and of plant nutrients. It leaves gullies and buries crops under silt. It also fills drainage ditches, road ditches, and ponds with silt. Even when it does not entirely destroy the soil, erosion increases the costs of production and reduces crop yields.

Contouring, terracing, stripcropping, and growing meadow crops all help to control water erosion (fig. 10.) Mulch tillage, which leaves oats stubble, corn-

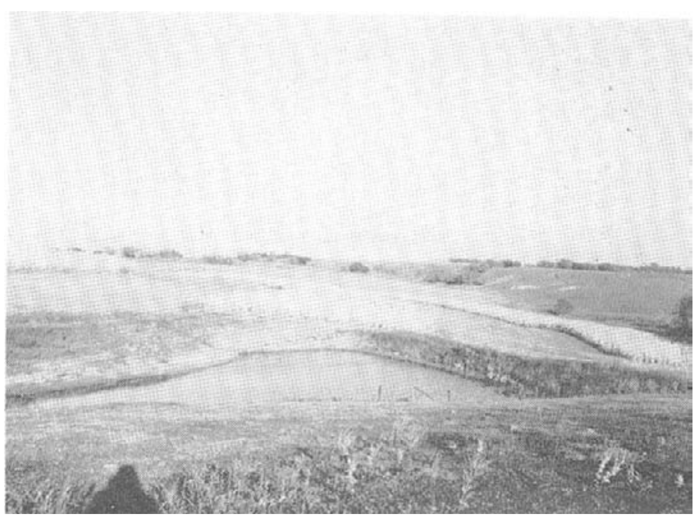

***Figure 10.*—Stripcropping of corn and meadow on Runnells silt loam, 9 to 14 percent slopes, moderately eroded. Pasture in foreground on Fayette silt loam, 9 to 14 percent slopes, moderately eroded. Other Fayette soils in background.**

stalks, or other crop residues on the surface or partially buried, helps to control wind erosion. It is particularly needed on sandy soils.

The Soil Conservation Service, assisting the Polk County Soil Conservation District, can help make an erosion control plan for your farm. Useful suggestions will be found in the subsection, Soil Properties Affecting Soil Conservation Practices, under Engineering Applications, in this report.

Fertilizer and lime.—The need for fertilizer and lime varies according to the kind of soil, past soil management, the crop grown, and the fertility level of the soil. On each farm, the soils from the various fields should be sampled and tested to determine needs for lime and fertilizer. Soils themselves change very slowly, but fertilizer recommendations for a soil may change from year to year as additional knowledge is acquired. Therefore, specific recommendations are not given here.

The soil map is the best guide for soil sampling. Samples from different areas of each soil should not be mixed if the most accurate results are to be obtained. The maximum area that should be represented by one sample is about 10 acres. Consult the extension director for more information about soil testing and for information about fertilization based on soil tests.

Crop Yields

Before choosing a cropping system for a soil, some estimate of the expected yields should always be made. To help evaluate the suitability of the soils for different crops, estimates of crop yields have been made for most of the soils that are suitable for cultivation. Table 4 shows the average yields that can be expected on the soils of the county under a high level of management. It is assumed that the high level of management includes the following:

1. Erosion control practices are being used where needed.
2. The corn stands are 14,000 to 16,000 plants per acre.
3. Fertilizer and lime are applied in accordance with the results of soil tests and at a level approaching that now established by the Iowa State College Soil Testing Laboratory.
4. The crops are grown in the rotation suggested and in combination with the special management practices suggested. All hay is from first-year stands, with three cuttings during the year. On soils suited to alfalfa, the meadow crop is alfalfa and bromegrass.
5. Tile or surface drains have been installed where needed and are working properly.
6. Suitable crop varieties are used.
7. Weeds, diseases, and insects are controlled by approved methods.
8. All farming operations are timely within practical limits.
9. Flooding is controlled if there is a flood hazard.
10. The management system has been in effect long enough (at least 10 years) so that the results are reflected in yields.

Improved varieties of crops, better fertilizer practices, improved farming practices, or new information may make it necessary to revise the estimates of average yields in the future.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the needs of the soils and their responses to management. All the soils in one capability class have limitations of about the same degree. The classes are identified by Roman numerals. All the soils in one subclass have the same kind of hazards. The subclasses are identified by letter symbols: "e" if the principal hazard is erosion, "w" if it is wetness, and "s" if it is shallowness, droughtiness, or coarseness of texture.

Soils in classes I, II, and III are suitable for cultivated crops. Soils in class IV are less suitable for a regular cropping system than soils in the first three classes, but they can be cultivated part of the time or with special management practices. Soils in classes V, VI, VII, and VIII are not generally suitable for cultivation.

In Iowa, class VIII is included with class VII because only small areas are in class VIII. Class I and class V are not divided into subclasses.

The capability classes and subclasses of Polk County are the following:

Class I.—Soils that have few limitations that restrict their use. Class I consists of the silty bottom-land soils that do not require artificial drainage and the level or nearly level upland and bench soils that do not require artificial drainage or erosion control practices.

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

- Subclass IIe.—Gently sloping soils that require simple erosion control practices.
- Subclass IIw.—Soils that have wetness problems but can usually be drained satisfactorily with tile.
- Subclass IIs.—Slightly droughty soils that may or may not be subject to erosion.

Class III.—Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both. These soils may need terracing to control erosion, or intensive water management on flat, wet areas.

- Subclass IIIe.—Moderately sloping to rolling soils that can be cultivated safely if protected by terracing, contour stripcropping, or other erosion control practices.
- Subclass IIIw.—Soils that have serious wetness problems because they pond after heavy rains or because they have clayey subsoils that make them difficult to drain with tile.
- Subclass IIIs.—Droughty and slightly droughty soils that are also subject to wind or water erosion.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems*

[See text preceding for assumptions on which estimates of yields are based]

Map symbol	Soil	Capability Subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2]			
						Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu.*	*Tons*
AaC	Adair clay loam, 5 to 9 percent slopes.	IIIw	Moderate erosion hazard; slight wetness; "tight" subsoil.	Same as surrounding soils.	If cultivated, interceptor tile drainage and terraces.	26	------	20	1.0
AaC2	Adair clay loam, 5 to 9 percent slopes, moderately eroded.	IIIw	Moderate erosion hazard; slight wetness.	Same as surrounding soils.	Same	25	------	20	1.0
AaD2	Adair clay loam, 9 to 14 percent slopes, moderately eroded.	IVe	Severe erosion hazard; slight wetness.	Hay or pasture	None	------	------	------	------
AbC3	Adair soils, 5 to 9 percent slopes, severely eroded.	IVe	Moderate erosion hazard; little or no topsoil.	Hay or pasture	None	------	------	------	------
AbD3	Adair soils, 9 to 14 percent slopes, severely eroded.	IVe	Severe erosion hazard; thin or no topsoil; slight wetness.	Hay or pasture	None	------	------	------	------
Ac	Alluvial land	IIw	Very severe flood and wetness hazards; channeling.	CS	Surface drainage; levees.	60	25	------	------
Ad	Ames loam	IIIw	Poor drainage; "tight" subsoil	CSOM	Shallow surface ditches	50	19	35	2.0
				Hay or pasture	None	------	------	------	------
AeA	Ankeny sandy loam, 0 to 2 percent slopes.	IIs	Droughtiness; sand overwash; difficult fertility maintenance.	COM	Mulch tillage	48	18	36	1.8
				Alfalfa	None	------	------	------	------
AeB	Ankeny sandy loam, 2 to 5 percent slopes.	IIs	Droughtiness; slight erosion hazard; difficult fertility maintenance.	COM	Mulch tillage	44	16	32	1.6
				Alfalfa	None	------	------	------	------
AfA	Atterberry silt loam, 1 to 3 percent slopes.	I	Slight wetness	CCOM	Possibly tile drainage	73	27	50	3.0
AgA	Atterberry silt loam, bench position, 1 to 3 percent slopes.	I	Runoff from slopes above; slight wetness.	CCOM	Possibly tile drainage and diversion terraces.	73	27	50	3.0
BaC2	Bauer silt loam, 5 to 9 percent slopes, moderately eroded.	IVe	Moderate erosion hazard; shallowness; low natural fertility.	COMMMM	Contouring	20	12	20	.8
				Hay or pasture	None	------	------	------	------
BaD2	Bauer silt loam, 9 to 14 percent slopes, moderately eroded.	VIe	Severe erosion hazard, some gullying; shallowness; low fertility.	Woodland or pasture	None	------	------	------	------
BaE2	Bauer silt loam, 14 to 20 percent slopes, moderately eroded.	VIIe	Severe erosion; shallowness; low fertility.	Woodland or pasture	None	------	------	------	------
BaF2	Bauer silt loam, 20 to 40 percent slopes, moderately eroded.	VIIe	Very severe erosion hazard; shallowness; low fertility.	Woodland or pasture	None	------	------	------	------
BbA	Blockton silt loam, 0 to 2 percent slopes.	IIw	Poor drainage; runoff from slopes above; poor workability; flood hazard in some areas.	CSCOM	Diversion terraces and surface drainage.	58	24	35	1.8
				CSOgm	Same	52	22	33	------
BbB	Blockton silt loam, 2 to 5 percent slopes.	IIw	Poor drainage; poor workability; slight erosion hazard.	CSCOM	Surface drainage	60	26	36	2.0
				CSOgm	Surface drainage	54	24	34	------
BcA	Buckner loamy sand, 0 to 2 percent slopes.	IIIs	Extreme droughtiness; hazard of wind erosion; difficult fertility maintenance.	Specialty crops, small grain, or alfalfa.	Mulch tillage	------	------	------	------
BcB	Buckner loamy sand, 2 to 5 percent slopes.	IIIs	Extreme droughtiness; hazard of wind erosion and some hazard of water erosion; difficult fertility maintenance.	Specialty crops or alfalfa.	Mulch tillage	------	------	------	------
BcC	Buckner loamy sand, 5 to 9 percent slopes.	IIIs	Extreme droughtiness; hazard of wind and water erosion; difficult fertility maintenance.	Specialty crops or alfalfa.	Mulch tillage and contouring.	------	------	------	------
BdB	Buckner-Hagener complex, 2 to 5 percent slopes.	IIIs	Droughtiness; slight wind and water erosion hazards; difficult fertility maintenance.	COM	Mulch tillage and contouring.	36	15	25	1.6
				Alfalfa	------	------	------	------	------

BdC	Buckner-Hagener complex, 5 to 9 percent slopes.	IIIs	Droughtiness; slight wind and moderate water erosion hazards; fertility maintenance.	COM	Mulch tillage and contouring.	32	------	22	1.5
				Alfalfa	------	------	------	------	------
CaA	Cantril silt loam, 0 to 2 percent slopes.	IIw	Slight wetness	Same as surrounding soils.	Possibly diversion terraces and surface drainage if cultivated.	55	24	46	3.0
CaB	Cantril silt loam, 2 to 5 percent slopes.	IIe	Slight wetness; slight erosion hazard.	Same as surrounding soils.	Same	55	24	46	3.0
CbA	Chaseburg silt loam, 0 to 2 percent slopes.	I	Runoff from slopes above; slight wetness.	Same as surrounding soils.	Possibly diversion terraces for overflow protection and tile drainage if cultivated.	65	27	48	3.2
CbB	Chaseburg silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard; wetness; need for runoff control.	Same as surrounding soils.	Possibly diversion terraces for overflow protection and tile drainage if cultivated; grassed waterways to control runoff and prevent gullying.	65	27	48	3.2
CcC2	Chelsea loamy fine sand, 5 to 9 percent slopes, eroded.	IVs	Severe droughtiness; difficult fertility maintenance; erosion hazard.	Small grains or alfalfa	Mulch tillage	------	------	------	------
CcD2	Chelsea loamy fine sand, 9 to 14 percent slopes, eroded.	VIs	Severe droughtiness; difficult fertility maintenance; severe erosion hazard.	Woodland or pasture	None	------	------	------	------
CcE2	Chelsea loamy fine sand, 14 to 20 percent slopes, eroded.	VIIs	Severe droughtiness; severe erosion hazard; difficult fertility maintenance.	Woodland or pasture	None	------	------	------	------
CcF2	Chelsea loamy fine sand, 20 to 30 percent slopes, eroded.	VIIs	Severe droughtiness; severe erosion hazard; low natural fertility.	Woodland or pasture	None	------	------	------	------
CdC	Clarinda silty clay loam, 5 to 9 percent slopes.	IIIw	Wetness; "tight" subsoil; low natural fertility; erosion.	Same as surrounding soils.	Interceptor tile and terraces if cultivated.	20	------	15	.8
CeC3	Clarinda soils, 5 to 9 percent slopes, severely eroded.	IVe	Wetness; clayey surface soil; low natural fertility; erosion hazard.	Hay or pasture	None	------	------	------	------
CfA	Clarion loam, 0 to 2 percent slopes	I	None	CSCOM	None	77	29	52	3.2
CfB	Clarion loam, 2 to 5 percent slopes	IIe	Slight erosion hazard	CCOMM	None	75	29	52	3.0
				CSCOM	Contouring	75	29	52	3.0
CfB2	Clarion loam, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard; low organic-matter content.	CCOMM	None	72	28	50	3.0
				CSCOM	Contouring	72	28	50	3.0
CfC	Clarion loam, 5 to 9 percent slopes	IIIe	Slight to moderate erosion hazard	COMMM	None	71	26	49	2.9
				CCOMM	Contouring	71	26	49	2.9
				CCOM	Terracing	71	26	49	2.9
CfC2	Clarion loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard; low organic-matter content.	COMMM	None	68	24	47	2.8
				CCOMM	Contouring	68	24	47	2.8
				CCOM	Terracing	68	24	47	2.8
CfD2	Clarion loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Same	Hay or pasture	None	60	------	40	2.6
				CCOMM	Terracing	60	------	40	2.6
CfE2	Clarion loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard; low organic-matter content.	Hay or pasture	None	------	------	------	------
CfF2	Clarion loam, 20 to 30 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; gullying; thin topsoil.	Pasture	None	------	------	------	------
CkC3	Clarion soils, 5 to 9 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; low organic-matter content; thin topsoil.	COMMMM	None	62	20	43	2.6
				COMM	Contouring	62	20	43	2.6
				CCOMM	Terracing	62	20	43	2.6
CkD3	Clarion soils, 9 to 14 percent slopes, severely eroded.	IVe	Moderate erosion hazard; gullying; low organic-matter content; thin topsoil.	Hay or pasture	None	------	------	------	------
				COM	Terracing	50	------	38	2.2
CkE3	Clarion soils, 14 to 20 percent slopes, severely eroded.	VIe	Severe erosion hazard; gullying; low organic-matter content; thin topsoil.	Pasture	None	------	------	------	------
CgB	Clarion loam, thin solum, 2 to 5 percent slopes.	IIe	Slight erosion hazard; shallowness	CCOMM	None	70	26	48	2.8

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems—Continued*

Map symbol	Soil	Capability subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2]			
						Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu.*	*Tons*
CgB2	Clarion loam, thin solum, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard; low organic-matter content; shallowness.	CCOMM	None	66	25	46	2.7
CgC2	Clarion loam, thin solum, 5 to 9 percent slopes, moderately eroded.	IIIe	Slight to moderate erosion hazard; low organic-matter content; "thin" soil.	COMMM	None	60	23	42	2.6
				CCOMM	Contouring	60	23	42	2.6
ChB	Clarion silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard	CCOMM	None	78	30	53	3.4
				CSCOM	Contouring	78	30	53	3.4
ChC2	Clarion silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	None	73	26	49	3.2
				CCOMM	Contouring	73	26	49	3.2
				CCOM	Terracing	73	26	49	3.2
ChD2	Clarion silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	Hay or pasture	None	62	----	45	2.8
				CCOMM	Terracing	62	----	45	2.8
ChE2	Clarion silt loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard; gullying; low organic-matter content.	Hay or pasture	None	----	----	----	----
CmC	Clearfield silty clay loam, 5 to 9 percent slopes.	IIIw	Slight wetness; slight erosion hazard.	Same as surrounding Sharpsburg soils.	Tile drainage and contouring if cultivated.	60	23	40	2.2
CmC2	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded.	IIIw	Slight wetness; slight erosion hazard; thin topsoil.	Same as surrounding soils.	Same	55	22	38	2.2
CmD2	Clearfield silty clay loam, 9 to 14 percent slopes, moderately eroded.	IVe	Slight wetness; moderate erosion hazard.	Hay or pasture	None	----	----	----	----
Cn	Colo silty clay loam	IIw	Wetness; some flooding	CSCOM	Tile or surface drainage; protection from overflow.	70	29	52	3.0
				CCOgm	Same	64	27	50	----
Co	Colo silty clay loam, channeled	V	Wetness; flooding	Pasture or woodland	None	----	----	----	----
Cp	Colo loam, loamy subsoil variant	IIw	Wetness; some flooding	CSCOM	Tile or surface drainage; protection from overflow.	62	26	42	2.4
				CCOgm	Same	56	24	38	----
Cr	Colo-Judson-Nodaway complex	IIw	Wetness; flooding	Same as surrounding soils.	Possibly tile drainage, protection from overflow, or both, if cultivated.	65	27	34	2.6
CsA	Colo-Terril complex, 0 to 2 percent slopes.	IIw	Wetness; some flooding	Same as surrounding soils.	Tile or surface drainage and protection from overflow if cultivated.	72	29	52	3.0
CsB	Colo-Terril complex, 2 to 5 percent slopes.	IIw	Wetness; occasional flooding	Same as surrounding soils.	Same	74	30	53	3.2
Ct	Cooper silt loam, acid variant	IIw	Wetness; some flooding	CSCOM	Surface drainage and protection from overflow.	65	28	50	2.6
				CCOgm	Same	60	26	48	----
CuB	Crocker loamy fine sand, 2 to 5 percent slopes.	IIs	Droughtiness; slight erosion hazard; difficult fertility maintenance.	COM	Mulch tillage	39	15	30	1.8
				Hay or pasture	None	----	----	----	----
CuC2	Crocker loamy fine sand, 5 to 9 percent slopes, moderately eroded.	IIIs	Droughtiness; slight erosion hazard; thin topsoil; difficult fertility maintenance.	COM	Contouring and mulch tillage.	33	14	27	1.8
				Hay or pasture	None	----	----	----	----

CuD2	Crocker loamy fine sand, 9 to 14 percent slopes, moderately eroded.	IVs	Droughtiness; moderate erosion hazard; thin topsoil; difficult fertility maintenance.	Hay or pasture	None	-----	-----	-----	-----
CuE2	Crocker loamy fine sand, 14 to 20 percent slopes, moderately eroded.	VIs	Droughtiness; severe erosion hazard; difficult fertility maintenance.	Woodland or pasture	None	-----	-----	-----	-----
CuF	Crocker loamy fine sand, 20 to 30 percent slopes.	VIIs	Same	Woodland or pasture	None	-----	-----	-----	-----
DaA	Dickinson fine sandy loam, 0 to 2 percent slopes.	IIIs	Droughtiness	COM	Mulch tillage	44	18	36	2.0
				Alfalfa	None	-----	-----	-----	-----
DaB	Dickinson fine sandy loam, 2 to 5 percent slopes.	IIIs	Droughtiness; slight erosion hazard.	COM	Mulch tillage	43	17	36	2.0
				Alfalfa	None	-----	-----	-----	-----
DaB2	Dickinson fine sandy loam, 2 to 5 percent slopes, moderately eroded.	IIIs	Droughtiness; slight erosion hazard; thin topsoil.	COM	Mulch tillage	40	15	34	1.7
				Alfalfa	None	-----	-----	-----	-----
DaC2	Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded.	IIIs	Droughtiness; moderate erosion hazard; thin surface layer.	COMMM	Contouring and mulch tillage.	35	-----	32	1.6
				Alfalfa	None	-----	-----	-----	-----
DaD2	Dickinson fine sandy loam, 9 to 14 percent slopes, moderately eroded.	VIs	Droughtiness; moderate erosion hazard; thin surface layer.	Pasture	None	-----	-----	-----	-----
DaE2	Dickinson fine sandy loam, 14 to 20 percent slopes, moderately eroded.	VIIs	Droughtiness; severe erosion hazard.	Pasture	None	-----	-----	-----	-----
DaF2	Dickinson fine sandy loam, 20 to 30 percent slopes, moderately eroded.	VIIs	Droughtiness; severe erosion hazard.	Pasture	None	-----	-----	-----	-----
DdD3	Dickinson soils, 9 to 14 percent slopes, severely eroded.	VIs	Droughtiness; moderate erosion hazard; thin topsoil.	Pasture	None	-----	-----	-----	-----
DdE3	Dickinson soils, 14 to 20 percent slopes, severely eroded.	VIIs	Droughtiness; severe erosion hazard; thin topsoil.	Pasture	None	-----	-----	-----	-----
DbB	Dickinson loam, 2 to 5 percent slopes.	IIs	Slight droughtiness; slight erosion hazard.	COM	None	45	18	38	2.2
				CCOM	Contouring	45	18	38	2.3
DbC2	Dickinson loam, 5 to 9 percent slopes, moderately eroded.	IIIs	Slight drought hazard; moderate erosion hazard.	COMMM	Contouring	40	15	34	2.0
				CCOM	Terracing	-----	-----	-----	-----
				Alfalfa	None	-----	-----	-----	-----
DbD2	Dickinson loam, 9 to 14 percent slopes, moderately eroded.	IVs	Same	Alfalfa	None	-----	-----	-----	-----
DbE2	Dickinson loam, 14 to 20 percent slopes, moderately eroded.	VIs	Slight drought hazard; severe erosion hazard.	Pasture	None	-----	-----	-----	-----
DbF2	Dickinson loam, 20 to 30 percent slopes, moderately eroded.	VIIs	Slight drought hazard; severe erosion hazard.	Pasture	None	-----	-----	-----	-----
DcA	Dickinson sandy loam, bench position, 0 to 2 percent slopes.	IIIs	Droughtiness; slight wind erosion hazard; difficult fertility maintenance.	Alfalfa	None	-----	-----	-----	-----
				COM	None	42	18	30	1.7
DcB	Dickinson sandy loam, bench position, 2 to 5 percent slopes.	IIIs	Droughtiness; slight erosion hazard; difficult fertility maintenance.	Alfalfa	None	-----	-----	-----	-----
				COM	Mulch tillage and contouring.	40	18	30	1.7
DcC	Dickinson sandy loam, bench position, 5 to 9 percent slopes.	IIIs	Droughtiness; moderate erosion hazard; difficult fertility maintenance.	Alfalfa	-----	-----	-----	-----	-----
				COMM	Mulch tillage and contouring.	35	16	28	1.5
De	Dorchester silt loam	I	Severe flood hazard	CCOgm	Protection from overflow.	60	24	50	-----
				Woodland or pasture	None	-----	-----	-----	-----
Df	Dorchester silt loam, moderately shallow over sand.	IIIs	Droughtiness; severe flood hazard	CCOgm	Protection from overflow.	35	18	35	-----
				Woodland or pasture	None	-----	-----	-----	-----
Dg	Dorchester silt loam, deep over sand.	I	Slight drought hazard; severe flood hazard.	CCOgm	Overflow protection	55	25	45	-----
				Woodland or pasture	None	-----	-----	-----	-----
DhA	Downs silt loam, 0 to 2 percent slopes.	I	None	CCOM	None	80	29	50	3.2
DhB	Downs silt loam, 2 to 5 percent slopes.	Ie	Slight erosion hazard	CCOMM	None	78	29	50	3.2
				CCOM	Contouring	78	29	50	3.2
DhC2	Downs silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	None	70	27	46	3.0
				CCOMM	Contouring	70	27	46	3.0
				CCOM	Terracing	70	27	46	3.0

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems—Continued*

Map symbol	Soil	Capability subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2]			
						Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu.*	*Tons*
DhD2	Downs silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	CCOMM	Terracing	62	----	42	2.8
				Hay or pasture	None	----	----	----	----
DhE2	Downs silt loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay, pasture, or woodland.	None	----	----	----	----
DhF2	Downs silt loam, 20 to 30 percent slopes, moderately eroded.	VIIe	Severe erosion hazard	Pasture or woodland	None	----	----	----	----
DkC3	Downs soils, 5 to 9 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; thin topsoil.	COMM	Contouring	64	24	42	2.8
				CCOMM	Terracing	64	24	42	2.8
DkD3	Downs soils, 9 to 14 percent slopes, severely eroded.	IVe	Moderate erosion hazard; thin topsoil.	COMM	Terracing or stripcropping.	58	----	38	2.6
				Hay, pasture, or woodland.	None	----	----	----	----
DkE3	Downs soils, 14 to 20 percent slopes, severely eroded.	VIe	Severe erosion hazard; thin surface layers.	Pasture or woodland	None	----	----	----	----
FaB	Farrar fine sandy loam, 2 to 5 percent slopes.	IIs	Slight drought and erosion hazards.	COM	Mulch tillage	53	18	36	2.2
				CCOM	Mulch tillage and contouring.	53	18	36	2.2
FaC	Farrar fine sandy loam, 5 to 9 percent slopes.	IIIs	Slight drought hazard	COMMM	Mulch tillage	48	16	34	2.0
				COMM	Mulch tillage and contouring.	48	16	34	2.0
				CCOM	Mulch tillage and terracing.	48	16	34	2.0
FaC2	Farrar fine sandy loam, 5 to 9 percent slopes, moderately eroded.	IIIs	Slight drought hazard; medium erosion hazard.	COMMM	Mulch tillage	46	16	28	2.0
				COMM	Mulch tillage and contouring.	46	16	28	2.0
				CCOM	Mulch tillage and terracing.	46	16	28	2.0
FaD2	Farrar fine sandy loam, 9 to 14 percent slopes, moderately eroded.	IVs	Same	Hay or pasture	None	----	----	----	----
FaE2	Farrar fine sandy loam, 14 to 20 percent slopes, moderately eroded.	VIs	Slight drought hazard; severe erosion hazard.	Pasture	None	----	----	----	----
FaF2	Farrar fine sandy loam, 20 to 30 percent slopes, moderately eroded.	VIIs	Same	Pasture	None	----	----	----	----
FbA	Fayette silt loam, 0 to 2 percent slopes.	I	Lime deficiency; low organic-matter content.	CCOM	None	74	28	48	3.0
FbB	Fayette silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard; lime deficiency.	CCOMM	None	74	28	48	3.0
				CCOM	Contouring	74	28	48	3.0
FbB2	Fayette silt loam, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard; lime deficiency.	CCOMM	None	73	27	46	3.0
				CCOM	Contouring	73	27	46	3.0
FbC2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard; lime deficiency.	COMM	Contouring	68	26	44	2.8
				CCOM	Terracing	68	26	44	2.8
FbD2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	CCOMM	Terracing	58	----	40	2.6
				Hay or pasture	None	----	----	----	----
FbE2	Fayette silt loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay or pasture	None	----	----	----	----
FbF2	Fayette silt loam, 20 to 30 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; gullying	Pasture or woodland	None	----	----	----	----
FbG2	Fayette silt loam, 30 to 40 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; gullying	Pasture or woodland	None	----	----	----	----

