Issued March 1960

SOIL SURVEY

Jefferson County Iowa

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
IOWA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Jefferson County will serve several groups of readers. It will help farmers plan the kind of management that will protect their soils and provide good yields; assist engineers who design roads, buildings, ponds, terraces, or other structures; and add to the soil scientists' fund of knowledge.

In making this survey, soil scientists walked over the land. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noticed differences in growth of crops, weeds, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming, engineering, and other uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the colored soil map in the back of this report. Towns, roads, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has a symbol Pa. The legend for the detailed map shows that this symbol identifies Pershing silt loam, 2 to 4 percent slopes. This soil and all the others mapped in the county are described in the section, Descriptions of the Soils.

Finding information

Few readers will be interested in all parts of the soil report, for it has special sections for different groups. The sections, Physiography and Drainage, Climate, and Agriculture will be of interest mainly to those not familiar with the county.

Farmers and those who work with farmers can learn about the soils in the section, Descriptions of the Soils, and then go to the section, Soil Management. In this way they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected.

Engineers will want to refer to the section, Engineering Applications. One table in that section shows characteristics of the soils that affect engineering. Others tell how soils are classified by two groups of engineers. One table gives results of engineering tests on the major layers of some of the extensive soils.

Soil scientists will find information about how the soils were formed and how they were classified in the section, Formation and Classification of Soils.

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

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

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH IOWA AGRICULTURAL EXPERIMENT STATION

Location and Extent

Jefferson County is in the southeastern part of Iowa. It is in the second tier of counties north of Missouri and in the third tier west of the Mississippi River. Fairfield, the county seat, is 95 miles southeast of Des Moines and 80 miles southwest of Davenport (fig. 1). The county is

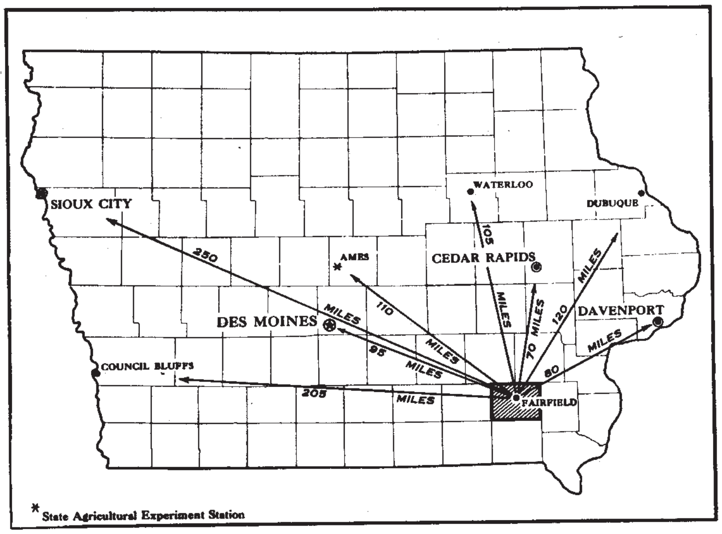

***Figure 1.*—Location of Jefferson County in Iowa.**

rectangular in shape, extending 24 miles from east to west and 18 miles from north to south. The total land area is 436 square miles, or 279,040 acres. The county is made up of 12 congressional townships.

General Relationships of Soils

Ninety soils were mapped in the county and are described in this report. Each of these soils is different from the others. The soils vary in their suitability for crops and other plants and in their response to various kinds of treatment.

This section consists of three parts, each aimed to help make clear some of the differences in the soils and some of the relationships of different kinds of soils. In the first, the description and the map of general soil areas suggest in a broad way some of the soils that are likely to be found on a farm in each part of the county. In the next part a sketch of a typical landscape is described. This sketch shows how certain soils occur on ridges, others on slopes, and still others in the valleys. In the third part the soils of three farms are described and mapped to show how the kinds of soils affect land use and type of farming.

General Soil Areas

Figure 2 is a general map of soil areas in the county. Each of these areas, which are also called soil associations, consists of one or more extensive soils and, as a rule, contains several other soils of lesser extent. Within each association the soils occur on the landscape in a pattern that is characteristic and recurring, although of course it is not strictly uniform.