FcB	Fayette silt loam, bench position, 2 to 5 percent slopes.	IIe	Slight erosion hazard; runoff water from slopes above.	CCOMM	None	74	28	48	3.0
				CCOM	Contouring	74	28	48	3.0
FdC3	Fayette soils, 5 to 9 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; thin topsoil; lime deficiency.	COMMM	Contouring	61	23	40	2.6
				COMMM	Terracing	61	23	40	2.6
FdD3	Fayette soils, 9 to 14 percent slopes, severely eroded.	IVe	Moderate erosion hazard; thin topsoil.	COMM	Terracing or stripcropping.	55	----	36	2.4
				Hay or pasture	None	----	----	----	----
FdE3	Fayette soils, 14 to 20 percent slopes, severely eroded.	VIe	Severe erosion hazard; thin topsoil.	Pasture or woodland	None	----	----	----	----
GaC2	Gara loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard; low natural fertility.	COMM	Contouring	40	----	32	2.0
				CCOMM	Terracing	40	----	32	2.0
GaD2	Gara loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Severe erosion hazard; low natural fertility.	COM	Terracing	38	----	30	1.8
				Hay or pasture	None	38	----	30	1.8
GaE2	Gara loam, 14 to 20 percent slopes, moderately eroded.	IVe	Same	Hay, pasture, or woodland.	None	----	----	----	----
GbD3	Gara soils, 9 to 14 percent slopes, severely eroded.	IVe	Severe erosion hazard; low natural fertility; thin topsoil.	Hay, pasture, or woodland.	None	----	----	----	----
GbE3	Gara soils, 14 to 20 percent slopes, severely eroded.	VIe	Same	Woodland or pasture	None	----	----	----	----
GbF2	Gara soils, 20 to 40 percent slopes, slightly to severely eroded.	VIIe	Severe erosion hazard; low natural fertility; gullying.	Woodland or pasture	None	----	----	----	----
Gc	Glencoe silty clay loam	IIIw	Wetness; lack of outlets for tile drainage; ponding.	Same as surrounding soils.	Tile and surface drainage.	[3]	[3]	[3]	[3]
GdC2	Gosport silt loam, 5 to 9 percent slopes, moderately eroded.	IVe	Severe erosion hazard; gullying; shallow soil.	Woodland or pasture	None	----	----	----	----
GdD2	Gosport silt loam, 9 to 14 percent slopes, moderately eroded.	VIe	Same	Woodland or pasture	None	----	----	----	----
GdE2	Gosport silt loam, 14 to 20 percent slopes, moderately eroded.	VIIe	Same	Woodland or pasture	None	----	----	----	----
GdF2	Gosport silt loam, 20 to 40 percent slopes, moderately eroded.	VIIe	Very severe erosion hazard; gullying; shallowness.	Woodland or pasture	None	----	----	----	----
GeE3	Gosport soils, 14 to 20 percent slopes, severely eroded.	VIIe	Severe erosion hazard; gullying; extreme shallowness.	Woodland or pasture	None	----	----	----	----
GfB	Gravity silty clay loam, 2 to 4 percent slopes.	IIw	Slight wetness hazard; slight flood hazard in some areas.	Same as surrounding soils.	Tile drainage and diversion terraces for protection from overflow if cultivated.	65	29	50	3.0
HaA	Hagener loamy fine sand, 0 to 2 percent slopes.	IIIs	Droughtiness; slight wind erosion hazard; difficult fertility maintenance.	COM	Mulch tillage	38	15	26	1.6
				Alfalfa	None	----	----	----	----
HaA2	Hagener loamy fine sand, 0 to 2 percent slopes, moderately eroded.	IIIs	Severe droughtiness; slight wind erosion hazard; difficult fertility maintenance.	COM	Mulch tillage	38	15	25	1.6
				Alfalfa	None	----	----	----	----
HaB	Hagener loamy fine sand, 2 to 5 percent slopes.	IIIs	Severe droughtiness; slight wind and water erosion hazard; difficult fertility maintenance.	COM	Mulch tillage	38	15	25	1.6
				Alfalfa	None	----	----	----	----
HaB2	Hagener loamy fine sand, 2 to 5 percent slopes, moderately eroded.	IIIs	Same	COM	Mulch tillage	36	14	24	1.6
				Alfalfa	None	----	----	----	----
HaC	Hagener loamy fine sand, 5 to 9 percent slopes.	IIIs	Droughtiness; slight wind and moderate water erosion hazard; fertility maintenance.	COM	Mulch tillage and contouring	34	----	22	1.5
				Alfalfa	None	----	----	----	----
HaC2	Hagener loamy fine sand, 5 to 9 percent slopes, moderately eroded.	IIIs	Same	COM	Mulch tillage and contouring	30	----	20	1.4
				Alfalfa	None	----	----	----	----
HaD2	Hagener loamy fine sand, 9 to 14 percent slopes, moderately eroded.	VIs	Severe droughtiness; slight wind and severe water erosion hazard; difficult fertility maintenance.	Pasture	None	----	----	----	----
HaD3	Hagener loamy fine sand, 9 to 14 percent slopes, severely eroded.	VIs	Same	Pasture	None	----	----	----	----
HaE2	Hagener loamy fine sand, 14 to 20 percent slopes, eroded.	VIIs	Same	Pasture	None	----	----	----	----
Hb	Harpster loam	IIw	Wetness; special fertilization for high-lime or alkali soils; high potassium requirements.	Same as surrounding soils.	Tile drainage; potash fertilizers.	60	24	40	2.5

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems—Continued*

Map symbol	Soil	Capability Subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2]			
						Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu.*	*Tons*
HcA	Hayden loam, 0 to 2 percent slopes.	I	Lime deficiency; low organic-matter content.	CCOM	Possibly drainage	65	24	46	2.8
HcB	Hayden loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard	CCOMM	None	65	24	45	2.8
				CCOM	Contouring	65	24	45	2.8
HcB2	Hayden loam, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard	CCOMM	None	62	22	44	2.7
				CCOM	Contouring	62	22	44	2.7
HcC2	Hayden loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	None	58	-----	40	2.6
				CCOMM	Contouring	58	-----	40	2.6
				CCOM	Terracing	58	-----	40	2.6
HcD2	Hayden loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	Hay or pasture	None	51	-----	36	2.4
				COMMM	Contouring	51	-----	36	2.4
				CCOMM	Terracing	51	-----	36	2.4
HcE2	Hayden loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay, pasture, or woodland.	None	-----	-----	-----	-----
HcF2	Hayden loam, 20 to 30 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; gullying	Pasture or woodland	None	-----	-----	-----	-----
HcG2	Hayden loam, 30 to 40 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; gullying	Pasture or woodland	None	-----	-----	-----	-----
Hf	Huntsville silt loam	I	Some flood hazard	CCOgm	Overflow protection	65	27	48	-----
Hg	Huntsville silt loam, channeled	V	Very severe flood hazard	Woodland or pasture	None	-----	-----	-----	-----
Hd	Huntsville sandy loam	IIs	Some flood hazard	CCOgm	Overflow protection	45	20	38	-----
He	Huntsville sandy loam, channeled	V	Very severe flood hazard	Woodland or pasture	None	-----	-----	-----	-----
IaC2	Ida silt loam, 5 to 9 percent slopes, eroded.	IIIe	Moderate erosion hazard; special fertilization for high lime.	COMM	Contouring	55	-----	34	2.4
				CCOM	Terracing	55	-----	34	2.4
JaB	Judson silt loam, 2 to 5 percent slopes.	IIe	Slight wetness hazard; runoff from slopes above.	Same as surrounding soils.	May need tile drainage or diversion terraces, or both, for protection from overflow if cultivated.	75	29	50	3.2
JaC	Judson silt loam, 5 to 9 percent slopes.	IIIe	Slight wetness hazard; slight erosion hazard.	Same as surrounding soils.	Same	70	27	47	3.0
KaA	Kato loam, moderately deep over sand and gravel, 1 to 3 percent slopes.	IIs	Droughtiness; shallowness over sand and gravel; slight wetness.	CCOM	None	54	23	40	2.0
KbA	Kato loam, deep over sand and gravel, 1 to 3 percent slopes.	I	Slight wetness hazard	CCOgm	May need tile drainage	69	28	50	-----
				CCOM	May need tile drainage	76	30	55	3.0
LaB	Ladoga silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard	COMM	None	70	26	45	3.0
				CCOM	Contouring	70	26	45	3.0
LaC2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMM	Contouring	64	22	40	2.8
				CCOM	Terracing	64	22	40	2.8
LaD2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	Hay or pasture	None	55	-----	36	2.4
				CCOMM	Terracing	55	-----	36	2.4
				COMM	Stripcropping	55	-----	36	2.4
LaE2	Ladoga silt loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay, pasture, or woodland.	None	-----	-----	-----	-----
LaF2	Ladoga silt loam, 20 to 30 percent slopes, moderately eroded.	VIIe	Severe erosion hazard	Woodland or pasture	None	-----	-----	-----	-----
LbC3	Ladoga soils, 5 to 9 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; thin topsoil.	COMMM	Contouring	52	17	34	2.4
				CCOM	Terracing	52	17	34	2.4

510689—60——6

LcB	Lakeville sandy loam, 2 to 5 percent slopes.	IIIs	Droughtiness; slight erosion hazard; shallowness over limy material.	Alfalfa	None	------	------	------	------
				COM	Mulch tillage and contouring.	35	14	32	1.5
LcC2	Lakeville sandy loam, 5 to 9 percent slopes, moderately eroded.	IIIs	Droughtiness; moderate erosion hazard.	Alfalfa	None	------	------		------
				COMM	Mulch tillage and contouring.	30	------	32	
				COM	Mulch tillage and terracing.	30	------	32	
LcD2	Lakeville sandy loam, 9 to 14 percent slopes, moderately eroded.	VIs	Droughtiness; moderate erosion hazard.	Pasture	None	------	------	------	------
LcE2	Lakeville sandy loam, 14 to 20 percent slopes, moderately eroded.	VIIs	Droughtiness; severe erosion hazard; thin or no topsoil.	Pasture	None	------	------	------	------
LcF2	Lakeville sandy loam, 20 to 40 percent slopes, moderately eroded.	VIIs	Droughtiness; severe erosion hazard.	Pasture	None	------	------	------	------
LdB	Lamont fine sandy loam, 2 to 5 percent slopes.	IIs	Droughtiness; slight erosion hazard; difficult fertility maintenance.	Alfalfa	None	------	------	------	------
				COM	Mulch tillage	40	15	32	1.4
LdC	Lamont fine sandy loam, 5 to 9 percent slopes.	IIIs	Droughtiness; moderate erosion hazard; difficult fertility maintenance.	Alfalfa	None	------	------	------	------
				COMM	Mulch tillage and contouring.	34	------	28	1.2
LdD	Lamont fine sandy loam, 9 to 14 percent slopes.	VIs	Droughtiness; moderate erosion hazard; low natural fertility.	Pasture or woodland	None	------	------	------	------
LdE	Lamont fine sandy loam, 14 to 20 percent slopes.	VIIs	Droughtiness; severe erosion hazard; difficult fertility maintenance.	Pasture or woodland	None	------	------	------	------
LdF	Lamont fine sandy loam, 20 to 30 percent slopes.	VIIs	Same	Pasture or woodland	None	------	------	------	------
LeA	Lester loam, 0 to 2 percent slopes	I	Lime deficiency	CSCOM	None	75	28	50	3.2
				CCOgm	None	68	26	47	------
LeB	Lester loam, 2 to 5 percent slopes	IIe	Slight erosion hazard	CCOMM	None	73	27	49	3.0
				CSCOM	Contouring	73	27	49	3.0
LeB2	Lester loam, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard	CCOMM	None	68	26	47	2.9
				CSCOM	Contouring	68	26	47	2.9
LeC2	Lester loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	None	65	25	45	2.8
				CCOMM	Contouring	65	25	45	2.8
				CCOM	Terracing	65	25	45	2.8
LeD2	Lester loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	Hay or pasture	None	------	------	------	------
				CCOMM	Terracing	58	------	40	2.6
LeE2	Lester loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Pasture or woodland	None	------	------	------	------
LeF	Lester loam, 20 to 40 percent slopes.	VIIe	Severe erosion hazard; gullying	Pasture or woodland	None	------	------	------	------
LfC3	Lester soils, 5 to 9 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; thin or no topsoil.	COMMM	None	60	22	42	2.6
				COMM	Contouring	60	22	42	2.6
				COM	Terracing	60	22	42	2.6
LfD3	Lester soils, 9 to 14 percent slopes, severely eroded.	IVe	Moderate erosion hazard; thin or no topsoil.	Hay or pasture	None	------	------	------	------
LgE	Lester-Colo complex, 0 to 20 percent slopes.	IVe	Erosion hazard; flooding and wetness (on Colo).	Hay, pasture, or woodland.	None	------	------	------	------
LgF	Lester-Colo complex, 0 to 40 percent slopes.	VIIe	Same	Woodland or pasture	None	------	------	------	------
LhA	LeSueur loam, 1 to 3 percent slopes	I	Slight wetness	CCOgm	Possibly tile drainage	63	25	47	------
				CSCOM	Possibly tile drainage	70	27	50	3.0
LkD2	Lindley loam, 9 to 14 percent slopes, moderately eroded.	IVe	Moderate erosion hazard; low natural fertility.	Pasture or woodland	None	38	------	26	1.4
LkE2	Lindley loam, 14 to 20 percent slopes, moderately eroded.	VIe	Severe erosion hazard; low natural fertility.	Pasture or woodland	None	------	------	------	------
LmD3	Lindley soils, 9 to 14 percent slopes, severely eroded.	VIe	Moderate erosion hazard; thin or no topsoil; low natural fertility.	Pasture or woodland	None	------	------	------	------
LmE3	Lindley soils, 14 to 20 percent slopes, severely eroded.	VIIe	Severe erosion hazard; thin or no topsoil; low natural fertility.	Pasture or woodland	None	------	------	------	------
LmF2	Lindley soils, 20 to 40 percent slopes, moderately eroded.	VIIe	Severe erosion hazard; low natural fertility.	Pasture or woodland	None	------	------	------	------
Mb	Marshan silty clay loam, deep over sand and gravel.	IIw	Wetness; slight flood hazard in places.	CSCOM	Tile drainage	76	29	55	3.2
				CCOgm	Tile drainage	69	27	50	------
Ma	Marshan silty clay loam, moderately deep over sand and gravel.	IIw	Wetness; slight flood hazard	CCOgm	Tile drainage	55	23	45	------
				CSCOM	Tile drainage	60	25	50	2.6

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems*—Continued

Map symbol	Soil	Capability subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2]			
						Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu.*	*Tons*
Md	Muck, moderately shallow	IIIw	Wetness; lack of outlets for tile drainage; early frost hazard.	Continuous corn or truck crops.	Tile and surface drainage.	([3])	([3])	([3])	([3])
				Pasture	Surface drainage	([3])	([3])	([3])	([3])
Mc	Muck, very shallow	IIIw	Wetness; early frost hazard	Continuous corn or truck crops.	Tile and surface drainage.	([3])	([3])	([3])	([3])
MeA	Muscatine silt loam, 1 to 3 percent slopes.	I	None	CCOM	Possibly tile drainage	85	30	55	3.6
				CCOgm	Possibly tile drainage	78	28	50	-----
NaA	Nicollet loam, 1 to 3 percent slopes	I	Slight wetness	CCOM	Possibly tile drainage	81	31	55	3.4
				CCOgm	Possibly tile drainage	73	29	50	-----
Nb	Nodaway silt loam	I	Slight wetness; medium flood hazard.	CCOgm	Protection from overflow.	68	28	50	-----
Oa	Okoboji silt loam	IIIw	Wetness; lack of outlets for tile drainage in potholes.	Same as surrounding soils.	Tile and surface drainage if cultivated.	([3])	([3])	([3])	([3])
ObB	Olmitz loam, 2 to 5 percent slopes	IIe	Slight wetness	Same as surrounding soils.	May need tile drainage and diversion terraces for protection from overflow if cultivated; grassed waterways.	73	28	50	3.2
ObC	Olmitz loam, 5 to 9 percent slopes	IIIe	Very slight wetness	Same as surrounding soils.	Same	68	27	47	3.0
OcA	Olmitz sandy loam, 0 to 2 percent slopes.	IIs	Droughtiness; slight wetness; low natural fertility.	Same as surrounding soils.	Same	55	20	40	2.0
OcB	Olmitz sandy loam, 2 to 5 percent slopes.	IIs	Droughtiness; slight wetness	Same as surrounding soils.	Same	53	18	38	2.0
Pa	Peat	IIIw	Wetness; shallowness over clayey material.	Continuous corn or truck crops.	Tile and surface drainage.	([3])	([3])	([3])	([3])
				Pasture	Surface drainage	([3])	([3])	([3])	([3])
Ra	Riverwash	VIIs	Extreme droughtiness; very severe flood hazard.	Nonagricultural land	None	-----	-----	-----	-----
Rb	Rolfe loam	IIIw	Wetness; very "tight" subsoil	Same as surrounding soils.	Tile with surface intakes and surface drainage.	([3])	([3])	([3])	([3])
Rc	Rolfe loam, bench position	IIIw	Wetness; slight flood hazard; very "tight" subsoil.	Same as surrounding soils.	Same	([3])	([3])	([3])	([3])
RdC2	Runnells silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	Hay or pasture	None	-----	-----	-----	-----
				COMM	Contouring	50	-----	40	2.4
RdD2	Runnells silt loam, 9 to 14 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay or pasture	None	-----	-----	-----	-----
RdE2	Runnells silt loam, 14 to 20 percent slopes, moderately eroded.	VIe	Severe erosion hazard; gullying	Pasture or woodland	None	-----	-----	-----	-----
RdF2	Runnells silt loam, 20 to 40 percent slopes, moderately eroded.	VIIe	Very severe erosion hazard; gullying.	Pasture or woodland	None	-----	-----	-----	-----
ReD3	Runnells soils, 9 to 14 percent slopes, severely eroded.	IVe	Severe erosion hazard; gullying; thin topsoil.	Hay or pasture	None	-----	-----	-----	-----
Sa	Sarpy loamy sand	IIIs	Severe flood and drought hazards	Hay or pasture	None	25	-----	25	2.0
SbA	Saylor fine sandy loam, 0 to 2 percent slopes.	IIs	Droughtiness; slight wetness in spring; difficult fertility maintenance.	CCOM	Mulch tillage; possibly drainage.	48	22	32	2.0
ScA	Sharpsburg silt loam, 0 to 2 percent slopes.	I	None	CSCOM	Possibly tile drainage	80	30	45	3.2
ScB	Sharpsburg silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard	CCOMM	None	76	28	45	3.0
				CSCOM	Contouring	76	28	45	3.0

ScC	Sharpsburg silt loam, 5 to 9 percent slopes.	IIIe	Slight to moderate erosion hazard	CCOMM	Contouring	69	27	42	2.8
				CCOM	Terracing	69	27	42	2.8
ScC2	Sharpsburg silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	CCOMM	Contouring	66	26	40	2.8
				CCOM	Terracing	66	26	40	2.8
ScD2	Sharpsburg silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	CCOMM	Terracing	60	------	38	2.6
				Hay or pasture	None	------	------	------	------
ScE2	Sharpsburg silt loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay or pasture	None	------	------	------	------
SdD3	Sharpsburg soils, 9 to 14 percent slopes, severely eroded.	IVe	Medium erosion hazard; thin topsoil.	COM	Terracing	56	------	32	2.5
				Hay or pasture	None	------	------	------	------
SeC2	Shelby loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	Contouring	50	------	36	2.0
				CCOM	Terracing	50	------	36	2.0
SeD2	Shelby loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate to severe erosion hazard	Hay or pasture	None	------	------	------	------
				CCOMM	Terracing	45	------	32	1.8
SeE2	Shelby loam, 14 to 20 percent slopes, moderately eroded.	IVe	Severe erosion hazard	Hay or pasture	None	------	------	------	------
SfE3	Shelby soils, 14 to 20 percent slopes, severely eroded.	VIe	Severe erosion hazard; thin topsoil	Pasture	None	------	------	------	------
SfF3	Shelby soils, 20 to 30 percent slopes, severely eroded.	VIIe	Severe erosion hazard; gullying; thin topsoil.	Pasture	None	------	------	------	------
SgC	Storden loam, 3 to 9 percent slopes	IIIe	Moderate erosion hazard; shallowness over limy glacial till.	Hay or pasture	None	------	------	------	------
				COMM	Contouring	60	------	39	2.1
				CCOM	Terracing	60	------	39	2.1
SgF2	Storden loam, 20 to 40 percent slopes, moderately eroded.	VIIe	Very severe erosion hazard; shallowness; gullying.	Pasture	None	------	------	------	------
ShC3	Storden soils, 5 to 9 percent slopes, severely eroded.	IIIe	Severe erosion hazard; very thin or no topsoil; shallowness.	Hay or pasture	None	------	------	------	------
				COMM	Contouring	52	------	37	2.0
				CCOM	Terracing	52	------	37	2.0
ShD3	Storden soils, 9 to 14 percent slopes, severely eroded.	IIIe	Severe erosion hazard; shallowness	Hay or pasture	None	------	------	------	------
				COM	Terracing	45	------	35	1.8
ShE3	Storden soils, 14 to 20 percent slopes, severely eroded.	IVe	Severe erosion hazard; shallowness	Hay or pasture	None	------	------	------	------
SkE	Storden-Colo complex, 0 to 20 percent slopes.	IVe	Severe erosion hazard on Storden; flooding and wetness on Colo.	Pasture	None	------	------	------	------
SkF	Storden-Colo complex, 0 to 40 percent slopes.	VIIe	Same	Pasture	None	------	------	------	------
SmC2	Storden-Lakeville complex, 5 to 9 percent slopes, moderately eroded.	IIIs	Moderate erosion hazard; droughtiness; gravel; shallowness.	COMM	Contouring	40	------	34	1.8
				COM	Terracing	40	------	34	1.8
SmD2	Storden-Lakeville complex, 9 to 14 percent slopes, moderately eroded.	IVs	Droughtiness; gravel; shallowness; severe erosion hazard.	Hay or pasture	None	------	------	------	------
SmE2	Storden-Lakeville complex, 14 to 20 percent slopes, moderately eroded.	VIs	Same	Pasture	None	------	------	------	------
Sn	Stronghurst silt loam	I	Slight wetness	CCOM	Possibly tile drainage	65	25	45	2.9
So	Stronghurst silt loam, bench position.	I	Slight wetness; runoff from slopes above.	CCOM	Possibly tile drainage	65	25	45	2.9
TaA	Tama silt loam, 0 to 2 percent slopes.	I	None	CSCOM	None	83	31	55	3.6
TaB	Tama silt loam, 2 to 5 percent slopes.	IIe	Slight erosion hazard	CCOM	None	80	31	55	3.5
				CSCOM	Contouring	80	31	55	3.5
TaB2	Tama silt loam, 2 to 5 percent slopes, moderately eroded.	IIe	Slight erosion hazard	CCOM	None	78	30	53	3.5
				CSCOM	Contouring	78	30	53	3.5
TaC	Tama silt loam, 5 to 9 percent slopes.	IIIe	Moderate erosion hazard	CCOMM	Contouring	76	30	52	3.4
				CCOM	Terracing	76	30	52	3.4
TaC2	Tama silt loam, 5 to 9 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	CCOMM	Contouring	73	29	50	3.4
				CCOM	Terracing	73	29	50	3.4
TaD2	Tama silt loam, 9 to 14 percent slopes, moderately eroded.	IIIe	Moderate erosion hazard	COMMM	Contouring	65	------	46	3.2
				COMM	Contour stripcropping	65	------	46	3.2
				CCOMM	Terracing	65	------	46	3.2
TbD3	Tama soils, 9 to 14 percent slopes, severely eroded.	IIIe	Moderate erosion hazard; thin topsoil.	Hay or pasture	None	------	------	------	------
				CCOMM	Terracing	60	------	42	3.0

TABLE 4.—*Expected average yields, suggested rotations, and principal management problems—Continued*

Map symbol	Soil	Capability Subclass	Most serious limiting factors	Suggested rotations or other land use [1]	Special management needs	Expected average acre yields of crops in the suggested rotation, under a high level of management [2] Corn	Soybeans	Oats	Hay
						Bu.	*Bu.*	*Bu*	*Tons*
TcA	Terril loam, 0 to 2 percent slopes	I	Slight wetness; runoff from upland slopes.	CCOM	Possibly tile drainage and diversion terraces for protection from overflow; grassed waterways to control gullying.	78	30	55	3.4
TcB	Terril loam, 2 to 5 percent slopes	IIe	Slight wetness; runoff from upland slopes.	CCOM	Same	77	30	55	3.4
TcC	Terril loam, 5 to 9 percent slopes	IIIe	Slight wetness; slight erosion hazard.	CCOM	Contouring; possibly diversion terraces for protection from overflow.	74	28	52	3.2
Wa	Wabash silt loam	IIIw	Wetness; "tight" subsoil; some flooding.	CCOgm	Protection from overflow and surface drainage (subsoil may be too "tight" and clayey to tile).	55	25	40	------
Wb	Wabash silty clay	IIIw	Wetness; "tight" subosil; some flooding.	CCOgm	Same	45	22	30	------
Wc	Wabash-Gravity-Nodaway complex.	IIw	Wetness; flooding; "tight" clayey subsoil in Wabash.	Same as surrounding soils.	May need protection from overflow and surface drainage if cultivated.	60	25	30	2.4
WdA	Waukegan loam, moderately deep over sand and gravel, 0 to 2 percent slopes.	IIs	Moderate to severe droughtiness; shallowness.	CCOM	None	43	18	33	2.0
WdB	Waukegan loam, moderately deep over sand and gravel, 2 to 5 percent slopes.	IIs	Moderate to severe droughtiness; shallowness; slight erosion hazard.	COMM	None	41	16	31	1.9
				COM	Contouring	41	16	31	1.9
WdC	Waukegan loam, moderately deep over sand and gravel, 5 to 9 percent slopes.	IIIs	Moderate to severe droughtiness; shallowness; medium erosion hazard.	COMM	Stripcropping	36	------	29	1.7
				COMMM	Contouring	36	------	29	1.7
				Alfalfa	None	----	----	----	----
WeA	Waukegan loam, deep over sand and gravel, 0 to 2 percent slopes.	I	Very slight drought hazard	CCOM	None	68	28	53	2.8
				CCOgm	None	62	26	48	------
WeB	Waukegan loam, deep over sand and gravel, 2 to 5 percent slopes.	IIe	Very slight drought hazard; slight erosion hazard.	COM	None	65	27	52	2.6
				CCOM	Contouring	65	27	52	2.6
				CSCOM	Terracing	65	27	52	2.6
WeC	Waukegan loam, deep over sand and gravel, 5 to 9 percent slopes.	IIIe	Same	COMM	Contouring	58	24	48	2.4
				COMMM	None	58	24	48	2.4
Wf	Webster silty clay loam	IIw	Wetness	CSCOM	Tile drainage	79	29	55	3.2
				CCOgm	Tile drainage	71	27	50	------
Wg	Webster silty clay loam, calcareous variant.	IIw	Wetness; high lime content	CSCOM	Tile drainage; special fertilization.	72	26	50	3.0
				CCOgm	Tile drainage	64	24	45	------

[1] C = 1 year of corn (or other row crop); S = 1 year of soybeans (or other row crop); O = 1 year of oats (or other small grain); M = 1 year of meadow; gm = oats seeded with a legume for green manure. No rotation or land use is suggested for soils that occur in very small areas and are cropped along with adjacent soils.