Most farms contain several soils, but within a soil association the patterns of soils on different farms are likely to be somewhat alike. Thus, to some degree the results of studies and demonstrations on representative farms can be applied to other farms within the same association if they have similar patterns and proportions of soils. A description of each of the soil associations in Jefferson County follows:

1A. Dark-colored, nearly level soils: Haig.—This association, dominated by the Haig soil, occurs on tabular divides in all parts of the county. The Haig soil has a black surface soil of slightly firm silty clay loam and a dark-gray, somewhat mottled subsoil of very firm silty clay. Where this soil occurs on the broad divides, it is level or nearly level. Near the edges of the divides, where the dark-colored Grundy or Mahaska soils occur, it has gentle slopes. Besides the Grundy and Mahaska soils, minor soils in this association are the Taintor, Edina, and Belinda.

With proper drainage the soils of this association respond well to good management and can be made highly productive (fig. 3). Nearly all of the farmland is used for crops in a system of grain and livestock farming.

1B. Dark-colored, nearly level or gently sloping soils: Taintor-Mahaska.—This association occurs on tablelike divides. Most of it is nearly level, but some is on undulating slopes near the edges of the divides. The main divide extends from about 2 miles north of Fairfield to the northwestern corner of the county.

The Taintor and Mahaska soils dominate the association The Taintor soil resembles the Haig soil of association 1A, but it has a slightly more permeable subsoil. The Mahaska soils have better internal drainage than the level Taintor soils. The Sperry and Otley soils occupy a minor part of this association. The Sperry soil occurs in small areas in depressions. It is moderately dark colored and has a slowly permeable subsoil of silty clay.

This general area is the most productive in the county. Nearly all of it is cultivated. Under good management excellent yields of crops are obtained.

2A. Dark and moderately dark colored, gently sloping to moderately steep soils: Grundy-Shelby-Pershing.—This association is dominated by the Grundy and Shelby soils. Most of it occurs in that part of the southern two-thirds of the county where the soils are dark or moderately dark colored. The Grundy and Pershing soils, on gentle slopes, are better drained than the Haig soil of association 1A, but the Pershing soils are not so dark colored as the Haig.