[2] Where no yield figure is given, the crop is not grown or the soil is not suitable for it.

[3] The potential yield of corn for these pothole soils is 50 to 75 bushels an acre. Actual yields depend on the degree to which drainage can be improved. Complete drainage is seldom achieved, because of ponding.

management, or both. As a rule, they are best used for pasture or hay, but some soils in this class in Polk County may be cultivated occasionally if properly safeguarded.

Subclass IVe.—Moderately sloping to steep soils that can be cultivated safely only if rotations contain a high percentage of meadow and other appropriate conservation practices are followed.

Subclass IVs.—Droughty and slightly droughty sloping soils that are subject to wind or water erosion, or both.

Class V.—Soils that have little or no erosion hazard but have other limitations that are impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover. These are most commonly bottom-land soils that flood frequently. They have little or no erosion hazard.

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

Subclass VIe.—Rolling to very steep soils that erode readily but, under careful management, are fairly well suited to trees or pasture.

Subclass VIs.—Droughty soils that erode readily. They are not suitable for cultivation but, under careful management, may be used for pasture or woodland.

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

Subclass VIIe.—Rolling to very steep soils that have a severe erosion hazard. They are suited to trees or pasture if they are carefully managed.

Subclass VIIs.—Droughty soils that have a severe erosion hazard. They are not suitable for cultivation but, under very careful management, may be used for pasture or woodland.

The capability classification for each soil will be found at the end of the map unit description, in table 4, and in the Guide to Map Units.

Planning a Farm Program

After the farmer has identified the different soils on his farm, noted the general suggestions for good soil management, and studied the special practices needed on his soils, he may want to work out a more efficient program of soil use and management for his farm. When planning a farm program, he must consider carefully the requirements of good soil management. He must know the characteristics of his soils, the need for erosion control and artificial drainage, the need for lime and fertilizer, and the crop yields that can be expected.

Especially in the rolling areas, many fields contain two or more soils that call for different management and different rotations. If one of the soils occupies a very small area, it may have to be farmed in the same way as the rest of the field. It may be that one rotation is suitable for the entire acreage but that each soil area needs different special practices. If soil areas are large enough, field boundaries can be rearranged so that similar soils can be grouped and each group used to best advantage.

Usually, several good field arrangements and cropping systems can be worked out for any given farm. On a farm that consists partly of undulating and rolling farmland and partly of bottom land, two different crop rotations may be needed to get the best results from all the soils.

The local farmer-governed Soil Conservation District and the soil conservationist and other specialists of the Soil Conservation Service will assist in farm planning. These men are experienced in terrace layout and construction, seeding and shaping waterways, contour farming, gully control, artificial drainage, and other conservation practices.

Genesis, Morphology, and Classification of Soils

This section has three parts. The first is a discussion of soil genesis and morphology; the second shows the classification of the soils of Polk County by great soil groups; the third presents data obtained by laboratory analysis of samples of selected soils and gives detailed descriptions of modal soil profiles.

Soil Genesis and Morphology

Soil genesis is the mode of origin of the soil, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Morphology is the physical constitution of the soil, including the texture, structure, consistence, color, and other physical and chemical properties of the various horizons that make up the soil profile.

The kind of soil that develops depends on the interaction of parent materials, climate, relief, vegetation, and time. These combined factors affect soil formation and give the soil distinct horizons. During the process of soil formation minerals disintegrate, new minerals and new chemical compounds form, organic matter accumulates and decomposes, and materials in suspension and solution move downward in the soil and are partly removed by drainage waters.

Factors of soil formation

In the following paragraphs, the five factors of soil formation are discussed in relation to the soils of Polk County.

PARENT MATERIALS

Shale bedrock, glacial till, loess, and stream-laid deposits are the principal materials from which the soils of Polk County have developed. Wind-deposited sand is the parent material in small areas.

Shale bedrock.—The entire county is underlain by shale bedrock that is part of the Des Moines group of the Pennsylvanian system (*17*). When exposed, this shale weathers to firm and plastic silty clay or silty clay loam that ordinarily is strongly acid in reaction. Most of it, however, was covered by glacial deposits. Only in a few places along the steeper areas adjacent to the Des Moines River was the shale exposed so that it weathered and became parent material for soils.

The Bauer and Gosport soils are the only soils in the county that developed entirely from shale. The Runnells soils developed from a thin layer of loess over weathered shale. Many of the soils that developed from the older glacial till are underlain by shale at depths of 4 to 5 feet.

Older glacial till.—Nebraskan and Kansan glacial till are the oldest glacial deposits in the county. The Nebraskan was deposited first and was later covered by the Kansan (*7*). The Kansan till is firm, calcareous material of clay loam texture. In Polk County, it ranges in thickness from a very few feet to a few tens of feet.

Thick, well-defined, fine-textured soils developed from the Kansan till. Later, these soils were buried by deposits of Wisconsin loess. As geologic erosion took place, some of these buried soils were reexposed. Many areas of the forested Lindley soils and the prairie-forest transition Gara soils and most of the Adair and Clarinda soils have relict or paleo soil features acquired before the loess was deposited (*13*). Where geologic erosion has removed the Wisconsin loess and the paleo soils and exposed the unweathered calcareous till, Shelby soils have developed.

Soils formed from the Kansan till were mapped only in the southern part of the county, which was not covered by the Wisconsin glaciers.

Loess.—Loess, an important parent material in the southern one-fifth of the county, was probably deposited in Early Wisconsin times (*8, 13*). It consists of calcareous, friable, floury silt loam that contains no stones or gravel. At least part of that in the southwestern part of the county apparently originated in the bottom lands of the Missouri River (*4, 14, 19*). The Sharpsburg soils formed from this material. The southwestern part of Polk County is their most northeasterly extension in Iowa. The loess in the southeastern part of Polk County apparently originated in the Early Wisconsin till plains north of Des Moines. The Fayette, Downs, and Tama soils formed from this loess (*3*).[5] [6]

Younger glacial till.—The younger of the two glacial deposits from which soils in Polk County developed is that of the Cary substage, or Middle Wisconsin stage (*8, 11, 10, 13*). The Cary till is a friable, calcareous loam. It was the parent material of the forested Hayden soils, the prairie Clarion soils, and several other soil series. In some places, especially in the more hilly areas, where the Lakeville soils occur, the till contains sandy and gravelly materials.

Younger local loess.—Some thin and patchy loess presumably of Cary age occurs in a few places as a mantle on the Cary till.[7] Clarion silt loam formed partly from this local loess and partly from Cary till. It is also possible that the belt of loess, 1 to 2 miles wide, extending from the Des Moines Airport to the southeastern city limits of Des Moines was deposited during this period. Fayette soils were mapped in this area.

Alluvium and glacial stream terraces.—Water-deposited sediments are extensive along the major streams. Some of these are recent deposits from which the Dorchester, Nodaway, and Sarpy soils have developed. Others, from which the Waukegan soils developed, are sediments deposited during glacial times. Still other water-laid sediments are intermediate in age; from these, the Colo and Huntsville soils have developed. The parent materials of the Glencoe soils probably are also partly water deposited. The texture of the water-laid deposits ranges from sand to silty clay.

Wind-deposited sands.—On the east side of the Des Moines River near Polk City and on the east side of the Skunk River, winds have blown fine sand from the river bottom lands onto the adjacent uplands. In places where the deposit of the fine sand is more than 3 feet thick, Hagener and Dickinson soils formed. In places where it is 1 to 2 feet thick over the Cary friable loam till, Farrar and Crocker soils formed.

VEGETATION

The native vegetation of the county was mainly of two types—prairie grasses and trees. In some wet areas a swamp-type vegetation thrived. Also, on the border between the grasses and the trees, there evidently was some shifting of vegetation as the soils developed. The Lester, LeSueur, Atterberry, and Downs soils apparently developed under the influence of both grasses and trees. The influence of vegetation on soil formation in Iowa has been studied by several soil scientists (*13, 15, 21*).[8] [9]

RELIEF AND DRAINAGE

Relief is an important cause of differences among soils. Indirectly, it influences soil development through its effect on drainage. In Polk County, the relief ranges from level to steep. Many nearly level areas are frequently flooded and have a high or periodically high water table. In nearly level areas and depressions that are not subject to flooding, water soaks in. On stronger slopes, much of the rainfall runs off.

In general, the soils in Polk County that formed under high or periodically high water tables have dominantly olive-gray subsoils. This includes the Ames and Webster. Those that developed where the water table was below the subsoil have yellowish-brown subsoils, like those of the Clarion and Fayette soils. Soils like the Nicollet, Atterberry, and LeSueur formed where the natural drainage was intermediate. Of the soils that developed under prairie, those that have a high water table generally have more organic matter in the surface layers than those that have good natural drainage.

[5] CAIN, C. C. PROFILE PROPERTIES AND SEQUENCE RELATIONSHIPS OF THE TRAER, BERWICK, AND MARION SERIES IN SOUTHEASTERN IOWA. 1956. [Unpublished Ph.D. thesis. Copy on file Iowa State College Library, Ames.]

[6] SCHAFER, G. M. PROFILE PROPERTIES OF A LOESS-DERIVED WIESENBODEN SEQUENCE OF SOUTHEASTERN IOWA. 1954. [Unpublished Ph.D. thesis. Copy on file Iowa State College Library, Ames.]

[7] MCCRACKEN, R. J. SOIL CLASSIFICATION IN POLK COUNTY, IOWA. 1956. [Unpublished Ph.D. thesis. Copy on file Iowa State College Library, Ames.]

[8] See footnote 7.

[9] CARDOSO, J. SEQUENCE RELATIONSHIPS OF CLARION, LESTER, AND HAYDEN SOIL CATENAS. 1957. [Unpublished Ph.D. thesis. Copy on file Iowa State College Library, Ames.]

CLIMATE

Available evidence suggests that in Polk County the soils have been developing under the influence of a midcontinental, subhumid climate for at least 5,000 years. Between 5,000 and 16,000 years ago, the climate was conducive to forest vegetation (*12*). The morphology of most of the soils of Polk County indicates that the soils developed in a climate similar to the present climate.

TIME

Radiocarbon studies of wood fragments found in glacial till and loess have made it possible to determine the approximate ages of soils and Pleistocene deposits in Iowa. For example, samples of wood collected from the loess in a deep road cut on State Highway No. 64, in the northeastern part of section 1, Franklin Township, have been determined to be about 16,000 years old (*13, 16*).

Ruhe and Scholtes (*13*) have studied the ages of soils in Iowa. They have concluded that the Clarinda and Adair soils and the more strongly developed of the Lindley and Gara soils are among the oldest soils in the county. These soils formed from Kansan till, which began to weather in the Late Sangamon interglacial stage. The Shelby and parts of the Lindley and Gara soils formed from Kansan till, which was exposed in the Wisconsin stage and in recent times. Thus, the Shelby soils, though formed from Kansan till, may be younger or as young as the Clarion soils.

The loess from which the Sharpsburg, Tama, Downs, Fayette, and related soils of Polk County developed is probably 14,000 to 16,000 years old, the maximum age for these soils. Cary glacial till is from 12,000 to 13,500 years old—the maximum age for Clarion, Nicollet, Webster, and related soils.

The outwash terraces on which the Waukegan, Kato, Marshan, and related soils developed may be of Cary age. Some may consist of outwash from the more recent Mankato glacier, which itself did not extend so far south as Polk County.

Classification of Soils

For the purpose of comparing the soils of Polk County with soils elsewhere, soil series with certain fundamental characteristics in common are grouped together.

The great soil groups represented in Polk County are Alluvial soils, Brunizems, Gray-Brown Podzolic soils, Humic Gley (Wiesenboden) soils, Lithosols, Planosols, and Regosols (*18*).

Alluvial soils develop from recent stream deposits. They have no B horizon (genetic subsoil) because they are young, in geologic terms. The Alluvial soils in Polk County are those of the following series: Chaseburg, Dorchester, Nodaway, and Sarpy.

Brunizems develop under prairie vegetation. They have dark-colored surface soils (A horizons) that are relatively high in organic matter, compared with the parent material. The amount of organic matter decreases gradually with depth. Brunizems have brownish subsoils (B horizons). Before Brunizems are plowed, they are most acid (lowest in pH value) at the surface and less acid with increasing depth. The Brunizems in Polk County are the soils of the following series: Adair, Ankeny, Clarion, Clearfield, Cooper, Dickinson, Farrar, Gravity, Hagener, Judson, Kato, Lakeville, Muscatine, Nicollet, Olmitz, Saylor, Sharpsburg, Shelby, Tama, and Terril. The Huntsville soils intergrade to Alluvial soils.

Gray-Brown Podzolic soils develop under forest vegetation. Typically, they have a dark-colored A_1 horizon, ordinarily thinner than that of the Brunizems, and a grayish, acid A_2 horizon. Because of clay accumulated during soil-forming processes, the B horizon is higher in clay content than the parent material from which it developed. The Gray-Brown Podzolic soils in Polk County are those of the following series: Chelsea, Fayette, Hayden, Lamont, Lindley, Runnells, and Stronghurst. The Cantril soils intergrade to Planosols. The Crocker, Downs, Gara, Ladoga, Lester, and LeSueur soils intergrade to Brunizems.

Lithosols and Regosols are shallow soils that lack B horizons. In Polk County, they are found on hilly and steep slopes from which soil material has been removed by geologic (as contrasted to man-caused) erosion almost as fast as soil development has taken place. Lithosols are underlain by consolidated bedrock. Regosols are underlain by soft, unconsolidated material, such as glacial till. The Bauer and Gosport soils are Lithosols. The Buckner, Ida, and Storden soils are Regosols.

Planosols have one horizon that is much higher in clay, more compact, or more strongly cemented than the horizon immediately above or below it. The Planosols in Polk County have a B horizon much higher in clay than the A horizon or the C horizon. They developed under conditions of poor natural drainage and have a grayish, leached A_2 horizon. Only a few soils in Polk County can be classed as Planosols, and these do not have the strong B horizon typical of Planosols elsewhere. The Ames, Blockton, and Rolfe soils are Planosols.

Humic Gley soils develop under poor natural drainage. They have a very dark colored A_1 horizon underlain by a mottled gray B horizon which may or may not have an accumulation of clay. In general, the Humic Gley soils of Polk County are young, and their characteristics are less strongly expressed than those of Humic Gley soils elsewhere. The Humic Gley (Wiesenboden) soils in Polk County are those of the following series: Clarinda, Harpster, Wabash, and Webster. The Colo, Glencoe, and Okoboji soils intergrade to Alluvial soils.

Descriptions of Soil Profiles

The following profile descriptions have been prepared in accordance with the nomenclature set forth in the Soil Survey Manual. The Munsell color notations are for moist soils unless otherwise indicated. The range in thickness is shown at the end of each horizon description. These are not descriptions of profiles at specific sites but composite descriptions that represent the modal concept for each soil.

Laboratory data on samples of nine selected soils are presented in table 5.

TABLE 5.—*Laboratory data for selected soils*[1]

Soil type and location of sample	Horizon	Depth	Mechanical analysis					pH	Chemical analysis						
			Distribution of particles < 2 mm. in diameter				Particles (> 2 mm. in diameter)		Free iron	Organic carbon	Bulk density	Exchangeable bases			Cation exchange capacity
			Sand (> 50 microns)	Coarse silt (50–20 microns)	Fine silt (20–2 microns)	Clay (< 2 microns)						Ca	Mg	K	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*		*meq./100 gm. of soil*	*meq./100 gm. of soil*	*meq./100 gm. of soil*	*meq./100 gm. of soil*
Ames loam: *SW¼SE¼SW¼ sec. 12, T. 80 N., R. 24 W., Crocker Township, 30 feet north of State Highway No. 60, 20 feet east of fence on east side of gravel road.*	A_h	0–7	32.3	22.8	23.4	21.5	<1.0	6.9	0.34	---	---	---	---	---	---
	Ae	7–14	28.2	25.2	24.7	21.9	<1.0	6.3	.35	---	---	---	---	---	---
	B_{11}	14–19	28.4	19.8	24.1	27.7	<1.0	5.3	.44	---	---	---	---	---	---
	B_{12}	19–23	28.6	16.2	23.1	32.1	<1.0	5.2	.50	---	---	---	---	---	---
	B_{21}	23–26	29.2	16.2	21.2	33.4	<1.0	4.6	.56	---	---	---	---	---	---
	B_{22}	26–31	30.8	15.9	17.9	35.4	1.4	5.8	.68	---	---	---	---	---	---
	B_3	31–37	34.4	16.1	16.6	32.9	1.8	6.3	.60	---	---	---	---	---	---
	C_1	37–42	40.4	13.0	14.8	31.8	6.6	7.2	.61	---	---	---	---	---	---
	C_2	42–60	42.3	13.7	16.8	25.1	6.8	7.7	.39	---	---	---	---	---	---
Clarion loam: *SW¼SE¼SW¼ sec. 12, T. 80 N., R. 24 W., Crocker Township, about 1,450 feet east of U. S. 69 on north side of road in fresh road cut—site was formerly in cultivated field.*	A_p	0–9	26.0	20.6	28.4	25.0	<1.0	6.7	.79	1.96	1.17	18.6	5.6	0.28	22.8
	B_1	9–13	23.0	25.5	24.7	26.8	<1.0	6.0	---	1.90	---	13.1	3.9	.26	20.9
	B_{21}	13–17	21.8	26.6	24.4	27.2	<1.0	5.6	.88	1.46	1.06	---	---	---	---
	B_{22}	17–22	20.9	26.6	24.7	27.8	<1.0	5.7	.95	1.29	1.15	12.0	3.3	.25	19.4
	B_{23}	22–27	19.8	25.6	27.2	27.4	<1.0	5.8	.78	1.21	1.17	12.1	4.0	.25	19.4
	B_3	27–30	21.4	21.5	32.3	24.8	<1.0	6.2	---	1.06	---	---	---	---	---
	C_1	30–36	20.8	21.6	31.4	26.2	<1.0	6.5	.72	.64	1.23	13.2	3.8	.24	19.9
	C_2	36–54	39.3	11.2	25.0	24.5	6.5	7.6	.52	---	---	---	---	---	---
Kato loam, deep over sand and gravel[2]: *NE¼SW¼SW¼ sec. 34, T. 81 N., R. 25 W., Union Township.*	A_h	0–16	31.7	27.4	19.1	21.8	0	5.9	---	2.77	---	---	---	---	---
	B_1	16–22	25.7	30.2	20.0	24.1	0	5.7	---	2.07	---	---	---	---	---
	B_2	22–36	24.5	30.7	21.0	23.8	0	5.8	---	1.09	---	---	---	---	---
	C_{11}	36–48	35.7	28.2	16.6	19.5	0	5.9	---	.48	---	---	---	---	---
	C_{12}	48–60	39.0	26.4	16.3	18.3	0	6.0	---	.37	---	---	---	---	---
Marshan silty clay loam, deep over sand and gravel: *NW¼NE¼ sec. 10, T. 81 N., R. 22 W., Washington Township. Samples taken from pit 100 feet south of east-west gravel road.*	A_h	0–13	12.0	16.7	36.7	34.6	<1.0	6.2	.21	2.56	1.07	---	---	---	---
	AB	13–17	30.0	14.4	25.7	29.9	5.2	6.6	.11	---	---	---	---	---	---
	B_{g1}	17–22	41.5	13.2	19.0	26.3	12.9	6.8	.12	1.92	1.23	---	---	---	---
	B_{g2}	22–27	41.3	16.8	17.4	24.5	8.4	6.9	.17	.63	1.29	---	---	---	---
	B_{g3}	27–31	43.5	14.8	17.0	24.7	4.4	7.1	.06	1.17	---	---	---	---	---
	C_g	31–40	42.8	16.5	17.1	23.6	5.8	7.2	.10	.89	1.30	---	---	---	---
	D	40–54	82.9	4.8	5.2	7.1	38.2	7.4	.21	---	---	---	---	---	---
Nicollet loam: *SW¼SW¼ sec. 12, T. 80 N., R. 24 W., Crocker Township. Samples taken from pit in field about 250 feet east and 50 feet north of State Highway No. 60.*	A_h	0–13	41.0	17.6	17.0	24.4	<1.0	6.2	.53	2.36	1.19	13.3	3.8	.26	21.6
	AB	13–17	43.3	16.0	15.7	25.0	<1.0	5.9	.50	1.97	---	12.7	3.5	.26	18.7
	B_{21}	17–23	43.5	15.9	14.8	25.8	<1.0	6.2	.55	1.68	1.23	13.5	3.5	.26	17.4
	B_{22}	23–30	46.2	12.4	15.7	25.7	3.0	6.9	.49	1.00	1.23	12.7	3.8	.24	17.2
	B_3	30–33	48.1	12.5	15.7	23.7	8.0	6.8	.45	.90	1.25	---	---	---	---
	C_1	33–40	57.2	9.1	13.4	20.3	7.0	7.0	.40	---	1.39	10.7	3.5	.20	14.6
	C_2	40–60	57.4	9.8	16.7	16.1	9.0	8.0	.38	---	---	---	---	---	---
Sharpsburg silt loam[2]: *NE¼SE¼SW¼ sec. 26, T. 78 N., R. 25 W., Bloomfield Township. Samples taken from pit 1,000 feet north and 75 feet west of road junction on south section line.*	A_p	0–10	2.0	34.4	33.1	30.5	0	6.4	.75	2.44	---	16.6	3.2	.8	27.3
	AB	10–13	1.4	32.1	33.7	32.8	0	5.2	---	2.21	---	13.3	3.6	.6	27.2
	B_1	13–18	1.4	30.2	32.8	35.6	0	5.6	.88	1.74	---	13.7	4.9	.6	28.4
	B_{21}	18–22	1.2	29.0	33.9	35.9	0	5.6	.83	1.30	---	14.0	5.7	.6	29.4
	B_{22}	22–25	1.4	28.4	33.2	37.0	0	5.6	1.00	1.08	---	14.6	6.7	.5	29.8
	B_{23}	25–29	1.1	27.8	34.6	36.5	0	5.6	---	.77	---	14.9	7.2	.5	29.7
	B_3	29–33	1.4	29.8	33.8	35.0	0	5.7	.81	.60	---	14.9	7.4	.5	29.9
	C_{11}	33–48	1.8	32.5	31.7	34.0	0	5.8	.82	.34	---	15.0	7.4	.5	28.7
	C_{12}	48–60	1.4	33.8	32.5	32.3	0	5.9	---	.32	---	15.2	7.2	.5	27.9