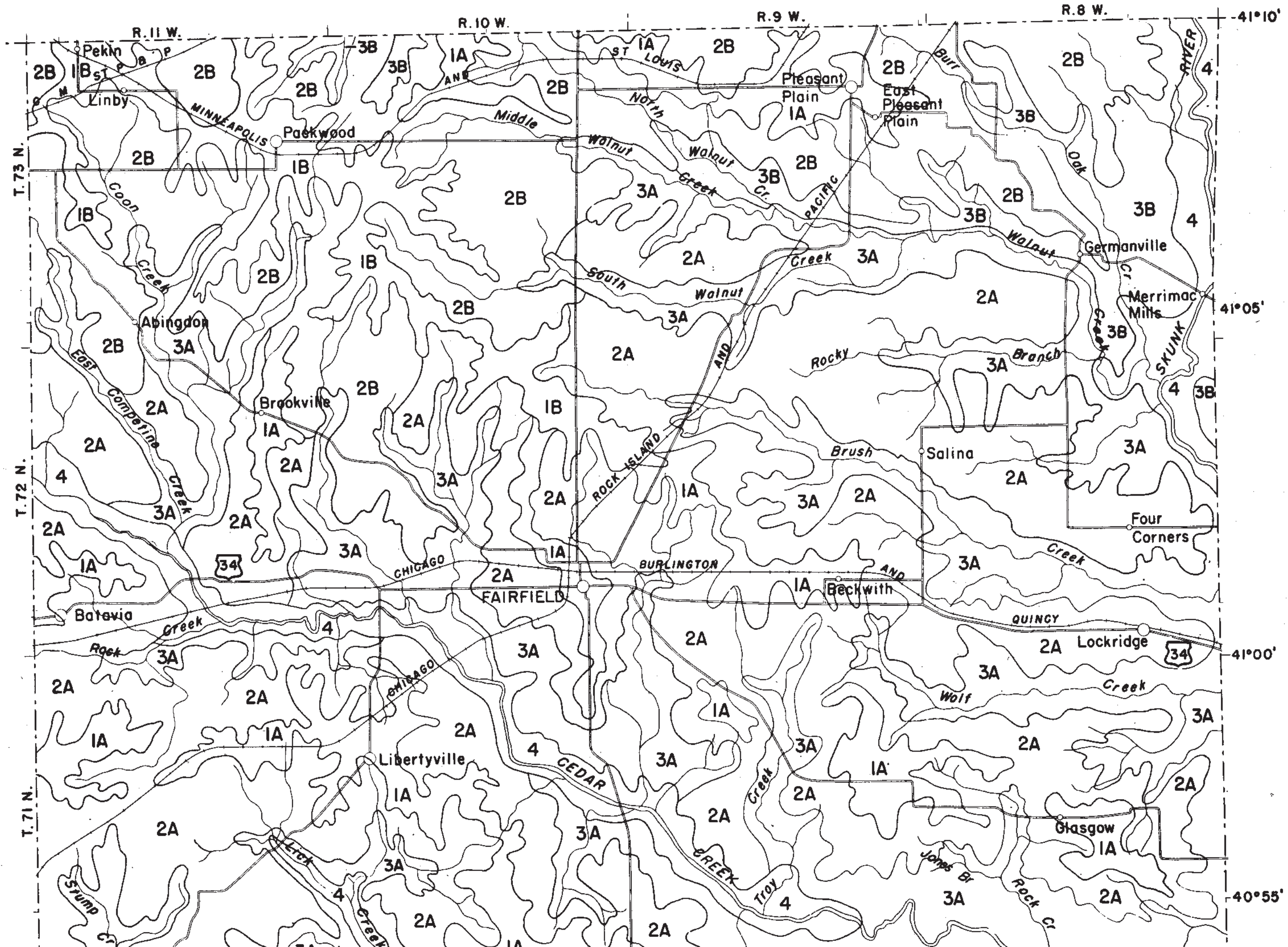

Figure 2.—**General soil areas of Jefferson County, Iowa.**

1A. Dark-colored, nearly level soils: Haig.
1B. Dark-colored, nearly level or gently sloping soils: Taintor-Mahaska.
2A. Dark and moderately dark colored, gently sloping to moderately steep soils: Grundy-Shelby-Pershing.
2B. Dark-colored, gently sloping to moderately steep soils: Otley-Shelby.
3A. Light-colored, undulating to steep soils: Weller-Lindley.
3B. Light-colored, undulating to steep soils: Clinton-Lindley.
4. Soils on flood plains and benches.

***Figure 3.*—Corn and soybeans growing on a typical field of Haig silty clay loam.**

The Shelby soils occur on rolling to moderately steep slopes below the Grundy and Pershing soils.

Minor soils in this association are the Adair and the soils of the Nodaway-Gravity-Wabash complex. The Adair soils, on slopes between the Grundy and Shelby soils, have a very firm, gritty silty clay subsoil. Some areas are severely eroded. The Nodaway-Gravity-Wabash complex is made up of somewhat poorly drained soils that lie next to the waterways that drain the area.

Many of the rolling to moderately steep areas are in permanent pasture, and livestock farming is practiced by nearly all of the farmers in the area. The less steep soils are fairly productive of crops if well managed.

2B. Dark-colored, gently sloping to moderately steep soils: Otley-Shelby.—This association is mostly in the northern one-third of the county. It is dominated by the Otley and Shelby soils. The Otley soils are dark colored. They have a subsoil of firm silty clay loam and are more permeable than the Grundy soils of association 2A. They occur on rolling and gently rolling topography above the Shelby and Adair soils, which are on moderately steep slopes.

The Ladoga and Adair soils, as well as the soils of the Nodaway-Gravity-Wabash complex, occupy a minor part of this soil association. The Ladoga soils have a lighter colored surface soil than the Otley.

Most of the soils of this area are fairly productive if well managed. The steeper areas are largely in permanent pasture, and a livestock system of farming is most prevalent.

3A. Light-colored, undulating to steep soils: Weller-Lindley.—This association is dominated by the Weller and Lindley soils. The Weller soils, developed from loess, have a light-colored surface soil and a rather slowly permeable subsoil of silty clay. They occur on undulating to rolling topography, primarily in the southern two-thirds of the county. The Lindley soils are on rolling to steep slopes below the Weller soils. Like the Shelby soils, they have developed from firm clay loam.