Tama silt loam	A_p	0–9	6.8	31.7	27.2	34.3	0	5.6	-------	1.72	1.26	12.8	6.2	.64	26.4
SE¼SW¼ sec. 1, T. 78 N., R. 22 W.,	B_{11}	9–13	10.0	25.7	26.9	37.4	0	5.6	-------	1.49	-------	-------	-------	-------	-------
Camp Township. Samples taken from	B_{12}	13–17	5.5	28.9	28.6	37.0	0	5.7	-------	.91	1.08	13.3	7.2	.54	28.0
pit about 500 feet west and 100 feet	B_{21}	17–21	7.4	27.6	29.1	35.9	0	5.7	-------	.69	1.08	13.6	7.2	.54	27.6
north of road junction at midpoint of	B_{22}	21–25	7.5	29.8	30.0	32.7	0	5.9	-------	.66	1.23	13.3	7.0	.52	27.4
south section line.	B_3	25–29	8.8	31.4	30.0	29.8	0	6.0	-------	.45	-------	-------	-------	-------	-------
	C_{11}	29–42	9.8	29.3	32.2	28.7	0	6.1	-------	.41	1.20	13.3	7.0	.47	23.0
	C_{12}	42–60	10.5	31.9	31.4	26.2	0	6.3	-------	.29	-------	15.4	8.0	.44	22.5
Waukegan loam, moderately deep over sand and gravel [2]	A_p	0–8	48.4	16.5	17.3	17.8	4.0	5.8	-------	2.05	-------	-------	-------	-------	-------
SE¼NE¼NE¼ sec. 13, T. 80 N.,	AB	8–11	44.0	15.5	18.0	21.5	2.0	5.9	-------	1.44	-------	-------	-------	-------	-------
R. 25 W., Madison Township. Sam-	B_1	11–16	47.6	14.8	17.0	20.6	2.0	5.8	-------	1.38	-------	-------	-------	-------	-------
ples taken from pit 50 feet north of	B_2	16–22	51.9	12.7	15.5	19.9	4.0	5.6	-------	1.05	-------	-------	-------	-------	-------
east-west gravel road, about 300 feet	D_1	22–25	62.0	8.6	11.2	18.2	68.0	5.6	-------	.73	-------	-------	-------	-------	-------
west of point at which this road bends.	D_2	25–36	91.9	1.9	2.6	3.6	34.0	6.9	-------	.24	-------	-------	-------	-------	-------
Waukegan loam, deep over sand and gravel	A_p	0–8	31.2	33.2	17.4	18.2	<1.0	5.5	.68	2.07	1.28	-------	-------	-------	-------
NW¼NW¼SW¼ sec. 10, T. 81 N.,	AB	8–12	31.4	32.0	17.8	18.8	<1.0	5.3	-------	1.86	-------	-------	-------	-------	-------
R. 22 W., Washington Township.	B_1	12–15	41.9	21.6	16.8	19.7	<1.0	5.5	.96	-------	-------	-------	-------	-------	-------
Samples taken from pit in edge of field	B_{21}	15–19	43.6	20.3	15.1	21.0	<1.0	5.5	-------	1.78	1.16	-------	-------	-------	-------
about ¾ mile south of Indian Creek	B_{22}	19–22	42.5	22.3	15.2	20.0	<1.0	5.4	1.30	1.63	1.12	-------	-------	-------	-------
and 25 feet east of the west section line	B_{31}	22–28	41.4	23.3	14.8	20.5	<1.0	5.2	1.36	1.22	-------	-------	-------	-------	-------
and 250 feet south of the northern	B_{32}	28–34	43.4	23.1	13.6	19.9	<1.0	5.1	-------	.81	1.15	-------	-------	-------	-------
boundary of the SW¼ sec. 10.	C	34–40	45.9	21.8	14.2	18.1	2.0	5.3	1.45	-------	-------	-------	-------	-------	-------
	D	40–78	75.8	6.4	5.2	12.6	8.0	5.4	-------	-------	-------	-------	-------	-------	-------

[1] Analysis by R. J. McCracken unless otherwise indicated. See SOIL CLASSIFICATION IN POLK COUNTY, IOWA, unpublished Ph.D. thesis, R. J. McCracken, 1956. Copy on file in Iowa State University library, Ames.

[2] Analysis by Soil Survey Laboratory, U. S. Dept. of Agriculture, Beltsville, Maryland.

Adair clay loam

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) clay loam to silt loam; moderate, fine and medium, granular structure; slightly firm to friable; medium acid to strongly acid; range, 6 to 12 inches.

B_1 7 to 14 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (2.5Y 4/2) clay loam; weak, subangular blocky structure that breaks readily to granular structure; firm; medium acid to strongly acid; range, 3 to 6 inches.

B_2 14 to 30 inches, dark grayish-brown (10YR 4/2) and very dark gray (10YR 3/1) gritty silty clay to "heavy" clay loam; moderate, medium, subangular blocky structure; common, coarse mottles of reddish yellow (7.5YR 6/6); very firm; medium acid to strongly acid; range, 7 to 18 inches.

C 30 to 42 inches +, very dark grayish-brown (2.5Y 3/2), olive-brown (2.5Y 4/4), and dark-gray (2.5Y 4/1) clay loam; common, coarse mottles of yellowish brown (10YR 5/8) and reddish yellow (7.5YR 6/6); massive; firm; medium to strongly acid.

Ames loam

A_1 0 to 4 inches, very dark gray (10YR 3/1) loam; weak to moderate, fine and medium, granular structure; friable; slightly acid; range, 3 to 8 inches.

A_2 4 to 12 inches, grayish-brown (10YR 5/2) loam grading to light brownish gray (10YR 6/2) in lower part of horizon; moderate to weak, fine, platy structure; friable; strongly acid; some concretions, apparently ferromanganese; range, 6 to 12 inches.

B_1 12 to 22 inches, dark grayish-brown (10YR 4/2) and light olive-brown (2.5Y 5/4) clay loam; moderate, medium and fine, subangular blocky structure; firm; medium acid; some concretions, apparently ferromanganese; range, 6 to 10 inches.

B_2 22 to 32 inches, light olive-brown (2.5Y 5/4) and olive (5Y 5/4) heavy clay loam to gritty silty clay; common iron stains; very firm, plastic when wet; moderate, medium, subangular blocky structure; medium acid; a few concretions, apparently ferromanganese; range, 10 to 16 inches.

B_3 32 to 36 inches, light brownish-gray (2.5Y 6/2), light yellowish-brown (2.5Y 6/4), and olive-yellow (2.5Y 6/6) clay loam; weak, coarse, subangular blocky structure; firm; medium acid; range, 0 to 6 inches.

C_1 36 to 42 inches, light brownish-gray (2.5Y 6/2) and olive-yellow (2.5Y 6/6) light clay loam; massive; firm; slightly acid to mildly alkaline; range, 6 to 12 inches.

C_2 42 to 60 inches +, loam; color as in above horizon but with dark coatings apparently of ferromanganese; massive; friable; calcareous.

Ankeny sandy loam

A_1 (or A_p) 0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; some coatings of very dark brown (10YR 2/2); weak, medium and coarse, granular structure; very friable; some gravel; slightly acid; range, 3 to 9 inches.

A_3 8 to 11 inches, very dark grayish-brown (10YR 3/2) sandy loam; very weak, medium and coarse, granular structure; very friable; medium acid; range, 0 to 6 inches.

B_2 11 to 24 inches, dark-brown (10YR 4/3 to 3/3) sandy loam; very weak, medium, subangular blocky structure; friable; medium acid.

B_3 24 to 30 inches, dark-brown (10YR 4/3 to 3/3) and some dark grayish-brown (10YR 4/2) sandy loam; single grain; very friable; range, 0 to 6 inches.

C_1 30 to 42 inches +, brown (10YR 5/3) to yellowish-brown (10YR 5/4) sandy loam to loamy sand; loose; slightly acid to alkaline.

Atterberry silt loam

A_1 (or A_p) 0 to 8 inches, very dark gray (10YR 3/1) silt loam; weak, medium and coarse, granular structure; friable; slightly acid; range, 6 to 10 inches.

A_2 8 to 12 inches, very dark gray (10YR 3/1) silt loam; prominent coatings of dark grayish brown (10YR 4/2) and dark gray (10YR 4/1); friable; weak, coarse, granular structure; medium acid; range, 2 to 6 inches.

B_1 12 to 16 inches, very dark grayish-brown (10YR 3/2 and 2.5Y 3/2) light silty clay loam mottled with olive brown (2.5Y 4/4); very weak, fine and medium, subangular blocky structure; firm; medium acid; range, 2 to 4 inches.

B_2 16 to 26 inches, dark grayish-brown (10YR 4/2 and 2.5Y 4/2) silty clay loam; common, fine and coarse mottles of yellowish brown (10YR 5/6); weak, fine and medium, subangular blocky structure; firm; clay films on aggregates; medium acid; range, 8 to 15 inches.

B_3 26 to 30 inches, dark grayish-brown (10YR 4/2 and 2.5Y 4/2) and very dark grayish-brown (10YR 3/2) light silty clay loam; numerous, fine mottles and spots of yellowish brown (10YR 5/6); very weak, medium, subangular blocky structure; firm; slightly acid; range, 2 to 4 inches.

C_1 30 to 48 inches +, grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2) silt loam to silty clay loam; numerous, coarse mottles of light olive brown (2.5Y 5/4); massive; friable; this is partly oxidized loess.

Bauer silt loam

A_1 0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; some stains of very dark brown (10YR 2/2); friable; weak, medium, granular structure; slightly acid to medium acid; range, 6 to 12 inches.

A_3 10 to 15 inches, brown (10YR 4/3) to dark grayish-brown (10YR 4/2) silt loam; some variegations of very dark gray (10YR 3/1); weak, medium, granular structure; friable; slightly acid to medium acid; range, 3 to 6 inches.

C_1 15 inches +, dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/4), and light brownish-gray (10YR 6/2) silty clay loam; structure inherited from parent shales; contains weathered shale fragments; firm; medium acid to strongly acid.

Blockton silt loam

A_1 0 to 12 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; slightly acid; range, 6 to 18 inches.

A_2 12 to 18 inches, black (10YR 2/1) silt loam; numerous coatings of light brownish gray (10YR 6/2) and gray (10YR 6/1); weak, medium, granular structure; friable; medium acid; range, 3 to 9 inches.

B_g 18 to 32 inches, very dark gray (10YR 3/1) silty clay; common, medium and fine mottles of very dark grayish brown (10YR 3/2); weak, medium, subangular and angular blocky structure; very firm; some clay skins on peds; slightly acid; range, 12 to 24 inches.

C_{1g} 32 to 42 inches +, very dark gray (10YR 3/1) and dark gray (10YR 4/1 silty clay; common, medium mottles of very dark grayish brown (10YR 3/2); weak, coarse, subangular blocky structure to massive; very firm; slightly acid.

Buckner loamy sand

A_1 0 to 9 inches, dark grayish-brown (10YR 4/2), coarse, light loamy sand to sandy loam; very weak, medium, granular structure; loose; slightly acid; range, 3 to 18 inches.

B (or BC) 9 to 30 inches, dark-brown (7.5YR 3/2) coarse sandy loam to loamy coarse sand; single grain; loose; medium acid; range, 12 to 21 inches.

C 30 to 50 inches +, very dark grayish-brown (10YR 3/2) loamy coarse sand to coarse sandy loam; single grain; loose; medium acid; in some areas, thin lenses (nearly parallel to the surface), apparently iron accumulations, at depths of more than 4 feet.

Cantril silt loam

A_1 0 to 10 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; slightly acid; range, 3 to 15 inches.

A_2 10 to 18 inches, grayish-brown (10YR 5/2 and 2.5Y 5/2) and brown (10YR 5/3) silt loam; weak, medium, granular structure; friable; medium acid; range, 6 to 9 inches.

B_1 18 to 21 inches, brown (10YR 5/3) heavy silt loam; ped coatings of grayish brown (10YR 5/2); weak, fine, subangular blocky breaking to granular structure; friable; range, 0 to 4 inches.

B_2 21 to 39 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, fine and medium mottles of strong brown (7.5YR 5/6); weak, fine, subangular blocky structure; firm; medium acid; range, 10 to 20 inches.

C_1 39 to 48 inches +, very dark grayish-brown (10YR 3/2) silt loam; spots of dark gray (10YR 4/1) and common, medium and fine mottles of strong brown (7.5YR 5/6); massive; friable.

Chaseburg silt loam

A_p 0 to 9 inches, grayish-brown (10YR 5/2) silt loam; common, medium and coarse, low-contrast mottles of dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2); very weak, coarse and medium, granular structure; friable; slightly acid to medium acid; range, 6 to 15 inches.

BC (or C_1) 9 to 27 inches, mottled dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) silt loam; common, coarse mottles and spots of light brownish gray (10YR 6/2); massive to very weak subangular blocky structure; friable; medium acid; range, 12 to 20 inches.

C 27 to 40 inches +, mottled grayish-brown (10YR 5/2), light brownish-gray (10YR 6/2), and light yellowish-brown (10YR 6/4) silt loam; massive; friable.

Chelsea loamy fine sand

A_1 0 to 2 inches, very dark brown (10YR 2/2) loamy fine sand; very weak, coarse, granular structure; loose; slightly acid; range, 0 to 3 inches.

A_2 2 to 8 inches, dark grayish-brown (10YR 4/2) and dark-gray (10YR 4/1) loamy fine sand; very weak, coarse, granular structure; loose; strongly acid; range, 3 to 12 inches.

B_2 8 to 30 inches, yellowish-brown (10YR 5/4) loamy fine sand; some coatings and stains of grayish brown (10YR 5/2); very weak, medium, subangular blocky structure to single grain; very friable; medium acid to strongly acid; range, 12 to 22 inches.

B_3 30 to 33 inches, yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 4/4) loamy sand; single grain; loose; medium acid; range, 0 to 4 inches.

C_1 33 to 48 inches +, yellowish-brown (10YR 5/6) and very dark grayish-brown (10YR 3/2) loamy sand; some mottles of grayish brown (10YR 5/2); single grain; loose; some fine iron stains; medium acid.

Clarinda silty clay loam

A_1 0 to 8 inches, very dark gray (10YR 3/1) silt loam to silty clay loam; some coatings of black (10YR 2/1); moderate, medium, granular structure; firm; slightly acid; range, 3 to 15 inches.

A_3 8 to 12 inches, very dark gray (10YR 3/1 to 2.5Y 3/1) silty clay loam; weak, medium and coarse, granular structure; firm; slightly acid; range, 3 to 6 inches.

B_{2g} 12 to 25 inches, very dark grayish-brown (2.5Y 3/2) silty clay; some olive gray (5Y 5/2) and mottles of very dark gray (5Y 3/1) and yellowish brown (10YR 5/6); weak, medium and coarse, subangular and angular blocky structure; very firm; medium acid; range, 12 to 20 inches.

B_{3g} 25 to 35 inches, dark olive-gray (5Y 3/2) silty clay; common, medium and coarse mottles of yellowish brown (10YR 5/6); weak, coarse, angular and subangular blocky structure; very firm; medium acid; range, 6 to 15 inches.

C_1 35 to 45 inches +, olive-gray (5Y 4/2) silty clay mottled with light olive gray (5Y 6/2); weak, coarse, angular blocky structure; very firm; medium acid to slightly acid.

Clarion loam

A_p 0 to 7 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; friable; slightly acid; a few granitic pebbles; range, 3 to 10 inches.

A_3 7 to 10 inches, dark-brown (10YR 3/3) loam; prominent ped coatings of very dark brown (10YR 2/2); weak, fine, subangular blocky structure that breaks readily to granular structure; friable; slightly acid; a few pebbles; range, 2 to 6 inches.

B_2 10 to 27 inches, dark-brown (10YR 3/3 to 4/3) loam; weak to moderate, medium, subangular blocky structure; slightly firm; contains some gravel; medium acid; range, 15 to 20 inches.

B_3 27 to 30 inches, yellowish-brown (10YR 5/4) loam; some coatings and tongues of dark brown (10YR 3/3); very weak, coarse, subangular blocky structure; friable; contains some gravel; slightly acid; range, 2 to 4 inches.

C_1 30 to 36 inches, yellowish-brown (10YR 5/4) loam; massive; friable; contains a few, fine, soft, dark concretions, apparently ferromanganese; neutral.

C_2 36 to 54 inches +, light yellowish-brown (10YR 6/4) loam; some iron stains; massive; friable; calcareous; common concretions of calcium carbonate, 2 to 10 millimeters in diameter; contains considerable gravel.

Clearfield silty clay loam

A_1 0 to 9 inches, very dark gray (10YR 3/1) silty clay loam to silt loam; weak, medium, granular structure; friable to firm; medium acid; range, 6 to 18 inches.

A_3 9 to 13 inches, very dark grayish-brown (10YR 3/2) silty clay loam; prominent coatings of very dark gray (10YR 3/1); weak, medium, granular structure; firm; medium acid; range, 3 to 5 inches.

B_2 13 to 32 inches, dark grayish-brown (10YR 4/2) and very dark grayish-brown (10YR 3/2) silty clay loam; common, medium mottles of light yellowish brown (10YR 6/4) and pale brown (10YR 6/3); weak, medium, subangular blocky structure; firm; medium acid; range, 18 to 30 inches.

B_3 32 to 38 inches, very dark grayish-brown (10YR 3/2) silty clay loam; prominent, medium mottles of light brownish gray (10YR 6/2); very weak, medium, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

C_1 38 to 48 inches +, grayish-brown (10YR 5/2), pale-brown (10YR 6/3), and light brownish-gray (10YR 6/2) silty clay loam; massive; firm to friable; slightly acid.

Colo silty clay loam

A_p 0 to 8 inches, very dark gray (10YR 3/1) to black (10YR 2/1) silty clay loam; moderate, coarse, granular structure; firm; mildly alkaline; range, 8 to 18 inches.

A_3 8 to 14 inches, very dark grayish-brown (2.5Y 3/2) to very dark gray (10YR 3/1) or black (10YR 2/1) silty clay loam; weak, medium and fine, subangular blocky structure; firm; slightly acid; range, 3 to 9 inches.

B_{g1} 14 to 20 inches, very dark gray (10YR 3/1) and some very dark grayish-brown (2.5Y 3/2) silty clay loam; very weak, medium, subangular blocky structure; firm; slightly acid to mildly alkaline; very gradual transition to B_{g2} horizon; range, 3 to 9 inches.

B_{g2} 20 to 33 inches, black (10YR 2/1 and 2.5Y 2/0) and some very dark grayish-brown (2.5Y 3/2) firm silty clay loam; weak, fine, subangular blocky structure; slightly acid to mildly alkaline; range, 12 to 15 inches.

C_{g11} 33 to 45 inches, very dark gray (2.5Y 3/1) silty clay loam; numerous, fine mottles of yellowish brown (10YR 5/6); massive; firm; slightly acid to mildly alkaline.

C_{g12} 45 to 54 inches, dark grayish-brown (2.5Y 4/2) and olive-gray (5Y 4/2) firm clay loam to silty clay loam; massive; slightly acid to mildly alkaline.

Cooper silt loam, acid variant

A_1 0 to 10 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; slightly acid; range, 9 to 18 inches.

A_3 10 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam; nearly continuous ped coatings of very dark gray (10YR 3/1); weak, medium, subangular blocky structure that breaks to granular structure; friable; slightly acid; range, 0 to 6 inches.

B_1 15 to 20 inches, very dark grayish-brown (10YR 3/2) silty clay loam; some coatings of very dark gray (10YR 3/1); moderate, medium, subangular blocky structure; firm; slightly acid; range, 3 to 6 inches.

B_2 20 to 29 inches, very dark grayish-brown (10YR 3/2) and some very dark brown (10YR 2/2) silty clay loam; moderate, medium, subangular blocky structure; some thin, discontinuous clay skins; firm; slightly acid; range, 9 to 18 inches.

B_{2b} 29 to 36 inches, dark grayish-brown (10YR 4/2) silty clay; coatings of very dark gray (10YR 3/1); common, fine mottles of reddish yellow (7.5YR 6/6); strong, medium and coarse, subangular to angular blocky structure; very firm; medium acid; range, 6 to 18 inches.

B_{3b} 36 to 46 inches, dark grayish-brown (10YR 4/2) and very dark grayish-brown (10YR 3/2) silty clay; common, fine mottles of reddish yellow (7.5YR 6/6); moderate, coarse and medium, subangular blocky structure; very firm; common, soft, fine, ferromanganese concretions; medium acid; range, 3 to 10 inches.

C_b 46 to 60 inches, very dark grayish-brown (10YR 3/2 and 2.5Y 3/2) heavy silty clay loam; a few mottles of light gray (2.5Y 7/2) and reddish yellow (7.5YR 6/6); weak, coarse, subangular blocky structure; firm; slightly acid.

Crocker loamy fine sand

A_1 0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand or loamy fine sand; very weak, fine and medium, granular structure; loose; slightly acid; range, 3 to 10 inches.

A_2 8 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand; prominent coatings of grayish brown (10YR 5/2); very weak, medium, granular structure; loose; some gravel; medium acid; range, 2 to 4 inches.

B_1 11 to 14 inches, brown (10YR 4/3) fine sandy loam; coatings of dark grayish brown (10YR 4/2); weak, medium, subangular blocky structure; very friable; some gravel; medium acid; range, 0 to 12 inches.

B_2 14 to 27 inches, brown (10YR 4/3) heavy loam; some spots of yellowish brown (10YR 5/4); moderate, medium, subangular blocky structure; firm; some gravel; medium acid; range, 12 to 20 inches.

B_3 27 to 33 inches, yellowish-brown (10YR 5/4) heavy loam; some ped coatings of brown (10YR 4/3); weak, coarse, subangular blocky structure; firm; slightly acid; range, 3 to 6 inches.

C_1 33 to 45 inches, yellowish-brown (10YR 5/4) and light yellowish-brown (10YR 6/4) loam; massive; friable; slightly acid.

Dickinson fine sandy loam

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; some coatings of very dark brown (10YR 2/2); very weak, medium, granular structure; friable; slightly acid; range, 4 to 12 inches.

B_1 7 to 14 inches, dark-brown (10YR 3/3) fine sandy loam; some thin coatings of very dark brown (10YR 2/2); very weak, medium, subangular blocky structure; friable; slightly acid; range, 6 to 12 inches.

B_2 14 to 27 inches, dark-brown (10YR 3/3) fine sandy loam; weak, medium and coarse, subangular blocky structure; friable; some gravel; slightly acid; range, 12 to 15 inches.

B_3 27 to 33 inches, dark-brown to brown (10YR 4/3) fine sandy loam; some mottles of yellowish brown (10YR 5/6); very weak, coarse, subangular blocky structure; very friable; considerable gravel; slightly acid; range, 3 to 6 inches.

C_1 33 to 36 inches, yellowish-brown (10YR 5/6) sandy loam; some spots of pale brown (10YR 6/3); single grain; very friable to loose; some gravel and small stones; neutral; range, 0 to 24 inches.

C_2 36 to 48 inches, yellowish-brown (10YR 5/6) and pale-brown (10YR 6/3) sandy loam to loamy sand; single grain; loose; some gravel and small stones; calcareous; mildly alkaline.

Dickinson sandy loam, bench position

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; ped coatings of very dark brown (10YR 2/2); weak, coarse, granular structure; very friable; slightly acid; range, 4 to 10 inches.

B_1 7 to 12 inches, dark-brown (10YR 3/3) sandy loam; coatings of very dark brown (10YR 2/2); weak, coarse, granular structure; very friable; slightly acid to medium acid; range, 2 to 5 inches.

B_2 12 to 25 inches, dark-brown (10YR 3/3 and 7.5YR 3/2) sandy loam; very weak, coarse, subangular blocky structure; very friable; slightly acid to medium acid; range, 10 to 18 inches.

B_3 25 to 30 inches, dark-brown (10YR 3/3 and 7.5YR 3/2) sandy loam; variegations of brown (10YR 5/3); single grain; very friable; slightly acid; range, 3 to 6 inches.

C_{11} 30 to 45 inches, brown (10YR 5/3) and pale-brown (10YR 6/3) light sandy loam; single grain; loose; slightly acid.

C_{12} 45 to 60 inches, pale-brown (10YR 6/3) and light yellowish-brown (10YR 6/4) light sandy loam to loamy sand; medium, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) mottles in reticulate pattern and bands; mottles seem to be iron segregations; single grain; loose; neutral to mildly alkaline.

Dorchester silt loam

A_1 0 to 7 inches, very dark gray (10YR 3/1) and some dark grayish-brown (10YR 4/2) silt loam; very weak, fine and medium, granular structure; friable; calcareous.

A_3–C_1 7 to 20 inches, dark grayish-brown (10YR 4/2) silt loam; some light coatings of very dark gray (10YR 3/1); very weak, medium, granular structure; friable; calcareous.