Some of the minor soils in this association are the Beckwith, Gosport, and Sogn, and soils of the Nodaway-Gravity-Wabash complex. The Beckwith soils have a light-colored surface layer and a very slowly permeable silty clay subsoil. They occur in small depressions or on small flats on the ridges. The Gosport soils, mainly on steep slopes, are shallow over shale. The Sogn soils, which also are generally on steep slopes, are shallow over limestone. The soils of the Nodaway-Gravity-Wabash complex lie along waterways that drain this general soil area. Where the soils of this complex are surrounded by dark-colored soils, they are darker colored than the typical soils and are not so well drained.

3B. Light-colored, undulating to steep soils: Clinton-Lindley.—This soil association, dominated by the Clinton and Lindley soils, occurs primarily in the northeastern corner of Jefferson County. The Clinton soils were formed from loess, and the Lindley, from glacial till. The Clinton soils are similar to the Weller soils but are more permeable. They occur on undulating to rolling slopes above the Lindley soils.

Minor soils in this general soil area are the Berwick, Keomah, Gosport, and Sogn, and soils of the Nodaway-Gravity-Wabash complex. The Berwick soils occur in small depressions or on small flats on the ridges. They are light colored and have a very slowly permeable subsoil of silty clay. The Keomah soils are light colored and have a mottled subsoil. They occur on nearly level areas.

The soils of this association are only moderately productive, and a livestock system of farming is common. Many of the steeper areas are in permanent pasture and timber.

4. *Soils on flood plains and benches.*—This association consists of soils on the flood plains and of other soils that are no longer flooded. They include the Nodaway, Wabash, Jackson, and Waukegan soils and Alluvial land, wet. The Nodaway soils are moderately dark, silty soils that generally occur next to the stream channel. The Wabash is a dark-colored soil that is very slowly permeable throughout. Most of it occurs on first bottoms, but it is farther back from the stream channel than the Nodaway soils. The Jackson soils are light colored and have a mottled subsoil. They occur on benches above the level reached by floodwaters. The Waukegan, also on benches above the flood plain, is a dark-colored soil that is deep over sand. Much of Alluvial land, wet, is in old river channels where floodwaters are trapped.

A large part of this soil association is very productive and is used intensively for row crops. In some areas, however, floods occasionally drown out a crop. Alluvial land, wet, is too wet for crops. Many farms within the association have some adjoining steep soils that are used for pasture.

A Landscape May Contain Several Soils

Figure 4 shows how six of the major soil series are related as to slope, native vegetation, and parent material. The Haig and Edina soils of association 1A are on the upland shown in the right part of the sketch. The Grundy and Shelby soils of association 2A make up one side of the sloping valley, and the lighter colored Weller and Lindley soils of association 3A make up the other. The alluvial soils of the bottom land are part of association 4. Along some of the streams, the areas of alluvial soils are too narrow to be shown on a small map.

The sketches below the landscape diagram show the nature of the surface soil, subsoil, and underlying material of the soils of each of these soil series. This succession of soil layers, from the surface downward, is called the soil profile. The layers, also called horizons, within some of

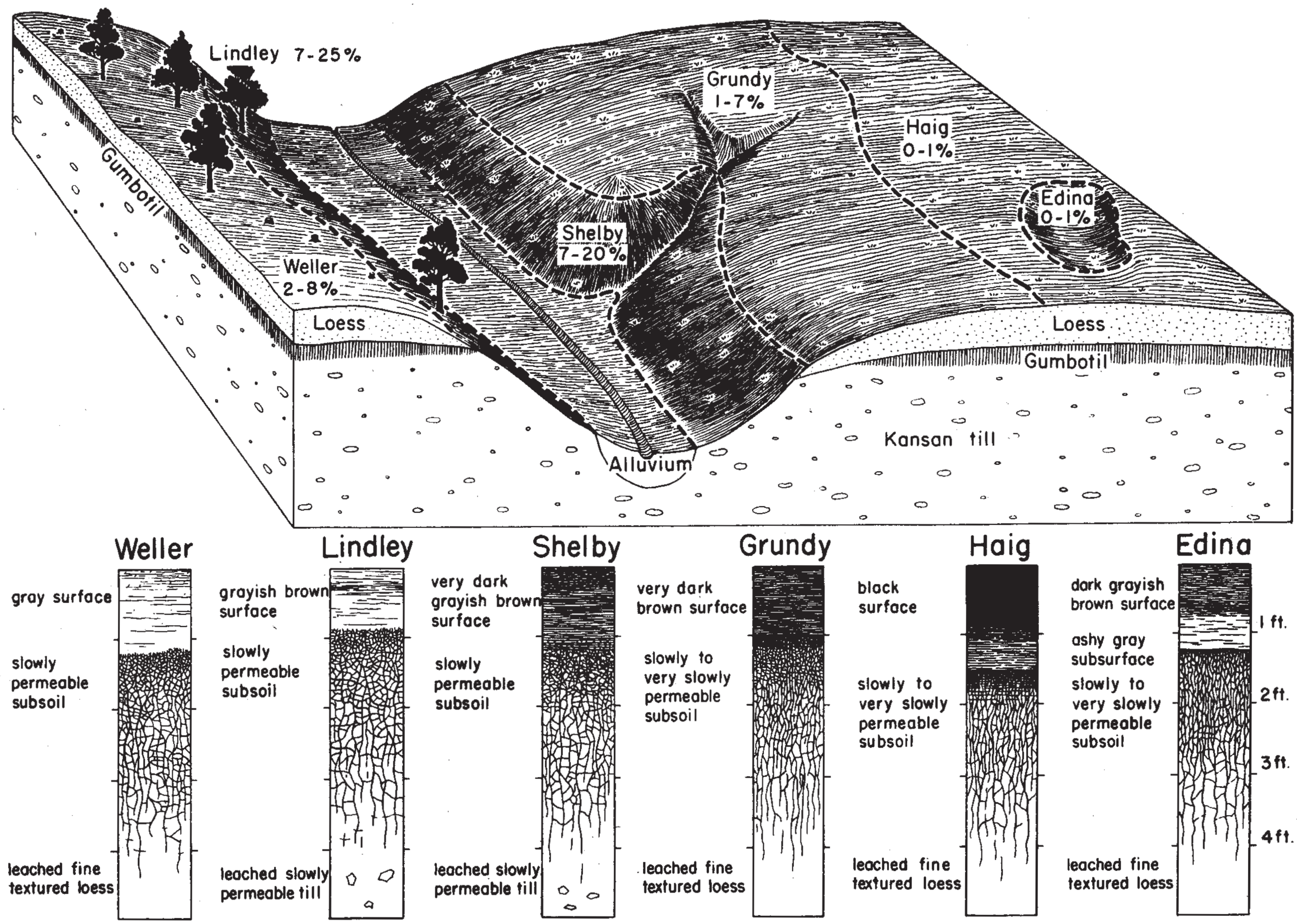

Figure 4.—**Schematic diagram of some of the dominant soils in Jefferson County.**

the profiles differ greatly from each other in texture, color, and other properties.

Soils of Three Farms

Soils may differ from place to place to the extent that the land use and type of farming that is suitable for one farm cannot be successfully used on a neighboring farm. The descriptions of three 160-acre farms in Jefferson County shown in the soil maps, figure 5, illustrate this fact.

Farm A consists mainly of Mahaska silty clay loam, 0 to 2 percent slopes (Ma), and Mahaska silty clay loam, 2 to 4 percent slopes (Mb). Farm B consists mainly of Keomah silt loam, 2 to 5 percent slopes (Kb); Clinton silt loam, 5 to 13 percent slopes, moderately eroded (Cn); and Lindley loam, 9 to 14 percent slopes, moderately eroded (Lg). Farm C consists mostly of Weller silt loam, 5 to 12 percent slopes (Wd); Lindley loam, 14 to 25 percent slopes (Lh); and Lindley loam, 14 to 25 percent slopes, moderately eroded (Lk).

Farm A, which is mostly in the Taintor-Mahaska soil association, is well suited to corn, oats, and hay. It is estimated that yields of 80 bushels of corn an acre can be produced on the soils of this farm if a rotation consisting of 2 years of corn, 1 year of oats, and 1 year of alfalfa-bromegrass meadow is followed. In addition, the proper kinds and amounts of fertilizer must be applied, adequate planting rates must be used, and other good management practiced.