C_2 20 to 60 inches, dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) silt loam; common, coarse mottles of pale brown (10YR 6/3); massive; very friable; mildly alkaline (calcareous) to neutral; common, thin lenses and pockets of fine sandy loam.

Downs silt loam

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; some ped coatings of dark grayish brown (10YR 4/2); moderate, medium and fine, granular structure; friable; slightly acid; range, 4 to 8 inches.

A_2 7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; common coatings of grayish brown (10YR 5/2); weak, medium, granular structure; friable; medium acid; range, 2 to 6 inches.

B_1 10 to 13 inches, brown (10YR 4/3) light silty clay loam to heavy silt loam; common ped coatings of dark grayish brown (10YR 4/2); moderate, fine and medium, subangular blocky structure; a few discontinuous clay skins; firm; medium acid; range, 2 to 4 inches.

B_2 13 to 27 inches, brown (10YR 5/3) light silty clay loam; common ped coatings of yellowish brown (10YR 5/4); moderate, medium, subangular blocky structure; common, thin, discontinuous clay skins; firm; medium acid; range, 12 to 18 inches.

B_3 27 to 32 inches, brown (10YR 5/3) light silty clay loam; common, fine mottles of pale brown (10YR 6/3) and a few stains and mottles of reddish yellow (7.5YR 6/6); weak, medium, subangular blocky structure; a few thin clay skins; a few fine, soft, dark concretions; firm; medium acid to slightly acid; range, 2 to 6 inches.

C_{11} 32 to 42 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, fine and medium mottles of pale brown (10YR 6/3) and light brownish gray (10YR 6/2); some thin coatings of dark brown (10YR 3/3) along cleavage planes, which may contain manganese; massive with some vertical cleavage; a few iron-rich "pipestem" concretions of 2 to 5 millimeters in diameter; slightly acid.

C_{12} 42 to 60 inches, mottled yellowish-brown (10YR 5/4), light brownish-gray (10YR 6/2), and dark grayish-brown (10YR 4/2) silt loam; common, iron-rich "pipestems"; massive; friable; slightly acid to neutral or mildly alkaline in lower part.

Farrar fine sandy loam

A_p 0 to 6 inches, very dark brown (10YR 2/2) fine sandy loam; weak, fine and medium, granular structure; very friable; medium acid to slightly acid; range, 4 to 8 inches.

A_3 6 to 9 inches, very dark brown (10YR 2/2) and very dark grayish-brown (10YR 3/2) fine sandy loam; weak, fine and medium, granular structure; very friable; medium acid to slightly acid; range, 0 to 6 inches.

B_1 9 to 15 inches, dark-brown (10YR 3/3) fine sandy loam; common, thin ped coatings of very dark brown (10YR 2/2), especially in upper part of horizon; weak, fine and medium, subangular blocky structure; friable; slightly acid to medium acid; range, 3 to 6 inches.

B_2 15 to 24 inches, dark yellowish-brown (10YR 4/4) and brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; slightly acid; range, 6 to 15 inches.

B_3 24 to 27 inches, dark yellowish-brown (10YR 4/4) loam; very weak, medium, subangular blocky structure; friable; slightly acid; range, 3 to 6 inches.

C_1 27 to 33 inches, yellowish-brown (10YR 5/4) and brown (10YR 5/3) loam; massive; friable; scattered pebbles; neutral to mildly alkaline; range, 0 to 12 inches.

C_2 33 to 40 inches +, yellowish-brown (10YR 5/4) loam; some fine mottles of reddish yellow (7.5YR 6/6); massive; very friable; some calcium carbonate concretions; scattered pebbles; calcareous.

Fayette silt loam

A_1 0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; very friable; slightly acid; range, 0 to 6 inches.

A_2 4 to 8 inches, grayish-brown (10YR 5/2) silt loam; numerous, prominent, nearly continuous ped coatings of light brownish gray (10YR 6/2) and light gray (10YR 7/2); moderate, fine and medium, platy structure; very friable; medium acid to strongly acid; range, 3 to 9 inches.

B_1 8 to 15 inches, yellowish-brown (10YR 5/4) heavy silt loam to light silty clay loam; common, prominent, nearly continuous ped coatings of light brownish gray (10YR 6/2); weak, fine and medium, subangular blocky structure; slightly firm; medium acid; range, 3 to 9 inches.

B_2 15 to 28 inches, yellowish-brown (10YR 5/4) light to medium silty clay loam; numerous, continuous ped coatings, so thick and prominent that uncrushed color is brown (7.5YR 4/4); moderate to strong, medium, subangular blocky structure; slightly firm to firm; common, nearly continuous, thick clay skins; common, soft, fine concretions, apparently ferromanganese; a few iron stains or segregations in the lower part of the horizon; medium acid; range, 12 to 18 inches.

B_3 28 to 34 inches, dark-brown (10YR 4/3) light silty clay loam; common, coarse mottles of pale brown (10YR 6/3); a few fine stains and mottles of reddish yellow (7.5YR 6/6); weak, coarse, subangular blocky structure; slightly firm to firm; a few thin, discontinuous clay skins; common, soft, fine concretions, apparently ferromanganese; medium acid to slightly acid; range, 3 to 9 inches.

C_{11} 34 to 42 inches, mottled dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/4), and pale-brown (10YR 6/3) heavy silt loam; coatings of light brownish gray (2.5Y 6/2) on vertical cleavages; common mottles of reddish yellow (7.5YR 6/6); massive; friable; numerous, soft, fine concretions, apparently ferromanganese; slightly acid; range, 6 to 18 inches.

C_{12} 42 to 60 inches, mottled yellowish-brown (10YR 5/6), light yellowish-brown (10YR 6/4), and pale-brown (10YR 6/3) silt loam; numerous, reddish-yellow (7.5YR 6/6) mottles; massive; friable; common, iron-rich "pipestems," 2 to 5 millimeters in diameter; common, fine and medium-sized concretions, apparently ferromanganese; slightly acid to neutral.

Gara loam

A_p 0 to 5 inches, very dark gray (10YR 3/1) loam; weak, medium, granular structure; friable; medium acid; range, 4 to 8 inches.

A_2 5 to 8 inches, dark grayish-brown (10YR 4/2) loam; numerous, nearly continuous coatings of light brownish gray (10YR 6/2); very weak, coarse, platy structure breaking to weak, medium and coarse, granular structure; friable; medium acid to strongly acid; range, 2 to 6 inches.

B_1 8 to 12 inches, brown (10YR 4/3) light clay loam; common, thin coatings of light brownish gray (10YR 6/2); weak, fine and medium, subangular blocky structure; firm; medium acid; range, 2 to 6 inches.

B_2 12 to 24 inches, yellowish-brown (10YR 5/4) heavy clay loam to light gritty silty clay; some spots of light yellowish brown (10YR 6/4); moderate, medium, subangular blocky structure; common, thin, discontinuous clay skins; firm to very firm; medium acid; range, 12 to 18 inches.

B_3 24 to 30 inches, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) clay loam; common, medium mottles of brownish yellow (10YR 6/6); weak, coarse, subangular blocky structure; a few thin clay skins; firm; a few fine, dark concretions, apparently ferromanganese; medium acid; range, 3 to 9 inches.

C_1 30 to 45 inches +, mottled yellowish-brown (10YR 5/6) and brown (10YR 5/3) clay loam; numerous medium mottles of brownish yellow (10YR 6/6) and reddish yellow (7.5YR 6/6); massive; firm; common, fine and medium, dark concretions, apparently ferromanganese; medium acid.

Glencoe silty clay loam

A_1 0 to 20 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; firm; moderately plastic; slightly acid to mildly alkaline; range, 18 to 24 inches.

B_{g1} 20 to 27 inches, very dark grayish-brown (2.5Y 3/2) and dark olive-gray (5Y 3/2) silty clay; common ped coatings of black (10YR 2/1); weak, medium, subangular blocky structure; firm, plastic when wet; slightly acid to mildly alkaline; range, 6 to 12 inches.

B_{g2} 27 to 33 inches, olive-gray (5Y 4/2) and dark olive-gray (5Y 3/2) silty clay; common mottles of very dark grayish brown (2.5Y 3/2); weak, medium, subangular blocky structure; very firm, plastic when wet; neutral to mildly alkaline; range, 6 to 12 inches.

C_g 33 to 45 inches +, olive-gray (5Y 4/2) and light olive-gray (5Y 6/2) silty clay loam; common, coarse mottles of brownish yellow (10YR 6/6); massive; firm; calcareous.

Gosport silt loam

A_1 0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium and fine, granular structure; friable; medium acid; range, 0 to 3 inches.

A_2 2 to 6 inches, grayish-brown (10YR 5/2) silt loam; weak, medium, granular structure; friable; medium acid to strongly acid; range, 3 to 6 inches.

BC 6 to 15 inches, yellowish-brown (10YR 5/4) silty clay loam to silty clay; common, medium mottles of light brownish gray (10YR 6/2); very weak, medium, subangular blocky structure; firm to very firm; acid; range, 3 to 12 inches.

C 15 to 36 inches +, yellowish-brown (10YR 5/4) and light brownish-gray (10YR 6/2) silty clay loam to silty clay; common variegations of reddish brown (5YR 5/4); numerous shale fragments; massive, except for shale bedding; medium acid to strongly acid.

Gravity silty clay loam

A_1 0 to 10 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium and coarse, granular structure; firm to friable; slightly acid; range, 8 to 12 inches.

A_3 10 to 16 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) silty clay loam; weak to moderate, medium, subangular blocky structure; firm; slightly acid; range, 3 to 6 inches.

B_2 16 to 27 inches, very dark grayish-brown (10YR 3/2) and black (2.5Y 2/1) silty clay loam; weak, medium, subangular blocky structure; firm; slightly acid; range, 9 to 15 inches.

B_3 27 to 36 inches, very dark grayish-brown (2.5Y 3/2) silty clay loam; a few medium mottles of dark olive gray (5Y 3/2); weak, medium, subangular blocky structure; firm; slightly acid; range, 3 to 9 inches.

C 36 to 45 inches +, very dark grayish-brown (2.5Y 3/2) and olive-gray (5Y 4/2) silty clay loam; massive; firm; slightly acid.

Hagener loamy fine sand

A_1 0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; very weak, medium, granular structure; loose; slightly acid to medium acid; range, 3 to 15 inches.

B_1 10 to 20 inches, dark grayish-brown (10YR 4/2) loamy fine sand; common, thin coatings of very dark grayish brown (10YR 3/2); weak, coarse, granular structure; loose; slightly acid to medium acid; range, 6 to 12 inches.

B_2 20 to 30 inches, dark grayish-brown (10YR 4/2) to brown (7.5YR 4/2) loamy fine sand; very weak, medium, subangular blocky structure; loose; slightly acid to medium acid; range, 9 to 15 inches.

B_3 30 to 36 inches, dark grayish-brown (10YR 4/2) and brown (7.5YR 4/2) loamy fine sand; some spots of very dark gray (10YR 3/1); single grain; loose; slightly acid to medium acid; range, 3 to 9 inches.

C 36 to 84 inches, yellowish-brown (10YR 5/4) and dark grayish-brown (10YR 4/2) loamy fine sand; single grain; loose; slightly acid.

CB 84 to 100 inches, yellowish-brown (10YR 5/4) dark grayish-brown (10YR 4/2), and dark-brown (7.5YR 4/2) loamy fine sand; strong-brown (7.5YR 5/6) bands of sandy loam (so-called "iron bands"), ½ to 1 inch thick; single grain; loose; slightly acid.

Harpster loam

A_{11} 0 to 6 inches, dark-gray (10YR 4/1) loam; moderate, fine and medium, granular structure; very friable; highly calcareous; snail-shell fragments are common; range, 3 to 9 inches.

A_{12} 6 to 12 inches, dark-gray (10YR 4/1) loam; moderate, fine, granular structure; very friable; highly calcareous; range, 3 to 6 inches.

A_3 12 to 16 inches, dark-gray (10YR 4/1) loam; common, medium mottles of grayish brown (2.5Y 5/2); weak, coarse, subangular blocky structure that breaks to granular structure; friable; a few pebbles; calcareous; range, 3 to 6 inches.

B_{2g} 16 to 25 inches, olive-gray (5Y 5/2) and grayish-brown (2.5Y 5/2) heavy loam; weak, coarse, subangular blocky structure; slightly firm; a few pebbles; calcareous; range, 6 to 15 inches.

B_3 25 to 30 inches, pale-olive (5Y 6/3) heavy loam; common, coarse mottles of olive gray (5Y 5/2); very weak, coarse, subangular blocky structure; friable; a few pebbles; calcareous; range, 3 to 6 inches.

C_{ca} 30 to 45 inches +, pale-olive (5Y 6/3) heavy loam; common, coarse mottles of strong-brown (7.5YR 5/6); massive; friable; calcium carbonate (lime) concretions are common; a few dark concretions, apparently ferromanganese; calcareous.

Hayden loam

A_1 0 to 2 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; very friable; slightly acid; range, 2 to 4 inches.

A_2 2 to 8 inches, brown (10YR 5/3) to pale-brown (10YR 6/3) loam; weak, fine, platy structure; very friable; medium acid to slightly acid; range, 3 to 9 inches.

B_1 8 to 14 inches, dark-brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) loam; ped coatings of pale brown (10YR 6/3); moderate, medium, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

B_2 14 to 30 inches, yellowish-brown (10YR 5/4) clay loam; prominent ped coatings of dark yellowish brown (10YR 4/4); strong, medium, subangular blocky structure; thick, nearly continuous clay skins; firm; medium acid; range, 12 to 18 inches.

B_3 30 to 39 inches, yellowish-brown (10YR 5/4) light clay loam; some ped coatings of dark yellowish brown (10YR 4/4) and some mottles of dark brown (10YR 4/3); weak, coarse, subangular blocky structure; a few thin clay skins; firm; medium acid; range, 3 to 9 inches.

C_1 39 to 45 inches, yellowish-brown (10YR 5/4) and dark-brown (10YR 4/3) loam; massive; friable; slightly acid to neutral; range, 0 to 15 inches.

C_2 45 to 60 inches, brown (10YR 5/3) loam; massive; friable; calcium carbonate concretions are common; calcareous.

Huntsville silt loam

A_1 0 to 8 inches, very dark gray (10YR 3/1) silt loam; weak, fine and medium, granular structure; friable; slightly acid; range, 3 to 12 inches.

B_1 8 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam to loam; thin ped coatings of very dark gray (10YR 3/1); very weak, medium, subangular blocky structure that breaks readily to granular structure; friable; slightly acid; range, 0 to 4 inches.

B_2 12 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam to loam; thin coatings of very dark gray (10YR 3/1) and a few coarse mottles of reddish yellow (7.5YR 6/6); very weak, medium, subangular blocky structure; friable; slightly acid to neutral; range, 6 to 15 inches.

C_{11} 24 to 33 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (2.5Y 4/2) silt loam to loam; common, coarse mottles of reddish yellow (7.5YR 6/6); a few lenses of sand; massive; friable; neutral to mildly alkaline.

C_{12} 33 to 45 inches, dark grayish-brown (2.5Y 4/2 and dark-brown (10YR 3/3) silt loam to loam; common, coarse mottles of reddish yellow (7.5YR 6/6); massive; friable; calcareous; mildly alkaline.

Ida silt loam

A_1 0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; very weak, fine and medium, granular structure; very friable; calcareous; mildly alkaline.

C 6 to 42 inches +, yellowish-brown (10YR 5/4) silt loam; a few coarse mottles of reddish yellow (7.5YR 6/6); massive; very friable; calcareous.

Judson silt loam

A_1 0 to 15 inches, very dark brown (10YR 2/2) to very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; slightly acid; range, 12 to 20 inches.

A_3–B_1 15 to 21 inches, very dark grayish-brown (10YR 3/2) silt loam; prominent ped coatings of very dark brown (10YR 2/2); very weak, subangular blocky structure that breaks readily to medium, granular structure; friable; slightly acid; range, 3 to 9 inches.

B 21 to 36 inches, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) heavy silt loam; in some places, lower part of horizon has a few faint mottles; weak, subangular blocky structure that breaks readily to granular structure; friable to slightly firm; slightly acid; range, 12 to 18 inches.

C 36 to 45 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 4/3) silt loam; massive; friable; slightly acid to mildly alkaline.

Kato loam, deep over sand and gravel

A_p 0 to 8 inches, very dark gray (10YR 3/1) to very dark brown (10YR 2/2) silt loam to light silty clay loam; moderate, medium, granular structure; friable; slightly acid; range, 4 to 8 inches.

A_{12} 8 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; slightly acid to medium acid; range, 4 to 8 inches.

B_1 14 to 20 inches, very dark grayish-brown (10YR 3/2 to 2.5Y 3/2) heavy silt loam or loam; very weak, subangular blocky structure that breaks readily to medium, granular structure; friable; medium acid; range, 4 to 8 inches.

B_2 20 to 32 inches, very dark grayish-brown (10YR 3/2) heavy silt loam to loam; a few mottles of dark gray (10YR 4/1) and yellowish brown (10YR 5/4); weak, medium, subangular blocky structure; friable; medium acid; range, 10 to 16 inches.

B_3 32 to 38 inches, very dark grayish-brown (10YR 3/2) and yellowish-brown (10YR 5/4) silt loam to loam; spots of dark brown (10YR 4/3); very weak, medium, subangular blocky structure; friable; slightly acid; range, 0 to 6 inches.

D 38 to 45 inches +, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) stratified sand, gravel, and loamy sand; a few large mottles of reddish yellow (7.5YR 6/6); single grain; loose; slightly acid to mildly alkaline.

Ladoga silt loam

A_1 0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; a few ped coatings of very dark brown (10YR 2/2); weak, medium, granular structure; friable; slightly acid; range, 2 to 6 inches.

A_2 6 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; thin, nearly continuous ped coatings of grayish brown (10YR 5/2); very weak, platy structure that readily breaks to weak, medium granular; very friable; medium acid to slightly acid; range, 2 to 6 inches.

B_1 9 to 14 inches, dark-brown (10YR 3/3) heavy silt loam; some thin ped coatings of grayish brown (10YR 5/2) and very dark brown (10YR 2/2); weak, fine and medium, subangular blocky structure; firm; slightly acid to medium acid; range, 4 to 6 inches.

B_2 14 to 30 inches, yellowish-brown (10YR 5/4) heavy silty clay loam to light silty clay; numerous, thin, nearly continuous coatings of brown (10YR 4/3); moderate to strong, medium, subangular blocky structure; thin, nearly continuous clay skins; firm; medium acid; range, 12 to 20 inches.

B_3 30 to 36 inches, yellowish-brown (10YR 5/4) silty clay loam; a few coatings of brown (10YR 4/3); moderate, medium to coarse, subangular blocky structure; a few thin, discontinuous clay skins; firm; medium acid; range, 3 to 6 inches.

C_1 36 to 48 inches +, light yellowish-brown (10YR 6/4) and brown (10YR 4/3) silt loam; spots and streaks of light brownish gray (10YR 6/2) are common; massive; friable; slightly acid.

Lakeville sandy loam

A_p 0 to 6 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) sandy loam; weak to very weak, medium, granular structure; friable; slightly acid; range, 3 to 9 inches.

B_2 6 to 18 inches, brown (10YR 4/3) and very dark grayish-brown (10YR 3/2) sandy loam; very weak, coarse, subangular blocky structure; friable; slightly acid; range, 9 to 15 inches.

B_3 18 to 22 inches, brown (10YR 4/3) and yellowish-brown (10YR 5/4) gravelly sandy loam; very weak, subangular blocky structure to massive; friable; slightly acid to mildly alkaline; range, 0 to 4 inches.

D 22 to 36 inches +, yellowish-brown (10YR 5/4) and pale-brown (10YR 6/3) gravelly sandy loam; single grain; loose; calcareous to mildly alkaline; below a depth of 36 inches, material is mostly gravel.

Lamont fine sandy loam

A_1 0 to 4 inches, very dark brown (10YR 2/2) to very dark grayish-brown (10YR 3/2) fine sandy loam; weak, coarse, granular structure; very friable; slightly acid; range, 0 to 4 inches.

A_2 4 to 8 inches, dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) fine sandy loam; thin, nearly continuous coatings of dark gray (10YR 4/1); very weak, coarse, granular structure; very friable; medium acid; range, 2 to 9 inches.

B_1 8 to 12 inches, yellowish-brown (10YR 5/4) fine sandy loam; thin, discontinuous coatings of grayish brown (10YR 5/2); very weak, medium, subangular blocky structure; very friable; medium acid; range, 2 to 4 inches.

B_2 12 to 24 inches, yellowish-brown (10YR 5/4) fine sandy loam to loam; some spots of brown (10YR 5/3); very weak, medium and coarse, subangular blocky structure; friable; medium acid; range, 9 to 15 inches.

B_3 24 to 27 inches, yellowish-brown (10YR 5/4) fine sandy loam; massive to single grain; very friable; medium acid; range, 2 to 4 inches.

C 27 to 42 inches +, yellowish-brown (10YR 5/6) fine sandy loam; massive to single grain; very friable to loose; medium acid to slightly acid.

Lester loam

A_1 0 to 4 inches, very dark grayish-brown (10YR 3/2) to very dark brown (10YR 2/2) loam; moderate, medium, granular structure; friable; slightly acid; range, 4 to 9 inches.

A_2 4 to 9 inches, dark grayish-brown (10YR 4/2) loam; thin coatings and seams of grayish brown (10YR 5/2) are common; very weak platy structure that breaks readily to moderate, medium and fine, granular structure; friable; medium acid; range, 2 to 6 inches.

B_1 9 to 15 inches, dark-brown (10YR 4/3) loam; stains and coatings of dark grayish brown (10YR 4/2) are common; weak, medium, subangular blocky structure; friable; medium acid; range, 3 to 6 inches.

B_2 15 to 30 inches, dark-brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) light clay loam; common, thin ped coatings of dark brown (7.5YR 3/2); moderate, medium, subangular blocky structure; firm; a few thin, discontinuous clay skins; medium acid; range, 12 to 18 inches.

B_3 30 to 36 inches, yellowish-brown (10YR 5/4) light clay loam; some spots of brown (10YR 5/3) and a few ped coatings of dark brown (7.5YR 3/2); massive; friable; slightly acid; range, 3 to 6 inches.

C_1 36 to 42 inches, yellowish-brown (10YR 5/4) loam; a few mottles of light brownish gray (2.5Y 6/2) and common, fine spots of yellowish red (5YR 5/6); massive; friable; neutral; range, 0 to 24 inches.

C_2 42 to 60 inches +, color and texture the same as horizon above; calcareous; calcium carbonate concretions are common.

LeSueur loam

A_p 0 to 8 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; slightly acid; range, 5 to 10 inches.

A_2 8 to 11 inches, very dark gray (10YR 3/1) loam; prominent, thin, nearly continuous coatings and seams of dark gray (10YR 4/1) and very dark grayish brown (10YR 3/2); weak, medium, granular structure; friable; medium acid to slightly acid; range, 2 to 6 inches.

A_3 11 to 15 inches, very dark grayish-brown (10YR 3/2) loam; coatings of very dark gray (10YR 3/1); weak, medium, granular structure; friable; medium acid to slightly acid; range, 2 to 4 inches.

B_1 15 to 20 inches, very dark grayish-brown (10YR 3/2) light clay loam; a few spots of strong brown (7.5YR 5/6); weak, medium, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

B_2 20 to 30 inches, dark grayish-brown (10YR 4/2 and 2.5Y 4/2) and light brownish-gray (10YR 6/2) light clay loam; a few medium mottles of strong brown (7.5YR 5/6); moderate, medium, subangular blocky structure; firm; common, soft, fine, dark concretions, apparently ferromanganiferous; medium acid; range, 9 to 15 inches.

B_3 30 to 33 inches, dark grayish-brown (10YR 4/2 and 2.5Y 4/2) and light brownish-gray (2.5Y 6/2) loam; common, medium mottles of strong brown (7.5YR 5/6); weak, medium, subangular blocky structure; firm; common, soft, fine, dark concretions, apparently ferromanganiferous; slightly acid; range, 3 to 6 inches.

C_1 33 to 39 inches, light brownish-gray (2.5Y 6/2) and light yellowish-brown (2.5Y 6/4) loam; massive; friable; a few fine, soft, dark concretions, apparently ferromanganiferous; neutral to mildly alkaline; range, 0 to 9 inches.

C_2 39 to 45 inches +, color and texture as in above horizon; calcareous.

Lindley loam

A_1 0 to 4 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; very friable; slightly acid to medium acid; range, 2 to 6 inches.

A_2 4 to 8 inches, grayish-brown (10YR 5/2) loam; thin, nearly continuous ped coatings of light brownish gray (10YR 6/2); weak or very weak, medium, platy structure that breaks readily to granular structure; very friable; strongly acid to medium acid; range, 3 to 9 inches.

B_1 8 to 12 inches, yellowish-brown (10YR 5/4) loam; thin, discontinuous ped coatings of light brownish gray (10YR 6/2), which are more common in upper part of horizon; weak, fine and medium, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

B_2 12 to 28 inches, yellowish-brown (10YR 5/6) and light yellowish-brown (10YR 6/4) heavy clay loam to light gritty silty clay; prominent, thick, nearly continuous coatings of brown (7.5YR 5/4) and a few fine mottles of brownish yellow (10YR 6/6); moderate, fine to medium, subangular blocky structure; thin, nearly continuous clay skins; very firm; medium acid; range, 12 to 18 inches.