Farm B is principally in the Clinton-Lindley soil association. It can produce good yields of corn, oats, and meadow crops, but it needs more intensive management than farm A. On the gently rolling Clinton and the undulating Keomah soils, which are easily damaged by erosion, it is estimated that yields of 50 to 60 bushels of corn an acre can be maintained if the rotation consists of 1 year of corn, 1 year of oats, and 2 years of meadow. In addition, it is necessary to use proper practices to conserve soil and water and to apply adequate amounts of fertilizer. The rolling to hilly Lindley soils should be used mostly for permanent meadow or pasture. If they must be used for row crops and close-growing crops, intensive conservation practices are needed. With proper erosion control, corn could be grown once every 5 or 6 years if the stand of pasture or hay becomes sparse and needs reseeding.

Farm C is mainly in the Weller-Lindley soil association. It probably will produce poor crops of corn and oats even if fertilizers are properly used and good crop rotations are followed. The Lindley soils predominate on this farm. They lie below the Weller soils, which occupy the ridgetops. Farm C is severely limited for cultivation.

Soil Management

This section contains suggestions for the use and management of soils suited to cultivation; a brief explanation of a nationwide system of land capability grouping; a table showing the major characteristics of the soils; and a table showing principal management problems and management practices for each soil and estimated yields of crops under improved management.

General Management Practices

Many of the soils suited to cultivated crops require similar management. Other soils need special management if good yields are to be maintained. A general discussion of requirements for good soil management in Jefferson County follows.

Drainage.—Soils that are inadequately drained do not produce good crops consistently. Some of the soils that are wet early in the planting season cannot be drained effectively with tile. Crops grown on these soils do not develop a deep root system, and during dry seasons they are damaged by drought. Surface drains may be required to produce good yields on these soils.

Fertility management.—Without good management most soils that are tilled over a long period become less productive. Each crop removed from the soil takes with it some of the soil nutrients. On most soils tilled for long periods of time, the amount of organic matter is gradually reduced. As a result the soil structure is likely to deteriorate and the supply of available nitrogen will be reduced.

For good yields most soils require management practices that include the use of lime and fertilizer. The amounts needed can be determined by soil tests and field trials. If sod crops and legumes are grown or if organic matter is added in other ways, soil structure will be improved and additional nitrogen will be supplied.

Erosion control.—Losses of soil and water through erosion take place principally on cultivated areas and to a lesser extent on overgrazed pastures or woods. Erosion is slight or negligible on good pastures and protected woodland. If good plant cover is established and maintained on erodible soils, erosion losses can be reduced.

On sloping soils that are used for tilled crops, the use of grassed waterways, contour farming, stripcropping, or terracing will help to control erosion. Where the soils are not well suited to these practices, the proportion of meadow grown in the rotation can be increased sufficiently to control erosion.

Good drainage systems on soils not subject to erosion will permit the use of these soils for a greater number of tilled crops. The proportion of tilled crops can then be reduced on sloping, erodible soils.

Adequate tillage.—The main purposes of tillage are to prepare a seedbed, kill weeds, and to make the best use of plant residues. The principal factors that determine the time, quantity, and kind of cultivation are the requirements of the crops to be grown, the quantity and kinds of weeds or crop residues, the prevalence of plant diseases or insect pests, the amount and character of rainfall, and the kind of soil.

The individual farm plan.—After you have studied your soils, the suggestions for using and managing them, and the yields you can expect from a high level of management, you may wish to make some changes in your system of farming. Perhaps you wish to farm on the contour, stripcrop, or build terraces. If so, it may be advantageous to rearrange your field boundaries because contour farming is not well suited to square or rectangular fields. The local representative of the Soil Conservation Service can be consulted about the technical help you need.

Capability Grouping 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, limitations, and risks of damage to the soils, and also on their response to management.

There are 8 broad groups of soils in the capability system. In the first 3 of these—classes I, II, and III—are soils that are suitable for annual or periodic cultivation of annual or short-lived crops.