B_3 28 to 36 inches, yellowish-brown (10YR 5/6) clay loam; some thin brown (7.5YR 4/4) coatings on peds; common, coarse mottles of brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6); moderate, coarse, subangular blocky structure; firm; medium acid; range, 3 to 9 inches.

C_1 36 to 48 inches +, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/6) clay loam; common, fine mottles of reddish yellow (7.5YR 6/6); massive; firm; medium acid.

Marshan silty clay loam, deep over sand and gravel

A_1 0 to 12 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; slightly firm to firm; plastic; slightly acid; range, 10 to 15 inches.

A_3 12 to 16 inches, black (10YR 2/1) silty clay loam; very weak, medium, subangular blocky structure that breaks readily to granular structure; firm; slightly acid; range, 2 to 6 inches.

B_{g1} 16 to 22 inches, very dark grayish-brown (2.5Y 3/2) silty clay loam to clay loam; thick, continuous ped coatings of black (10YR 2/1); weak, medium, subangular blocky structure; firm; slightly acid; range, 3 to 9 inches.

B_{g2} 22 to 28 inches, very dark grayish-brown (2.5Y 3/2) to dark grayish-brown (2.5Y 4/2) silty clay loam to clay loam; a few coarse mottles of light olive brown (2.5Y 5/4) and some thin coatings of black (10YR 2/1); weak, medium, subangular blocky structure; firm; slightly acid; range, 5 to 10 inches.

B_{g3} 28 to 32 inches, very dark grayish-brown (2.5Y 3/2) and olive-gray (5Y 4/2) silty clay loam or clay loam; a few coarse mottles of light olive brown (2.5Y 5/4); very weak, coarse, subangular blocky structure; firm; few fine, soft, dark concretions, apparently ferromanganiferous; slightly acid to neutral; range, 3 to 6 inches.

C_{g1} 32 to 45 inches, olive-gray (5Y 4/2 and 5/2) clay loam to silty clay loam; common, coarse mottles of light olive brown (2.5Y 5/6); massive; slightly firm to firm; a few fine, soft, dark concretions; calcareous.

D 45 to 60 inches +, olive (5Y 5/3) and olive-gray (5Y 4/2) stratified gravel, sand, and sandy loam; common, coarse mottles of light olive brown (2.5Y 5/6); single grain; loose; calcareous.

Muck, moderately shallow

A_1 0 to 27 inches, black (10YR 2/1) muck; loose; very friable; mildly alkaline (calcareous) to neutral; range, 18 to 42 inches.

D 27 to 48 inches +, dark olive-gray (5Y 3/2) silty clay loam; common, coarse mottles of light olive brown (2.5Y 5/6); massive; firm to slightly firm; mildly alkaline (calcareous) to neutral.

Muscatine silt loam

A_1 0 to 10 inches, very dark brown (10YR 2/2) silt loam to light silty clay loam; moderate, medium and fine, granular structure; friable to firm; slightly acid to medium acid; range, 10 to 20 inches.

A_3 10 to 16 inches, very dark brown (10YR 2/2) light silty clay loam; some ped interiors of very dark grayish brown (10YR 3/2); moderate, medium and fine, granular structure; slightly firm; slightly acid to medium acid; range, 2 to 6 inches.

B_1 16 to 22 inches, very dark grayish-brown (10YR 3/2) light silty clay loam; some ped coatings of very dark brown (10YR 2/2); weak, medium, subangular blocky structure; slightly firm; slightly acid to medium acid; range, 3 to 6 inches.

B_2 22 to 30 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 3/3) silty clay loam; some ped interiors of brown (10YR 4/3); weak, medium and fine, subangular blocky structure; a few thin, discontinuous clay skins; slightly firm to firm; a few fine, soft, dark concretions, apparently ferromanganiferous; slightly acid to medium acid; range, 6 to 12 inches.

B_3 30 to 35 inches, brown (10YR 4/3) silty clay loam; a few medium mottles of yellowish brown (10YR 5/4); weak, medium to coarse, subangular blocky structure; slightly firm; a few fine, soft, dark concretions, apparently ferromanganiferous; slightly acid to medium acid; range, 3 to 6 inches.

C_1 35 to 60 inches, yellowish-brown (10YR 5/4) silty clay loam to silt loam; common, medium mottles of pale brown (10YR 6/3) and strong brown (7.5YR 5/6); massive; friable; common, soft, fine, dark concretions, apparently ferromanganiferous; slightly acid to medium acid.

Nicollet loam

A_p 0 to 8 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; friable; slightly acid to medium acid; range, 6 to 9 inches.

A_3 8 to 14 inches, very dark brown (10YR 2/2) loam; some ped interiors of very dark grayish brown (10YR 3/2); moderate to weak, medium, granular structure; friable; medium acid to slightly acid; range, 3 to 6 inches.

B_1 14 to 17 inches, very dark grayish-brown (10YR 3/2) loam; thick, continuous ped coatings of very dark brown (10YR 2/2); weak, medium and fine, subangular blocky structure; friable; medium acid to slightly acid; range, 3 to 6 inches.

B_2 17 to 29 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) heavy loam to light clay loam; common, fine mottles and spots of yellowish brown (10YR 5/4) and some thin, discontinuous ped coatings of very dark gray (10YR 3/1); moderate, fine and medium, subangular blocky structure; slightly firm; slightly acid; a few pebbles; range, 9 to 15 inches.

B_3 29 to 33 inches, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) heavy loam; common, medium spots and mottles of yellowish brown (10YR 5/4); very weak, medium, subangular blocky structure; friable; slightly acid; a few pebbles; range, 3 to 6 inches.

C_1 33 to 36 inches, yellowish-brown (10YR 5/4) loam; mottles of pale brown (10YR 6/3) and strong brown (7.5YR 5/6); massive; friable; neutral to mildly alkaline; a few pebbles; range, 0 to 12 inches.

C_2 36 to 48 inches, mottled yellowish-brown (10YR 5/4), light brownish-gray (10YR 6/2), and strong-brown (7.5YR 5/6) loam; massive; friable; lime concretions; calcareous; considerable gravel and a few cobblestones.

Nodaway silt loam

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; medium acid to slightly acid; range, 6 to 9 inches.

A_3 8 to 15 inches, dark grayish-brown (10YR 4/2) and brown (10YR 5/3) silt loam; weak, medium and fine, granular structure; friable; medium acid to slightly acid; range, 6 to 9 inches.

C_1 15 to 30 inches, dark grayish-brown (10YR 4/2) silt loam; prominent, medium mottles of strong brown (7.5YR 5/6); massive; friable; medium acid to slightly acid; range, 12 to 36 inches.

D (or A_{1b}) 30 to 45 inches +, black (10YR 2/1) to very dark gray (10YR 3/1) silty clay loam; mottles of strong brown (7.5YR 5/6) in lower part; weak, granular structure to massive; firm; slightly acid to medium acid.

Okoboji silt loam

A_1 0 to 25 inches, black (10YR 2/1) silt loam to mucky silt loam; weak, medium and fine, granular structure; friable; neutral to mildly alkaline; range, 15 to 30 inches.

B_{1g} 25 to 35 inches, dark grayish-brown (2.5Y 4/2) to grayish-brown (2.5Y 5/2) silt loam; coarse mottles of olive brown (2.5YR 4/4); very weak, medium, subangular blocky structure to massive; friable to slightly firm; calcareous; mildly alkaline; a few fine to medium-sized iron concretions.

C_g 35 to 45 inches, mottled grayish-brown (2.5Y 5/2), olive-brown (2.5Y 4/4), and dark olive-gray (5Y 3/2) silt loam to silty clay loam; massive; friable; calcareous; some fine and medium-sized iron concretions.

Olmitz loam

A_1 0 to 20 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; medium acid; range, 9 to 20 inches.

B_{1-2} 20 to 30 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 4/3) loam; very weak, fine and medium, subangular blocky structure; medium acid; range, 9 to 15 inches.

C 30 to 50 inches, grayish-brown (10YR 5/2), light brownish-gray (10YR 6/2), and dark-brown (10YR 4/3) loam; massive; friable; medium acid to slightly acid.

Rolfe loam

A_p 0 to 6 inches, black (10YR 2/1) loam; weak, coarse to medium, granular structure; friable; slightly acid; range, 3 to 15 inches.

A_2 6 to 12 inches, dark-gray (10YR 4/1) loam; coatings of light brownish gray (2.5Y 6/2) and gray (10YR 5/1); very weak, medium, platy structure that breaks readily to weak, coarse granular structure; friable; medium acid; range, 2 to 9 inches.

B_1 12 to 16 inches, very dark-gray (10YR 3/1) heavy loam to light clay loam; some ped coatings of black (10YR 2/1); weak, fine, subangular blocky structure; firm; medium acid to slightly acid; range, 3 to 6 inches.

B_{2g} 16 to 27 inches, dark-gray (10YR 4/1) and very dark grayish-brown (2.5Y 3/2) clay loam to silty clay loam or silty clay; some thin, discontinuous coatings of black (10YR 2/1); moderate, fine and medium, subangular blocky structure; thin, discontinuous clay skins; very firm to firm; medium acid to slightly acid; range, 9 to 15 inches.

B_3 27 to 33 inches, dark olive-gray (5Y 3/2) clay loam mottled with very dark grayish brown (2.5Y 3/2); a few coatings and spots of black (10YR 2/1); moderate, fine and medium, subangular blocky structure; firm; slightly acid to medium acid; range, 3 to 6 inches.

C_1 33 to 48 inches +, dark olive-gray (5Y 3/2) light clay loam to heavy loam; common, fine mottles of yellowish brown (10YR 5/6); massive; firm; slightly acid to neutral.

Runnells silt loam

A_1 0 to 5 inches, very dark gray (10YR 3/1) to very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; slightly acid; range, 4 to 10 inches. The A_p horizon, or plow layer, is dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2).

A_2 5 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; thin, nearly continuous coatings of grayish brown (10YR 5/2); weak, medium, platy structure that breaks readily to granular structure; friable; medium acid; range, 2 to 6 inches.

B_1 8 to 12 inches, dark-brown (10YR 4/3) light silty clay loam to heavy silt loam; common, thin, discontinuous coatings of dark grayish-brown (10YR 4/2) and common spots of yellowish brown (10YR 5/4); weak, medium, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

B_2 12 to 20 inches, yellowish-brown (10YR 5/4) to brown (10YR 5/3) light silty clay loam; moderate, medium, subangular blocky structure; firm; a few thin, discontinuous clay skins; medium acid; range, 6 to 18 inches.

B_{2u} 20 to 27 inches, yellowish-brown (10YR 5/4) gritty silty clay loam to clay loam; common, thin coatings of brown (7.5YR 4/4); moderate, medium, subangular blocky structure; firm; common, thin, discontinuous clay skins; a few hard concretions, 1 to 2 millimeters in diameter; gravel is common; medium acid; range, 0 to 9 inches. (This horizon seems to have developed from loess mixed with Kansan till, shale, or both.)

B_{3u} 27 to 32 inches, yellowish-brown (10YR 5/4) to brown (7.5YR 5/4) clay loam to silty clay; coatings of dark brown (10YR 4/3) with a few coarse variegations of reddish brown (5YR 5/4); weak, coarse, subangular blocky structure; very firm; a few thin, discontinuous clay skins; common, hard, dark concretions, 1 to 2 millimeters in diameter; gravel common; medium acid; range, 3 to 6 inches.

C_u 32 to 48 inches +, yellowish-brown (10YR 5/4) to dark yellowish-brown (10YR 4/4) and light brownish-gray (10YR 6/2) silty clay or clay; a few coarse variegations of reddish brown (5YR 5/4); massive; very firm; medium acid to strongly acid; common, hard, dark concretions; some gravel.

Sarpy loamy sand

A_1 0 to 6 inches, grayish-brown (10YR 5/2) loamy sand; very weak, granular structure to single grain; loose; calcareous; range, 3 to 9 inches.

C_1 6 to 36 inches, pale-brown (10YR 6/3) and light-gray (10YR 7/1) loamy sand; single grain; loose; calcareous; range, 24 to 60 or more inches.

C_2 36 to 45 inches, light yellowish-brown (10YR 6/4) and light-gray (10YR 6/1) loamy sand to sand; common stains or weak bands of strong brown (7.5YR 5/6); single grain; loose; calcareous.

Saylor fine sandy loam

A_1 0 to 12 inches, very dark gray (10YR 3/1) fine sandy loam; some coatings of black (10YR 2/1); weak, fine and medium, granular structure; very friable but hard when dry; slightly acid; range, 9 to 12 inches.

A_3 12 to 16 inches, very dark gray (10YR 3/1) fine sandy loam; very weak, medium and coarse, granular structure; very friable; slightly acid to medium acid; range, 3 to 6 inches.

B_2 16 to 26 inches, dark-brown (7.5YR 3/2) and very dark grayish-brown (10YR 3/2) fine sandy loam; few to common, fine mottles of strong brown (7.5YR 5/6); very weak, coarse, subangular blocky structure; very friable; slightly acid to medium acid; range, 9 to 15 inches.

B_3 26 to 30 inches, very dark grayish-brown (10YR 3/2) fine sandy loam to sandy loam; a few coarse spots of brown (10YR 5/3) and a few fine mottles of strong brown (7.5YR 5/6); single grain; very friable; slightly acid; range, 3 to 6 inches.

C_1 30 to 45 inches, brown (10YR 4/3 to 5/3) fine sandy loam to sandy loam; a few medium mottles of strong brown (7.5YR 5/6); single grain; a few fine, soft, dark concretions, apparently ferromanganiferous; very friable to loose; slightly acid.

Sharpsburg silt loam

A_p 0 to 8 inches, very dark grayish-brown (10YR 3/2) to very dark brown (10YR 2/2) silt loam to silty clay loam; moderate, medium, granular structure; firm; slightly acid.

A_3 8 to 12 inches, very dark grayish-brown (10YR 3/2) to dark grayish-brown (10YR 4/2) silt loam to silty clay loam; moderate, medium, granular structure; firm; medium acid; range, 3 to 6 inches.

B_1 12 to 18 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium, granular structure; firm; medium acid; range, 3 to 6 inches.

B_2 18 to 30 inches, dark-brown (10YR 4/3) heavy silty clay loam; moderate, medium, subangular blocky structure; firm; medium acid; range, 9 to 15 inches.

B_3 30 to 33 inches, dark-brown (10YR 4/3) silty clay loam; a few spots of light yellowish brown (10YR 6/4) and a few fine mottles of strong brown (7.5YR 5/6); weak, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

C_1 33 to 48 inches, yellowish-brown (10YR 5/4) to light yellowish-brown (10YR 6/4) light silty clay loam to silt loam; common, fine mottles of strong brown (7.5YR 5/6); massive; friable; medium acid to slightly acid.

Shelby loam

A_1 (or A_p) 0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; prominent ped coatings of very dark brown (10YR 2/2); moderate, medium, granular structure; friable; slightly acid; range, 3 to 12 inches.

A_3 8 to 12 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; friable; slightly acid; range, 3 to 9 inches.

B_1 12 to 15 inches, dark-brown (10YR 3/3) loam; weak; medium, subangular blocky structure; firm; slightly acid; range, 3 to 6 inches.

B_2 15 to 30 inches, dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) loam to light clay loam; weak, coarse and medium, subangular blocky structure; firm; medium acid; range, 12 to 20 inches.

B_3 30 to 36 inches, yellowish-brown (10YR 5/4) loam to clay loam; very weak, coarse and medium, subangular blocky structure; firm; slightly acid; range, 3 to 6 inches.

C_1 36 to 48 inches, yellowish-brown (10YR 5/6) to strong-brown (7.5YR 5/6) firm loam to clay loam; massive; slightly acid to mildly alkaline; in some places calcareous at a depth of less than 48 inches.

Storden loam

A_1 0 to 6 inches, very dark grayish-brown (10YR 3/2) loam; very weak, medium, granular structure; friable; calcareous; range, 3 to 9 inches.

C_1 6 to 10 inches, dark-brown (10YR 4/3) loam; thin coatings of very dark grayish brown (10YR 3/2); massive; friable; calcareous; range, 0 to 6 inches.

C_{2ca} 10 to 42 inches +, yellowish-brown (10YR 5/4) loam; massive; friable; calcareous.

Stronghurst silt loam

A_1 0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable; slightly acid; range, 2 to 4 inches.

A_2 3 to 10 inches, dark grayish-brown (10YR 4/2) and dark-gray (10YR 4/1) silt loam; prominent, thick coatings of light brownish gray (10YR 6/2); weak, medium, platy structure that breaks readily to granular structure; friable; medium acid; range, 6 to 9 inches.

B_1 10 to 14 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 4/3) silty clay loam; thin, discontinuous coatings of dark gray (10YR 4/1); weak, subangular blocky structure; firm; medium acid; range, 3 to 6 inches.

B_2 14 to 29 inches, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) silty clay loam; a few mottles of yellowish brown (10YR 5/6); moderate, medium, subangular blocky structure; firm; medium acid; range, 12 to 16 inches.

B_3 29 to 33 inches, dark-brown (10YR 4/3) and very dark grayish-brown (10YR 3/2) silt loam; numerous yellowish-brown mottles (10YR 5/6); very weak, medium, subangular blocky structure; firm; medium acid to slightly acid; range, 3 to 6 inches.

C 33 to 45 inches +, dark yellowish-brown (10YR 4/4) silt loam; numerous mottles of yellowish brown (10YR 5/6); massive; friable; slightly acid to moderately acid.

Tama silt loam

A_1 0 to 10 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, granular structure; friable; slightly acid to medium acid; range, 6 to 14 inches.

B_1 10 to 16 inches, dark-brown (10YR 4/3) silt loam to silty clay loam; thick but discontinuous coatings of very dark brown (10YR 2/2); weak, medium, subangular blocky structure that breaks readily to granular structure; friable; moderately to slightly acid; range, 3 to 9 inches.

B_2 16 to 26 inches, dark-brown (10YR 4/3) silty clay loam; moderate to weak, subangular blocky structure; a few thin, discontinuous clay skins; slightly firm to firm; medium acid to slightly acid; range, 9 to 15 inches.

B_3 26 to 33 inches, brown (10YR 5/3) silty clay loam; common, medium mottles of light brownish gray (10YR 6/2) and a few medium mottles of strong brown (7.5YR 5/6); weak, medium and coarse, subangular blocky structure; slightly firm; a few fine, soft, dark concretions, apparently ferromanganiferous; slightly acid to medium acid; range, 3 to 7 inches.

C_1 33 to 48 inches, mottled yellowish-brown (10YR 5/4) and light brownish-gray (10YR 6/2) silt loam; common, medium mottles of strong brown (7.5YR 5/6); massive; friable; common, soft, fine, dark concretions, apparently ferromanganiferous; slightly acid.

Terril loam

A_1 0 to 12 inches, very dark brown (10YR 2/2) to very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; friable; slightly acid; range, 9 to 15 inches.

A_3 12 to 16 inches, very dark grayish-brown (10YR 3/2) loam; thin, discontinuous coatings of very dark gray (10YR 3/1); very weak, medium, subangular blocky structure that breaks readily to granular structure; friable; slightly acid; range, 3 to 6 inches.

B_2 16 to 24 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 3/3) loam; weak, medium, subangular blocky structure; friable; slightly acid; range, 6 to 12 inches.

B_3 24 to 30 inches, very dark grayish-brown (10YR 3/2) and very dark gray (10YR 3/1) loam; a few mottles of yellowish brown (10YR 5/6); very weak, coarse, subangular blocky structure; friable; slightly acid; range, 3 to 9 inches.

C 30 to 45 inches, very dark grayish-brown (10YR 3/2) to dark grayish-brown (10YR 4/2) loam; a few mottles of yellowish brown (10YR 5/6); massive; friable; slightly acid.

Wabash silty clay

A_p 0 to 8 inches, black (10YR 2/1) silty clay; moderate, medium, granular structure; very firm; medium acid; range, 6 to 9 inches.

A_3 8 to 14 inches, dark-gray (10YR 4/1) silty clay; coatings of black (10YR 2/1); moderate, medium, granular structure; very firm; medium acid; range, 3 to 9 inches.

B_{g1} 14 to 20 inches, very dark gray (5Y 3/1) silty clay; coatings of black (5Y 2/1); moderate, fine, subangular blocky structure; very firm; medium acid; range, 3 to 9 inches.

B_{g2} 20 to 27 inches, very dark gray (5Y 3/1) and dark-gray (10YR 4/1) silty clay to clay; moderate, medium, subangular blocky structure; very firm; range, 6 to 9 inches.

B_{g3} 27 to 33 inches, dark-gray (10YR 4/1) silty clay; weak, coarse, subangular blocky structure; very firm; medium acid; range, 3 to 6 inches.

C_g 33 to 48 inches, dark-gray (2.5Y 4/1) silty clay to clay; mottles and coatings of olive gray (5Y 5/2); massive; very firm; medium acid to slightly acid.

Waukegan loam, moderately deep over sand and gravel

A_p 0 to 8 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; slightly acid; range, 4 to 9 inches.

A_3 8 to 11 inches, very dark grayish-brown (10YR 3/2) loam; prominent coatings of very dark brown (10YR 2/2); weak, medium, granular structure; slightly firm; slightly acid; range, 0 to 3 inches.

B_1 11 to 16 inches, brown (10YR 4/3) loam; weak, coarse, granular structure; slightly firm; slightly acid; range, 2 to 6 inches.

B_2 16 to 22 inches, brown (10YR 4/3) and dark yellowish-brown (10YR 3/4) loam; weak, medium, subangular blocky structure that breaks readily to coarse and medium granular structure; firm; slightly acid; range, 4 to 12 inches.

D_1 22 to 25 inches, brown (10YR 4/3) and dark-brown (10YR 3/3) gravelly sandy loam; massive; friable; slightly acid; range, 0 to 12 inches.

D_2 25 to 36 inches, brown (7.5YR 4/4) gravelly loamy sand; massive; loose; neutral to alkaline.

Webster silty clay loam

A_1 0 to 12 inches, black (10YR 2/1) silty clay loam; moderate to strong, medium, granular structure; slightly firm; slightly acid to neutral; range, 10 to 15 inches.

A_3 12 to 15 inches, black (10YR 2/1) silty clay loam; a few mottles of dark grayish brown (2.5Y 4/2); moderate, medium, granular structure; firm; slightly acid to neutral; range, 2 to 4 inches.

B_{g1} 15 to 20 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, thin, discontinuous coatings of black (10YR 2/1); moderate, medium, subangular blocky structure; firm; some gravel; slightly acid to neutral; range, 3 to 6 inches.

B_{g2} 20 to 26 inches, dark grayish-brown (2.5Y 4/2) and olive-gray (5Y 5/2) silty clay loam; a few thin coatings of very dark gray (10YR 3/1); moderate, medium, subangular blocky structure; firm; some gravel; slightly acid to neutral; range, 6 to 12 inches.

B_{g3} 26 to 29 inches, olive-gray (5Y 5/2) silty clay loam; a few thin, discontinuous coatings of black (10YR 2/1); weak, medium and coarse, subangular blocky structure; firm; some gravel; a few fine, soft dark concretions; slightly acid to mildly alkaline; range, 3 to 6 inches.

C_g 29 to 36 inches, olive-gray (5Y 5/2) and light olive-gray (5Y 6/2) silty clay loam to clay loam; massive; slightly firm; some gravel; numerous calcium carbonate (lime) concretions; common, dark, soft, fine concretions; calcareous.

Engineering Applications [10]

This soil survey report for Polk County, Iowa, contains information that can be used by engineers to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Assist in designing drainage and irrigation structures and in planning dams and other structures for water and soil conservation.
3. Make reconnaissance surveys of soil and ground conditions that will aid in selecting highway and airport locations and in planning more detailed soil surveys for the intended locations.
4. Locate sand and gravel for use in structures.
5. Correlate pavement performance with types of soil and thus develop information that will be useful in designing and maintaining the pavements.
6. Determine the suitability of soils for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs.

The map and the descriptive report are somewhat generalized, however, and should be used only in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed engineering construction.

Some of the terms used by the agricultural soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, sand, aggregate, and granular—have special meanings in soil science. These terms are defined as follows:

Aggregate: A cluster of primary soil particles held together by internal forces to form a clod or fragment.

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

Granular structure: Individual grains grouped into spherical aggregates that have indistinct sides. Highly porous granules are commonly called crumbs.

Sand: A soil separate that ranges in diameter from 2.0 millimeters to 0.05 millimeter. As a textural class, soil material that is 85 percent or more sand and not more than 15 percent silt and clay.

Silt: A soil separate that ranges in diameter from 0.05 millimeter to 0.002 millimeter. As a textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

[10] This section was prepared in cooperation with the Division of Physical Research, Bureau of Public Roads, and the Iowa State Highway Commission.

Soil: The natural medium for the growth of land plants on the surface of the earth; composed of organic and mineral materials.

Topsoil: Presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

Engineering Classification Systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of high-bearing capacity, to A-7, which is made up of clay soils having low strength when wet. The group symbols for the Polk County soils are shown in the next to last column in table 6.

Some engineers prefer to use the Unified soil classification system (*20*). In this system, soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic. An approximate classification can be made in the field. The classification of the soils in Polk County is given in the last column of table 6.

Basic engineering and soil information can be obtained from the PCA Soil Primer (*9*).

Soil Engineering Data and Interpretations

Some of the information needed by engineers can be obtained from the soil map. For more detailed information and for a better understanding of the general conditions in the area, it will be necessary to refer to other parts of the report, particularly to these sections: General Nature of the County; Soil Survey Methods and Definitions; General Soil Areas of Polk County; Descriptions of Soils; and Genesis, Morphology, and Classification of Soils.

The soil engineering data in table 6 are based on soil test data of Iowa State Highway Commission, on information given in the other sections of the report, and on experience with the same kinds of soils in other counties.

The bedrock in Polk County is shale of the Des Moines group. It consists of interbedded layers of shale, limestone, sandstone, siltstone, and coal. Normally it is buried beneath several feet of glacial till. Where the bedrock outcropped and weathered, it formed the parent material of the Gosport, Bauer, and Runnells soils. The shale expands when exposed to weathering and breaks up to form plastic clay and silty clay. When these materials are encountered in highway construction, the grade in embankments should be at least 5 feet above them, and, in cut sections, they should be covered with granular material. It is important to keep close control of the moisture content, to prevent excessive swelling or instability of high embankments.

When planning heavy structures whose foundations will rest on shale bedrock, local records should be carefully checked to locate abandoned coal mines. Extensive beds of coal in Polk County were mined and abandoned, and the surface over these mined areas subsequently settled.

In the southern one-fifth of the county, the shale is overlain by Kansan glacial till, which is covered with a loess mantle up to 20 feet thick. The Kansan glacial till is heterogeneous. Under the loess mantle, in the less dissected areas, lies what remains of the original Kansan till plain. In some areas this consists of an upper layer of very stiff, plastic clay, A-7 ("gumbotil"), which is unstable in highway subgrades and should not be used within 5 feet of grade. In other areas where the till-plain surface was more rolling, a reddish-brown, pebbly layer of till formed. Wherever glacial soils outcrop, either the gumbotil or the pebbly layer is ordinarily found near the top. Beneath these interface layers, the soils are predominantly A-7, although because of the method of deposition, any soil texture may occur, from sand and gravel to plastic clay. Frost heaving is common where sand or gravel pockets holding large quantities of free water are overlain by fine-grained soils that are within the zone of frost penetration. A perched water table may be encountered where a layer or pocket of sandy or gravelly soil overlies a layer of clayey soil.

The soils developed from the loess overlying the Kansan till are texturally fine grained (A-6 and A-7 or CL and CH) and fairly uniform in texture throughout their depth. Frost heaving is not normally a problem in loess soils, because of the uniformity of material; however, frost heaving of pavements may occur in cut sections where only a few feet of loess overlies the heterogeneous glacial till. If runoff is concentrated, the soils derived from loess are very erodible. Hence, sod, pavement, or check dams are needed in gutters and ditches to control erosion. The seasonally high water table in the loess soils usually lies above the glacial till-loess interface. The in-place density of the loess is low enough to permit a high moisture content, which may cause instability of slopes steeper than 30 degrees and of embankments placed without moisture and density control.

In the northern four-fifths of Polk County, the soils developed from glacial till of the more recent Cary substage of the Wisconsin glaciation. Although these soils are heterogeneous, like those developed from the Kansan till, they are texturally better for engineering (generally A-4 or A-6). Frost heaving is a greater problem in Cary till, which has more sand and gravel pockets containing free water.

In level to gently rolling soils like the Nicollet and Webster, the dark-colored, thick topsoil is more than 2 percent carbon. Good density is difficult to obtain in this topsoil, even with control of moisture content and compaction. Hence, this topsoil should not be used in the upper 2 feet of a highway embankment. Glencoe and Okoboji soils are excessively high in carbon and, like peat and muck, they are not suitable material for embankments or foundations. If embankments cross these soils, the black horizons of high carbon content should be excavated if they are shallow or displaced if deep.

Granular deposits are relatively abundant in the end-moraine and glacial outwash deposits from which the Lakeville, Buckner, Kato, Marshan, Saylor, Waukegan, and Dickinson, bench position, soils formed.

Many of these deposits are sources of construction materials of high quality. Some areas of the Chelsea, Hagener, and Lamont soils, which formed from eolian sands, are susceptible to wind erosion. Roadway slopes in these soils should be protected from both water and wind erosion.

The alluvial soils of the bottom lands, represented by the Colo, Cooper, Huntsville, Nodaway, Dorchester, and Wabash, are occasionally flooded. Roadways constructed in these bottom lands should be on embankments above the level of flooding. The fine sand and silt layers common in alluvial soils are susceptible to differential frost heave; hence, proper roadway drainage should be provided and foundation materials that are not susceptible to frost action should be used if pavements are constructed only a few feet above the water table. The water table is seasonally variable in these soils, but the moisture content is generally high and in-place density low; therefore, moisture and density control are needed if these soils are used as embankment material.

Table 6 shows the suitability of Polk County soils as sources of borrow for highway construction and as sources of topsoil for embankments, slopes, and ditches. Material suitable for topsoil is generally unsuitable for use on highway shoulders that have to support some traffic during wet periods.

At many construction sites, major variations in the soil may occur within the depth of the proposed excavation. Also, several soil units may occur within short distances. Nevertheless, soil engineers can use the information in soil survey reports to plan detailed surveys of soils at construction sites. This makes it possible to take a minimum number of soil samples for laboratory testing, and to make an adequate soil investigation at minimum cost.

Soil Properties Affecting Soil Conservation Practices

This section discusses soil properties and their relation to terraces, drainage, irrigation, and farm ponds —engineering structures that conserve soil and water.

Terraces

The factors to be considered before building terraces are: (1) the purpose of the terraces, (2) the slope of the land, and (3) the soil conditions. In general, terraces are built for two purposes. The more common of the two is to control sheet and gully erosion on sloping soils; the other is to divert water from lower areas to prevent flooding. Generally, diversion terraces are the larger in cross section and they are always on a grade because they are designed to carry more water.

Terraces may be constructed on any slope on which earth-moving machinery can operate. The steeper the slopes, the larger or closer together the terraces have to be, and, consequently, the more difficult they are to work over. Terraces for control of sheet and gully erosion can be used with excellent success on slopes of less than 14 percent and with fair to good success on slopes of 14 to 18 percent. Up to 1958, little experience had been had with terraces on slopes of more than 18 percent. However, some farmers have built terraces on such slopes in western Iowa and have reported that they are satisfactory.

Controlling gullies is a complicated problem in this county, and practices other than terracing may be needed. Technical service is available from the Soil Conservation Service.

Terraces can be constructed satisfactorily from most soil material unless it is very sandy. Loamy sand, loamy fine sand, sand, or gravel are not likely to make stable terraces. They will tend to drift with the wind or to slump into the terrace channels. On soils like Buckner loamy sand, Chelsea loamy fine sand, Crocker loamy fine sand, and Hagener loamy fine sand, it is hard to keep the channels from filling.

Most of the sloping soils in the uplands of Polk County are suitable for terracing. Graded terraces with outlets to grassed waterways are the most suitable for Polk County soils.

Drainage and irrigation

Artificial drainage of soils to improve crop yields is an important farming practice in this county. Tile drainage with outlets to manmade open ditches or to natural streams is the most common method. Open ditch drainage is second.

Tile drainage systems are installed to remove subsurface water from the soil and, in some cases, to remove surface water through surface intakes. Factors to consider before installing tile drainage are (1) the need for drainage, (2) the suitability of the soil for drainage by tile, (3) the availability of a suitable outlet for the tile, and (4) an adequate design to provide a complete and economical system.

Whether or not tile will work well depends on the permeability of the soil. Tile drains do not work well in soils that are very slowly permeable, except when used to remove surface water through open intakes. Tile drains do work well in soils that are moderately permeable. Tile should be closer together in soils that are slowly permeable than in soils that are moderately permeable and may then work only fairly well.

The Clarinda and Adair soils are very slowly permeable, but their principal drainage problem is caused by seepage through the overlying loess. Tile lines placed so as to intercept the seepage water will drain these soils satisfactorily.

Soils having a sand or gravel substratum present special problems of tile installation and maintenance because of their unstable nature.

The drainage and permeability classifications of the soils will be found in table 3, Summary of Major Characteristics of Soil Types.

To determine the suitability of a tile outlet and to get an adequate design for the tile system, the services of a drainage engineer are normally needed.

Open ditches are used to remove excess surface water or to remove water collected by tile or by other ditches. Shallow, open ditches that are crossable by farm machinery are effective in removing surface water from pothole soils such as the Glencoe or Okoboji, and they should be used in addition to tile drain-

TABLE 6.—*Soil characteristics that affect engineering*

Soil series and miscellaneous land types	Slope	Brief description of soil profile and ground condition	Parent material	Depth to seasonally high water table	Suitability as source of—		Classification	
					Topsoil	Borrow for highway construction	AASHO [1]	Unified [2]
				Feet				
Adair	5 to 14 percent.	Moderately well drained to imperfectly drained; very firm silty clay subsoil over firm clay loam.	Kansan glacial till	(3)	Unsuitable	Poor	A–7	CL–CH.
Alluvial land	0 to 1 percent.	Fresh stream deposits; variable texture but mostly in the medium range.	Alluvium	2 to 3	Fair	Fair	A–2 to A–7	SM–CH.
Ames	0 to 2 percent.	Poorly drained; firm silty clay loam to silty clay subsoil over firm loam.	Cary glacial till	1½ to 3	Fair	Poor	A–7	CH–OH.
Ankeny	0 to 5 percent.	Somewhat excessively drained; loose sandy loam subsoil over loose loamy sand to sand.	Local sandy alluvium.	3+	Unsuitable	Good	A–2 or A–3	SP–SM.
Atterberry	1 to 3 percent.	Moderately well drained to imperfectly drained; firm silty clay loam subsoil over friable silt loam.	Loess	3+	Fair to depth of dark surface layer.	Poor	A–6 or A–7	CL–CH.
Bauer	5 to 40 percent.	Moderately well drained; 6 to 24 inches thick over firm silty clay; shale fragments are common.	Shale	3+	Poor	Poor (shale unsuitable).	A–6 or A–7 over shale.	CL over shale.
Blockton	0 to 5 percent.	Poorly drained; very firm silty clay subsoil; high carbon content in upper 1½ to 2 feet; high moisture content throughout.	Alluvium	2 to 3	Fair	Unsuitable	A–7	CH–OH.
Buckner	0 to 9 percent.	Excessively drained; loose, loamy, coarse sand throughout; coarse sand and some fine gravel in the nearly level areas.	Glacial outwash	5+	Unsuitable	Good	A–1 or A–2	SW–SP.
Cantril	0 to 5 percent.	Imperfectly drained; firm silty clay loam subsoil over friable silt loam.	Local alluvium	2½ to 3	Fair	Poor	A–7	CL–CH.
Chaseburg	0 to 5 percent.	Moderately well drained to imperfectly drained; friable silt loam throughout.	Local alluvium	2 to 3	Good	Fair	A–4 to A–6	ML–CL.
Chelsea	5 to 30 percent.	Excessively drained; loamy fine sand throughout.	Aeolian sands	5+	Unsuitable	Good	A–2 or A–3	SM–SP.
Clarinda	5 to 9 percent.	Poorly drained to imperfectly drained; very firm silty clay or clay subsoil.	Kansan gumbotil	(3)	Unsuitable	Unsuitable	A–7	CH.
Clarion	0 to 30 percent.	Well drained; slightly firm loam to clay loam subsoil over friable loam; small sand and gravel lenses common.	Cary glacial till	5+	Good to depth of dark surface layer.	Good	A–4 to A–6	SC–CL.
Clearfield	5 to 14 percent.	Imperfectly drained; firm silty clay loam subsoil; silty clay gumbotil at 3½ to 5 feet.	Loess over gumbotil.	(3)	Good to depth of dark surface layer.	Poor	A–7	CL–CH.
Colo	0 to 1 percent.	Poorly drained; firm silty clay loam throughout; high organic-matter content in upper 1½ to 2 feet.	Alluvium	1 to 3	Good to depth of 1½ feet.	Unsuitable	A–7	OH–CH.

Cooper	0 to 2 percent.	Imperfectly drained; firm silty clay loam subsoil over very firm silty clay or clay at depths of 24 to 42 inches.	Alluvium	2 to 3	Good to depth of 1½ feet.	Unsuitable	A–7	CL–CH.
Crocker	2 to 30 percent.	Somewhat excessively drained; loose loamy fine sand over slightly firm loam or clay loam at depths of 12 to 24 inches.	Aeolian sands over glacial till.	5+	Unsuitable	Fair	A–2 to A–3 over A–4 to A–6.	SM–SP over SC–CL.
Dickinson	0 to 30 percent.	Well drained to somewhat excessively drained; friable fine sandy loam subsoil; underlying material ranges from a loam to sand.	Sandy Cary glacial drift.	5+	Poor	Good	A–2 to A–4	SM–SC.
Dickinson, bench position.	0 to 9 percent.	Somewhat excessively drained; very friable sandy loam subsoil; below depth of 30 inches, loose loamy sand to sandy loam with some gravel layers.	Glacial outwash	5+	Poor	Excellent	A–1 or A–2	SM–SP.
Dorchester	0 to 2 percent.	Imperfectly drained to excessively drained; friable silt loam; sand below depth of 12 inches.	Alluvium	1 to 3	Good to depth of sand.	Good	A–2 to A–4	SM–SP.
Downs	0 to 30 percent.	Well drained; slightly firm silty clay loam subsoil over friable silt loam.	Loess	5+	Good to depth of dark surface layer.	Fair	A–6 or A–7–6	ML–CL.
Farrar	2 to 30 percent.	Somewhat excessively drained; friable sandy loam subsoil over friable loam.	Aeolian sands over Cary glacial till.	5+	Poor	Good	A–2 to A–4	SM–SC.
Fayette	0 to 40 percent.	Well drained; slightly firm silty clay loam subsoil over friable silt loam.	Loess	5+	Fair to poor	Fair	A–6 or A–7–6	ML–CL.
Gara	5 to 40 percent.	Well drained; very firm to firm clay loam over firm clay loam; contains stones, pebbles, some sand pockets and, in places, some gumbotil-like material.	Cary glacial till	3 to 5+	Fair to depth of dark surface layer.	Fair	A–6 or A–7	CL–CH.
Glencoe	Depressions.	Very poorly drained; firm silty clay loam to silty clay subsoil; high organic-matter content to depths of 2 to 3 feet.	Local alluvium	0 to 3	Fair to good	Unsuitable	A–7	CH–OH.
Gosport	5 to 40 percent.	Well drained; plastic silty clay shale at depths of 6 to 18 inches.	Shale	(3)	Unsuitable	Unsuitable	Visual (shale)	Visual (shale).
Gravity	2 to 4 percent.	Imperfectly drained; firm to friable silty clay loam throughout; high organic-matter content to depths of 1½ to 2 feet.	Local alluvium	2½ to 3	Good	Fair	A–6 or A–7	CL.
Hagener	0 to 20 percent.	Excessively drained; loose loamy fine sand or loamy sand throughout.	Aeolian sands	5+	Unsuitable	Good	A–2 or A–3	SM–SP.
Harpster	1 to 2 percent.	Poorly drained; slightly firm clay loam subsoil over slightly firm loam; high organic-matter content to depths of 1½ feet.	Cary glacial drift	1½ to 3	Poor	Unsuitable	A–6 or A–7	CL–OH.
Hayden	0 to 40 percent.	Well drained; slightly firm clay loam subsoil over friable loam; sand and gravel lenses common.	Cary glacial till	5+	Poor	Good	A–4 to A–6	SC–CL.
Huntsville	0 to 2 percent.	Moderately well drained to imperfectly drained; friable silt loam or sandy loam throughout.	Alluvium	1 to 3	Good	Good	A–2 to A–4	SM–ML.

TABLE 6.—*Soil characteristics that effect engineering—Continued*

Soil series and miscellaneous land types	Slope	Brief description of soil profile and ground condition	Parent material	Depth to seasonally high water table	Suitability as source of—		Classification	
					Topsoil	Borrow for highway construction	AASHO [1]	Unified [2]
				Feet				
Ida	5 to 9 percent.	Well drained; very friable silt loam throughout.	Loess	5+	Poor	Fair	A-4 to A-6	ML-CL.
Judson	2 to 9 percent.	Moderately well drained; friable silt loam throughout; fairly high organic-matter content in top 2 to 3 feet.	Local alluvium	3+	Good	Poor	A-7	OL-CL.
Kato	1 to 3 percent.	Imperfectly drained; slightly firm loam subsoil; sand and gravel at depths of 24 to 36 inches or more.	Glacial outwash	2½ to 3	Good to depth of dark surface layer.	Excellent	A-4 over A-1 or A-2.	SM-SC over SP-SW.
Ladoga	2 to 30 percent.	Well drained; firm silty clay loam subsoil over friable silt loam.	Loess	5+	Good to depth of dark surface layer.	Fair	A-6 or A-7	ML-CL.
Lakeville	2 to 40 percent.	Excessively drained; very friable sandy loam subsoil; loose gravel and sand below depths of about 2 feet.	Cary glacial drift	5+	Unsuitable	Excellent	A-1 or A-2	GP-SW.
Lamont	2 to 30 percent.	Somewhat excessively drained; friable fine sandy loam subsoil; loose fine sandy loam to loamy fine sand below depths of about 2 feet.	Aeolian sands	5+	Unsuitable	Good	A-2 or A-3	SM-SP.
Lester	0 to 40 percent.	Well drained; firm loam to clay loam subsoil over friable loam; sand and gravel lenses common.	Cary glacial till	5+	Fair to depth of dark surface layer.	Good	A-4 to A-6	SC-CL.
LeSueur	1 to 3 percent.	Imperfectly drained; firm clay loam subsoil over friable loam.	Cary glacial till	3+	Fair to depth of dark surface layer.	Fair	A-6 or A-7	CL.
Lindley	9 to 40 percent.	Well drained; very firm, gritty silty clay subsoil over firm clay loam; contains pebbles, stones, sand pockets, and, in places some gumbotil-like material.	Kansan glacial till	3 to 5+	Poor	Fair	A-6 or A-7	CL-CH.
Marshan	0 to 2 percent.	Poorly drained; firm silty clay loam subsoil; stratified sand or gravel below depths of 24 to 60 inches; fairly high organic-matter content to depths of 1½ to 2 feet.	Glacial outwash	1½ to 3	Good to depth of dark surface layer.	Unsuitable above gravel.	A-6 or A-7 over A-1 or A-2.	OH over SP-SW.
Muck	Depressions.	Loose very friable organic material to depths of 6 to 42 inches over firm silty clay loam.	Organic material over glacial drift.	0 to 3	Good	Unsuitable	Visual	Pt.
Muscatine	1 to 3 percent.	Imperfectly drained; slightly firm silty clay loam subsoil over friable silt loam.	Loess	3+	Good	Poor	A-6 or A-7	CL-OL.
Nicollet	1 to 3 percent.	Imperfectly drained; slightly firm clay loam subsoil over friable loam; sand and gravel pockets are common.	Cary glacial till	3+	Good to depth of dark surface layer.	Fair	A-6 or A-7	SC-CL.
Nodaway	0 to 2 percent.	Moderately well drained to imperfectly drained; friable silt loam subsoil; a black silty clay loam buried soil com-	Alluvium	1 to 3	Good to fair	Fair	A-7	ML-CL.

		monly found below depths of 3 to 4 feet is classified A-7-6(18+).						
Okoboji	Depressions.	Very poorly drained; slightly firm silt loam subsoil over slightly firm silty clay loam; fairly high organic-matter content to depths of 2 to 3 feet.	Local alluvium	0 to 3	Good	Unsuitable	A-7 to peat or muck.	OH-Pt.
Olmitz	0 to 9 percent.	Moderately well drained; friable loam to sandy loam subsoil over friable loam to sandy loam.	Local alluvium	2 to 3	Good	Poor	A-6 or A-7	CL-OL.
Peat	Depressions.	Loose fibrous organic material to depths of 18 to 48 inches over firm silty clay loam.	Organic material over glacial drift.	0 to 3	Unsuitable	Unsuitable	Visual	Pt.
Riverwash	0 to 2 percent.	Recently deposited sands and sandy loams.	Alluvium	0 to 3	Unsuitable	Fair	A-2 or A-3	SW-SP.
Rolfe	Depressions.	Poorly drained; firm clay loam to silty clay subsoil over slightly firm loam or stratified sand and gravel at depths of 3 to 4 feet.	Local alluvium	0 to 3	Fair to depth of dark surface layer.	Unsuitable	A-7 over A-1 or A-2.	CH-OH over GP-SW.
Runnells	5 to 40 percent.	Well drained; firm silty clay loam to silty clay subsoil; very firm silty clay shale below depths of 18 to 36 inches.	Loess and glacial till over weathered shale.	3 to 5+	Fair to depth of dark surface layer.	Unsuitable	A-6 or A-7 over shale.	CL-CH over shale.
Sarpy	0 to 2 percent.	More than 40 inches of loose loamy sand or sand on stream bottoms.	Alluvium	2½ to 3	Unsuitable	Fair	A-3 or A-2	SM-SP.
Saylor	0 to 2 percent.	Moderately well drained to imperfectly drained; friable sandy loam subsoil; sandy loam, loamy sand, or fine gravel below depths of about 2½ feet.	Glacial outwash	2 to 3	Poor	Good	A-4 over A-1 or A-2.	SM-SC over SP-SW.
Sharpsburg	0 to 20 percent.	Moderately well drained; firm silty clay loam subsoil over friable silt loam.	Loess	5+	Good to depth of dark surface layer.	Fair	A-6 or A-7	ML-CL.
Shelby	5 to 30 percent.	Moderately well drained; firm clay loam subsoil over slightly firm loam to clay loam; contains pebbles, stones, and some sand pockets.	Kansan glacial till	3 to 5+	Fair to depth of dark surface layer.	Fair	A-6 or A-7	SC-CL-CH.
Storden	3 to 40 percent.	Well drained; friable loam throughout; sand and gravel pockets common.	Cary glacial till	5+	Unsuitable	Good	A-4 to A-6	SC-CL.
Stronghurst	0 to 2 percent.	Imperfectly drained; firm silty clay loam subsoil over friable silt loam.	Loess	3+	Poor	Poor	A-6 or A-7	CL-CH.
Tama	0 to 14 percent.	Well drained; firm silty clay loam subsoil over friable silt loam.	Loess	5+	Good to depth of dark surface layer.	Fair	A-6 or A-7	ML-CL.
Terril	0 to 9 percent.	Moderately well drained; friable loam throughout.	Local alluvium	3+	Excellent	Poor	A-6 or A-7	CL-OL.
Wabash	0 to 1 percent.	Poorly drained; firm silty clay subsoil over firm silty clay; high organic-matter content in top 1½ to 2 feet.	Alluvium	1 to 3	Poor	Unsuitable	A-7	OH-CH.
Waukegan	0 to 9 percent.	Well drained to excessively drained; friable loam subsoil; sand or gravel below depths of 24 to 60 inches.	Glacial outwash	5+	Good to depth of dark surface layer.	Excellent	A-4 over A-1 or A-2.	SM-SC over SP-GW.

TABLE 6.—*Soil characteristics that effect engineering*—Continued

Soil series and miscellaneous land types	Slope	Brief description of soil profile and ground condition	Parent material	Depth to seasonally high water table	Suitability as source of—		Classification	
					Topsoil	Borrow for highway construction	AASHO [1]	Unified [2]
				Feet				
Webster	0 to 1 percent.	Poorly drained; firm silty clay loam subsoil over slightly firm loam; fairly high organic-matter content to depths of 1½ to 2 feet.	Cary glacial till	1½ to 3	Good to depth of dark surface layer.	Unsuitable	A-6 or A-7	CL-OH.

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

[2] Based on The Unified Soil Classification System, Tech. Memo. No. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers, U. S. Army. March 1953.

[3] Wetness is due to sidehill seepage.

age. Open ditches, both crossable and noncrossable, can be used to drain soils in which tile drains do not work well because of slow or very slow permeability. The Wabash soils, for example, are best drained by open ditches.

Before deeper, noncrossable open ditches are installed, the nature of the substratum should be considered. For example, the Marshan soils, which are underlain by sand and gravel, may require wider ditches with less steep sides to insure bank stability and adequate channel capacity than soils that have a loam or clay loam substratum.

Irrigation has been practiced to a much lesser extent than drainage, but some farmers in the county have considered irrigating droughty soils. Factors to consider in planning an irrigation system are (1) expected yield increases, (2) the water intake rates and the moisture-holding capacity of the soil, (3) the availability of water for irrigation, (4) increased labor needs, and (5) costs of installation.

Detailed information concerning drainage and irrigation for the soils of the county can be obtained from drainage and irrigation guides prepared cooperatively by the U. S. Soil Conservation Service, the Iowa Agricultural Experiment Station, and the Iowa Agricultural Extension Service. The names of two of these guides are (1) Iowa Sprinkler Irrigation Guide, Special Report No. 11, Iowa State College, and (2) Iowa Drainage Guide, Special Report No. 13, Iowa State College. Both reports were published in 1955.

Farm ponds

Many of the soils in the uplands are suitable for ponds. The soils that are not suitable are those that have sandy textures or are underlain by sand or gravel. The Lakeville, Dickinson, Ankeny, Farrar, and Lamont are examples of sandy soils that are not suitable for pond construction. The soil descriptions contain information about the textures of each soil.

Any of the soils formed from glacial material may contain strata or lenses of sand and gravel that would create problems of water retention in ponds. Particularly in the northern four-fifths of the county, where the soils developed from the Late Wisconsin till, all pond sites should be examined carefully by deep boring to check for sand or gravel strata.

Technical advice should be solicited before construction of a farm pond is begun. Costly mistakes can be made unless a proper engineering survey is made.

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GUIDE TO MAP UNITS

[See table 4, p. 60, for management and estimated average acreage yields for cultivated soils, and table 2, p. 13, for approximate acreage and proportionate extent of soils. See pp. 85 to 93 for information on engineering properties of the soils.]

Map symbol	Capability subclass	Map unit	Page
AaC	IIIw	Adair clay loam, 5 to 9 percent slopes	11
AaC2	IIIw	Adair clay loam, 5 to 9 percent slopes, moderately eroded	15
AaD2	IVe	Adair clay loam, 9 to 14 percent slopes, moderately eroded	15
AbC3	IVe	Adair soils, 5 to 9 percent slopes, severely eroded	15
AbD3	IVe	Adair soils, 9 to 14 percent slopes, severely eroded	15
Ac	IIw	Alluvial land	15
Ad	IIIw	Ames loam	15
AeA	IIs	Ankeny sandy loam, 0 to 2 percent slopes	16
AeB	IIs	Ankeny sandy loam, 2 to 5 percent slopes	16
AfA	I	Atterberry silt loam, 1 to 3 percent slopes	16
AgA	I	Atterberry silt loam, bench position, 1 to 3 percent slopes	16
BaC2	IVe	Bauer silt loam, 5 to 9 percent slopes, moderately eroded	16
BaD2	VIe	Bauer silt loam, 9 to 14 percent slopes, moderately eroded	16
BaE2	VIIe	Bauer silt loam, 14 to 20 percent slopes, moderately eroded	16
BaF2	VIIe	Bauer silt loam, 20 to 40 percent slopes, moderately eroded	16
BbA	IIw	Blockton silt loam, 0 to 2 percent slopes	17
BbB	IIw	Blockton silt loam, 2 to 5 percent slopes	17
BcA	IIIs	Buckner loamy sand, 0 to 2 percent slopes	17
BcB	IIIs	Buckner loamy sand, 2 to 5 percent slopes	17
BcC	IIIs	Buckner loamy sand, 5 to 9 percent slopes	17
BdB	IIIs	Buckner-Hagener complex, 2 to 5 percent slopes	17
BdC	IIIs	Buckner-Hagener complex, 5 to 9 percent slopes	17
CaA	IIw	Cantril silt loam, 0 to 2 percent slopes	18
CaB	IIe	Cantril silt loam, 2 to 5 percent slopes	18
CbA	I	Chaseburg silt loam, 0 to 2 percent slopes	18
CbB	IIe	Chaseburg silt loam, 2 to 5 percent slopes	18
CcC2	IVs	Chelsea loamy fine sand, 5 to 9 percent slopes, eroded	19
CcD2	VIs	Chelsea loamy fine sand, 9 to 14 percent slopes, eroded	19
CcE2	VIIs	Chelsea loamy fine sand, 14 to 20 percent slopes, eroded	19
CcF2	VIIs	Chelsea loamy fine sand, 20 to 30 percent slopes, eroded	19
CdC	IIIw	Clarinda silty clay loam, 5 to 9 percent slopes	19
CeC3	IVe	Clarinda soils, 5 to 9 percent slopes, severely eroded	19
CfA	I	Clarion loam, 0 to 2 percent slopes	19
CfB	IIe	Clarion loam, 2 to 5 percent slopes	19
CfB2	IIe	Clarion loam, 2 to 5 percent slopes, moderately eroded	20
CfC	IIIe	Clarion loam, 5 to 9 percent slopes	20
CfC2	IIIe	Clarion loam, 5 to 9 percent slopes, moderately eroded	20
CfD2	IIIe	Clarion loam, 9 to 14 percent slopes, moderately eroded	20
CfE2	IVe	Clarion loam, 14 to 20 percent slopes, moderately eroded	20
CfF2	VIIe	Clarion loam, 20 to 30 percent slopes, moderately eroded	20
CgB	IIe	Clarion loam, thin solum, 2 to 5 percent slopes	21
CgB2	IIe	Clarion loam, thin solum, 2 to 5 percent slopes, moderately eroded	21
CgC2	IIIe	Clarion loam, thin solum, 5 to 9 percent slopes, moderately eroded	21
ChB	IIe	Clarion silt loam, 2 to 5 percent slopes	21
ChC2	IIIe	Clarion silt loam, 5 to 9 percent slopes, moderately eroded	21
ChD2	IIIe	Clarion silt loam, 9 to 14 percent slopes, moderately eroded	21
ChE2	IVe	Clarion silt loam, 14 to 20 percent slopes, moderately eroded	21
CkC3	IIIe	Clarion soils, 5 to 9 percent slopes, severely eroded	20
CkD3	IVe	Clarion soils, 9 to 14 percent slopes, severely eroded	20
CkE3	VIe	Clarion soils, 14 to 20 percent slopes, severely eroded	20
CmC	IIIw	Clearfield silty clay loam, 5 to 9 percent slopes	22
CmC2	IIIw	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded	22
CmD2	IVe	Clearfield silty clay loam, 9 to 14 percent slopes, moderately eroded	22
Cn	IIw	Colo silty clay loam	22
Co	V	Colo silty clay loam, channeled	22
Cp	IIw	Colo loam, loamy subsoil variant	22
Cr	IIw	Colo-Judson-Nodaway complex	22
CsA	IIw	Colo-Terril complex, 0 to 2 percent slopes	23
CsB	IIw	Colo-Terril complex, 2 to 5 percent slopes	23
Ct	IIw	Cooper silt loam, acid variant	23
CuB	IIs	Crocker loamy fine sand, 2 to 5 percent slopes	23
CuC2	IIIs	Crocker loamy fine sand, 5 to 9 percent slopes, moderately eroded	23
CuD2	IVs	Crocker loamy fine sand, 9 to 14 percent slopes, moderately eroded	23
CuE2	VIs	Crocker loamy fine sand, 14 to 20 percent slopes, moderately eroded	24
CuF	VIIs	Crocker loamy fine sand, 20 to 30 percent slopes	24
DaA	IIIs	Dickinson fine sandy loam, 0 to 2 percent slopes	24
DaB	IIIs	Dickinson fine sandy loam, 2 to 5 percent slopes	24
DaB2	IIIs	Dickinson fine sandy loam, 2 to 5 percent slopes, moderately eroded	24
DaC2	IIIs	Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded	24
DaD2	VIs	Dickinson fine sandy loam, 9 to 14 percent slopes, moderately eroded	24
DaE2	VIIs	Dickinson fine sandy loam, 14 to 20 percent slopes, moderately eroded	24
DaF2	VIIs	Dickinson fine sandy loam, 20 to 30 percent slopes, moderately eroded	24
DbB	IIs	Dickinson loam, 2 to 5 percent slopes	25
DbC2	IIIs	Dickinson loam, 5 to 9 percent slopes, moderately eroded	25
DbD2	IVs	Dickinson loam, 9 to 14 percent slopes, moderately eroded	25
DbE2	VIs	Dickinson loam, 14 to 20 percent slopes, moderately eroded	25
DbF2	VIIs	Dickinson loam, 20 to 30 percent slopes, moderately eroded	25
DcA	IIIs	Dickinson sandy loam, bench position, 0 to 2 percent slopes	25
DcB	IIIs	Dickinson sandy loam, bench position, 2 to 5 percent slopes	25
DcC	IIIs	Dickinson sandy loam, bench position, 5 to 9 percent slopes	25
DdD3	VIs	Dickinson soils, 9 to 14 percent slopes, severely eroded	24
DdE3	VIIs	Dickinson soils, 14 to 20 percent slopes, severely eroded	25
De	I	Dorchester silt loam	26
Df	IIIs	Dorchester silt loam, moderately shallow over sand	26

Map symbol	Capability subclass	Map unit	Page
Dg	I	Dorchester silt loam, deep over sand	26
DhA	I	Downs silt loam, 0 to 2 percent slopes	26
DhB	IIe	Downs silt loam, 2 to 5 percent slopes	26
DhC2	IIIe	Downs silt loam, 5 to 9 percent slopes, moderately eroded	26
DhD2	IIIe	Downs silt loam, 9 to 14 percent slopes, moderately eroded	26
DhE2	IVe	Downs silt loam, 14 to 20 percent slopes, moderately eroded	27
DhF2	VIIe	Downs silt loam, 20 to 30 percent slopes, moderately eroded	27
DkC3	IIIe	Downs soils, 5 to 9 percent slopes, severely eroded	27
DkD3	IVe	Downs soils, 9 to 14 percent slopes, severely eroded	27
DkE3	VIe	Downs soils, 14 to 20 percent slopes, severely eroded	27
FaB	IIs	Farrar fine sandy loam, 2 to 5 percent slopes	27
FaC	IIIs	Farrar fine sandy loam, 5 to 9 percent slopes	27
FaC2	IIIs	Farrar fine sandy loam, 5 to 9 percent slopes, moderately eroded	27
FaD2	IVs	Farrar fine sandy loam, 9 to 14 percent slopes, moderately eroded	27
FaE2	VIs	Farrar fine sandy loam, 14 to 20 percent slopes, moderately eroded	28
FaF2	VIIs	Farrar fine sandy loam, 20 to 30 percent slopes, moderately eroded	28
FbA	I	Fayette silt loam, 0 to 2 percent slopes	28
FbB	IIe	Fayette silt loam, 2 to 5 percent slopes	28
FbB2	IIe	Fayette silt loam, 2 to 5 percent slopes, moderately eroded	28
FbC2	IIIe	Fayette silt loam, 5 to 9 percent slopes, moderately eroded	28
FbD2	IIIe	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	28
FbE2	IVe	Fayette silt loam, 14 to 20 percent slopes, moderately eroded	28
FbF2	VIIe	Fayette silt loam, 20 to 30 percent slopes, moderately eroded	28
FbG2	VIIe	Fayette silt loam, 30 to 40 percent slopes, moderately eroded	28
FcB	IIe	Fayette silt loam, bench position, 2 to 5 percent slopes	28
FdC3	IIIe	Fayette soils, 5 to 9 percent slopes, severely eroded	29
FdD3	IVe	Fayette soils, 9 to 14 percent slopes, severely eroded	29
FdE3	VIe	Fayette soils, 14 to 20 percent slopes, severely eroded	29
GaC2	IIIe	Gara loam, 5 to 9 percent slopes, moderately eroded	29
GaD2	IIIe	Gara loam, 9 to 14 percent slopes, moderately eroded	29
GaE2	IVe	Gara loam, 14 to 20 percent slopes, moderately eroded	29
GbD3	IVe	Gara soils, 9 to 14 percent slopes, severely eroded	29
GbE3	VIe	Gara soils, 14 to 20 percent slopes, severely eroded	29
GbF2	VIIe	Gara soils, 20 to 40 percent slopes, slightly to severely eroded	30
Gc	IIIw	Glencoe silty clay loam	30
GdC2	IVe	Gosport silt loam, 5 to 9 percent slopes, moderately eroded	30
GdD2	VIe	Gosport silt loam, 9 to 14 percent slopes, moderately eroded	30
GdE2	VIIe	Gosport silt loam, 14 to 20 percent slopes, moderately eroded	30
GdF2	VIIe	Gosport silt loam, 20 to 40 percent slopes, moderately eroded	30
GeE3	VIIe	Gosport soils, 14 to 20 percent slopes, severely eroded	30
GfB	IIw	Gravity silty clay loam, 2 to 4 percent slopes	31
HaA	IIIs	Hagener loamy fine sand, 0 to 2 percent slopes	31
HaA2	IIIs	Hagener loamy fine sand, 0 to 2 percent slopes, moderately eroded	31
HaB	IIIs	Hagener loamy fine sand, 2 to 5 percent slopes	31
HaB2	IIIs	Hagener loamy fine sand, 2 to 5 percent slopes, moderately eroded	31
HaC	IIIs	Hagener loamy fine sand, 5 to 9 percent slopes	32
HaC2	IIIs	Hagener loamy fine sand, 5 to 9 percent slopes, moderately eroded	32
HaD2	VIs	Hagener loamy fine sand, 9 to 14 percent slopes, moderately eroded	32
HaD3	VIs	Hagener loamy fine sand, 9 to 14 percent slopes, severely eroded	32
HaE2	VIIs	Hagener loamy fine sand, 14 to 20 percent slopes, eroded	32
Hb	IIw	Harpster loam	32
HcA	I	Hayden loam, 0 to 2 percent slopes	33
HcB	IIe	Hayden loam, 2 to 5 percent slopes	33
HcB2	IIe	Hayden loam, 2 to 5 percent slopes, moderately eroded	33
HcC2	IIIe	Hayden loam, 5 to 9 percent slopes, moderately eroded	33
HcD2	IIIe	Hayden loam, 9 to 14 percent slopes, moderately eroded	33
HcE2	IVe	Hayden loam, 14 to 20 percent slopes, moderately eroded	33
HcF2	VIIe	Hayden loam, 20 to 30 percent slopes, moderately eroded	33
HcG2	VIIe	Hayden loam, 30 to 40 percent slopes, moderately eroded	33
Hd	IIs	Huntsville sandy loam	34
He	V	Huntsville sandy loam, channeled	34
Hf	I	Huntsville silt loam	33
Hg	V	Huntsville silt loam, channeled	33
IaC2	IIIe	Ida silt loam, 5 to 9 percent slopes, eroded	34
JaB	IIe	Judson silt loam, 2 to 5 percent slopes	34
JaC	IIIe	Judson silt loam, 5 to 9 percent slopes	35
KaA	IIs	Kato loam, moderately deep over sand and gravel, 1 to 3 percent slopes	35
KbA	I	Kato loam, deep over sand and gravel, 1 to 3 percent slopes	35
LaB	IIe	Ladoga silt loam, 2 to 5 percent slopes	35
LaC2	IIIe	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	36
LaD2	IIIe	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	36
LaE2	IVe	Ladoga silt loam, 14 to 20 percent slopes, moderately eroded	36
LaF2	VIIe	Ladoga silt loam, 20 to 30 percent slopes, moderately eroded	36
LbC3	IIIe	Ladoga soils, 5 to 9 percent slopes, severely eroded	36
LcB	IIIs	Lakeville sandy loam, 2 to 5 percent slopes	36
LcC2	IIIs	Lakeville sandy loam, 5 to 9 percent slopes, moderately eroded	36
LcD2	VIs	Lakeville sandy loam, 9 to 14 percent slopes, moderately eroded	36
LcE2	VIIs	Lakeville sandy loam, 14 to 20 percent slopes, moderately eroded	36
LcF2	VIIs	Lakeville sandy loam, 20 to 40 percent slopes, moderately eroded	36
LdB	IIs	Lamont fine sandy loam, 2 to 5 percent slopes	37
LdC	IIIs	Lamont fine sandy loam, 5 to 9 percent slopes	37
LdD	VIs	Lamont fine sandy loam, 9 to 14 percent slopes	37
LdE	VIIs	Lamont fine sandy loam, 14 to 20 percent slopes	37
LdF	VIIs	Lamont fine sandy loam, 20 to 30 percent slopes	37
LeA	I	Lester loam, 0 to 2 percent slopes	37
LeB	IIe	Lester loam, 2 to 5 percent slopes	37
LeB2	IIe	Lester loam, 2 to 5 percent slopes, moderately eroded	38

Map symbol	Capability subclass	Map unit	Page
LeC2	IIIe	Lester loam, 5 to 9 percent slopes, moderately eroded	38
LeD2	IIIe	Lester loam, 9 to 14 percent slopes, moderately eroded	38
LeE2	IVe	Lester loam, 14 to 20 percent slopes, moderately eroded	38
LeF	VIIe	Lester loam, 20 to 40 percent slopes	38
LfC3	IIIe	Lester soils, 5 to 9 percent slopes, severely eroded	38
LfD3	IVe	Lester soils, 9 to 14 percent slopes, severely eroded	38
LgE	IVe	Lester-Colo complex, 0 to 20 percent slopes	38
LgF	VIIe	Lester-Colo complex, 0 to 40 percent slopes	38
LhA	I	LeSueur loam, 1 to 3 percent slopes	38
LkD2	IVe	Lindley loam, 9 to 14 percent slopes, moderately eroded	39
LkE2	VIe	Lindley loam, 14 to 20 percent slopes, moderately eroded	39
LmD3	VIe	Lindley soils, 9 to 14 percent slopes, severely eroded	39
LmE3	VIIe	Lindley soils, 14 to 20 percent slopes, severely eroded	39
LmF2	VIIe	Lindley soils, 20 to 40 percent slopes, moderately eroded	39
Ma	IIw	Marshan silty clay loam, moderately deep over sand and gravel	40
Mb	IIw	Marshan silty clay loam, deep over sand and gravel	40
Mc	IIIw	Muck, very shallow	40
Md	IIIw	Muck, moderately shallow	40
MeA	I	Muscatine silt loam, 1 to 3 percent slopes	41
NaA	I	Nicollet loam, 1 to 3 percent slopes	41
Nb	I	Nodaway silt loam	41
Oa	IIIw	Okoboji silt loam	42
ObB	IIe	Olmitz loam, 2 to 5 percent slopes	42
ObC	IIIe	Olmitz loam, 5 to 9 percent slopes	42
OcA	IIs	Olmitz sandy loam, 0 to 2 percent slopes	42
OcB	IIs	Olmitz sandy loam, 2 to 5 percent slopes	42
Pa	IIIw	Peat	42
Ra	VIIs	Riverwash	42
Rb	IIIw	Rolfe loam	43
Rc	IIIw	Rolfe loam, bench position	43
RdC2	IIIe	Runnells silt loam, 5 to 9 percent slopes, moderately eroded	43
RdD2	IVe	Runnells silt loam, 9 to 14 percent slopes, moderately eroded	44
RdE2	VIe	Runnells silt loam, 14 to 20 percent slopes, moderately eroded	44
RdF2	VIIe	Runnells silt loam, 20 to 40 percent slopes, moderately eroded	44
ReD3	IVe	Runnells soils, 9 to 14 percent slopes, severely eroded	44
Sa	IIIs	Sarpy loamy sand	44
SbA	IIs	Saylor fine sandy loam, 0 to 2 percent slopes	44
ScA	I	Sharpsburg silt loam, 0 to 2 percent slopes	45
ScB	IIe	Sharpsburg silt loam, 2 to 5 percent slopes	45
ScC	IIIe	Sharpsburg silt loam, 5 to 9 percent slopes	45
ScC2	IIIe	Sharpsburg silt loam, 5 to 9 percent slopes, moderately eroded	45
ScD2	IIIe	Sharpsburg silt loam, 9 to 14 percent slopes, moderately eroded	45
ScE2	IVe	Sharpsburg silt loam, 14 to 20 percent slopes, moderately eroded	45
SdD3	IVe	Sharpsburg soils, 9 to 14 percent slopes, severely eroded	45
SeC2	IIIe	Shelby loam, 5 to 9 percent slopes, moderately eroded	46
SeD2	IIIe	Shelby loam, 9 to 14 percent slopes, moderately eroded	46
SeE2	IVe	Shelby loam, 14 to 20 percent slopes, moderately eroded	46
SfE3	VIe	Shelby soils, 14 to 20 percent slopes, severely eroded	46
SfF3	VIIe	Shelby soils, 20 to 30 percent slopes, severely eroded	46
SgC	IIIe	Storden loam, 3 to 9 percent slopes	46
SgF2	VIIe	Storden loam, 20 to 40 percent slopes, moderately eroded	46
ShC3	IIIe	Storden soils, 5 to 9 percent slopes, severely eroded	46
ShD3	IIIe	Storden soils, 9 to 14 percent slopes, severely eroded	47
ShE3	IVe	Storden soils, 14 to 20 percent slopes, severely eroded	47
SkE	IVe	Storden-Colo complex, 0 to 20 percent slopes	47
SkF	VIIe	Storden-Colo complex, 0 to 40 percent slopes	47
SmC2	IIIs	Storden-Lakeville complex, 5 to 9 percent slopes, moderately eroded	47
SmD2	IVs	Storden-Lakeville complex, 9 to 14 percent slopes, moderately eroded	47
SmE2	VIs	Storden-Lakeville complex, 14 to 20 percent slopes, moderately eroded	47
Sn	I	Stronghurst silt loam	47
So	I	Stronghurst silt loam, bench position	48
TaA	I	Tama silt loam, 0 to 2 percent slopes	48
TaB	IIe	Tama silt loam, 2 to 5 percent slopes	48
TaB2	IIe	Tama silt loam, 2 to 5 percent slopes, moderately eroded	48
TaC	IIIe	Tama silt loam, 5 to 9 percent slopes	48
TaC2	IIIe	Tama silt loam, 5 to 9 percent slopes, moderately eroded	48
TaD2	IIIe	Tama silt loam, 9 to 14 percent slopes, moderately eroded	48
TbD3	IIIe	Tama soils, 9 to 14 percent slopes severely eroded	48
TcA	I	Terril loam, 0 to 2 percent slopes	49
TcB	IIe	Terril loam, 2 to 5 percent slopes	49
TcC	IIIe	Terril loam, 5 to 9 percent slopes	49
Wa	IIIw	Wabash silt loam	49
Wb	IIIw	Wabash silty clay	49
Wc	IIw	Wabash-Gravity-Nodaway complex	50
WdA	IIs	Waukegan loam, moderately deep over sand and gravel, 0 to 2 percent slopes	50
WdB	IIs	Waukegan loam, moderately deep over sand and gravel, 2 to 5 percent slopes	50
WdC	IIIs	Waukegan loam, moderately deep over sand and gravel, 5 to 9 percent slopes	50
WeA	I	Waukegan loam, deep over sand and gravel, 0 to 2 percent slopes	50
WeB	IIe	Waukegan loam, deep over sand and gravel, 2 to 5 percent slopes	50
WeC	IIIe	Waukegan loam, deep over sand and gravel, 5 to 9 percent slopes	51
Wf	IIw	Webster silty clay loam	51
Wg	IIw	Webster silty clay loam, calcareous variant	51

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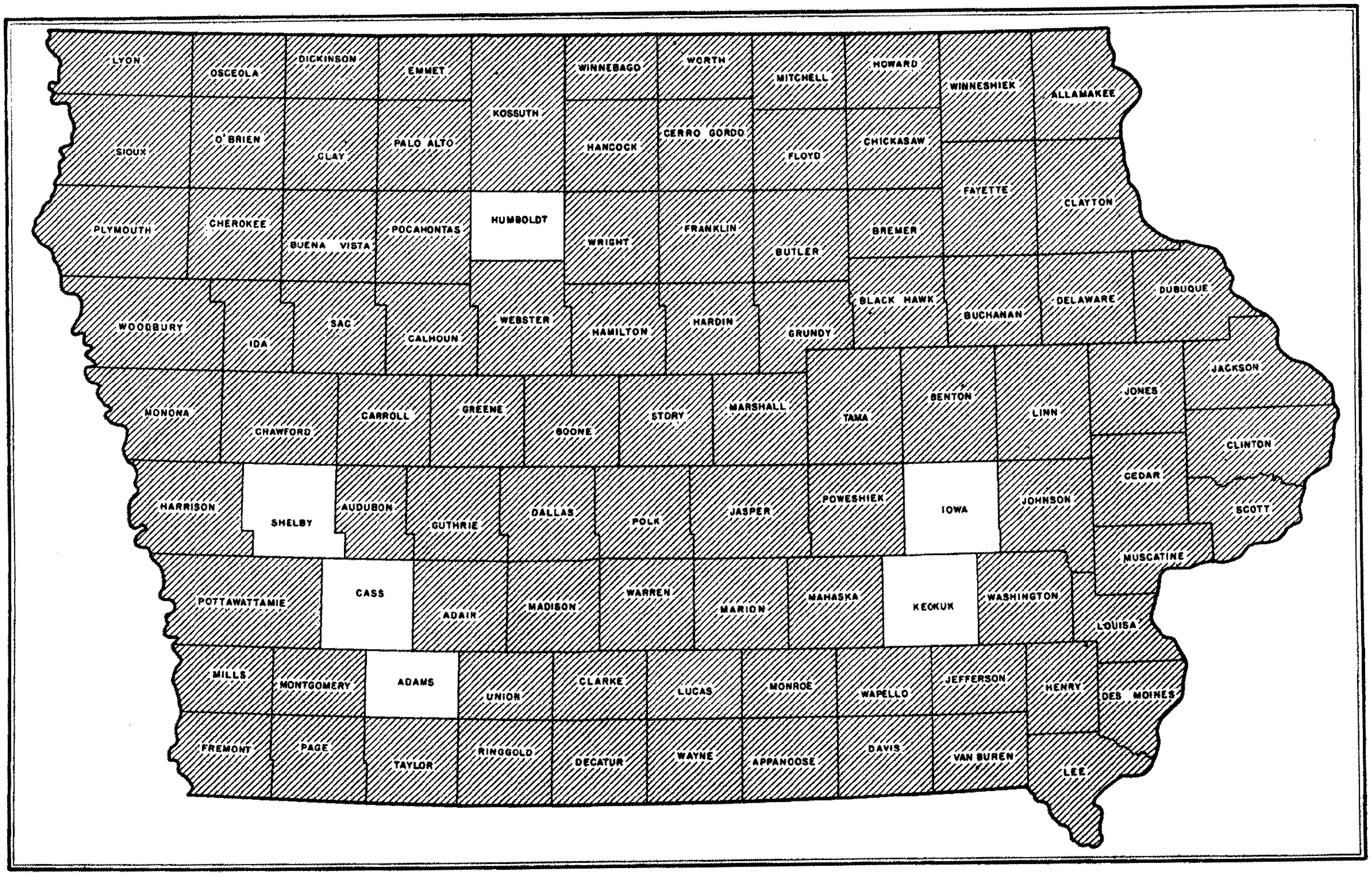

Areas surveyed in Iowa shown by shading.

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