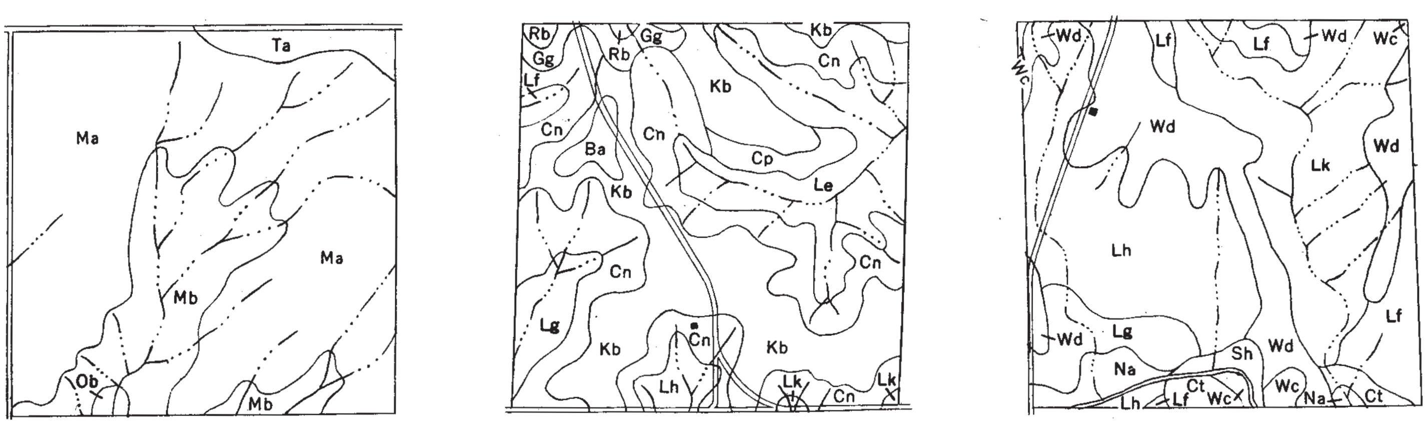

***Figure 5.*—Distribution of soils on three 160-acre farms in Jefferson County Farm A on left, farm B center, and farm C on right.**

Class I soils are those that have the largest range of use and the smallest risk of damage. They are nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty, slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use. These need even more careful management.

In class IV are soils that should be cultivated only occasionally or only under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops, but they can be used for pasture and range, as woodland, or for wildlife.

Class V soils are nearly level and gently sloping but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation.

Class VI soils are not suitable for crops because they are steep, or droughty, or otherwise limited, but they give fair yields of forage or forest products. Some soils in class VI can, without damage, be cultivated enough so that fruit trees, shrubs, or forest trees can be set out or pastures renovated and seeded.

Class VII soils provide only poor to fair yields of forage or forest products.

In class VIII (none in Jefferson County) are soils that have practically no agricultural use. Some of them have value as parts of watersheds, wildlife habitats, or for scenery.

Subclasses.—Although the soils in each capability class present use and management problems and have limitations of about the same degree, the kinds of problems may differ greatly. In Jefferson County these problems may result primarily from erosion, designated by the symbol "e"; by excess water, "w"; or by shallowness, low moisture-supplying capacity, or low fertility, "s". The symbol indicating the kind of limitation is added to the capability class symbol to indicate the main reason for placing each soil in a class. The capability classification of most, but not necessarily all, areas of each mapping unit is shown in table 2 in the section, Management of Individual Soils.

Management of Individual Soils

This section provides information on the limitations and capabilities of the soils of the county. To learn the strong and weak points of the various soils, consult table 1, which shows the major characteristics of each soil. The map symbol for an individual soil identifies the areas of this soil on the map in the back part of this report.

Estimated yields of crops to be expected on the soils under superior management are listed in table 2. This table also indicates for each soil the capability class and subclass, the principal management problems, the suitable rotations or alternative uses, and the principal supporting practices.

TABLE 1.—*Summary of major characteristics of the soils*

Map symbol	Soil	Thickness of A_1 horizon [1]	Organic matter content	Permeability of subsoil	Erosion: Degree	Erosion: Kind	Capacity for available moisture	Wetness hazard
		Inches						
Aa	Adair clay loam, 5 to 12 percent slopes.	8	Medium	Very slow	Slight	Sheet	High	Slight.
Ab	Adair clay loam, 5 to 12 percent slopes, moderately eroded.	5	Medium low	Very slow	Moderate	Sheet	High	Slight.
Ac	Adair soils, 5 to 12 percent slopes, severely eroded.	2	Low	Slow to very slow.	Severe	Sheet and gully.	High	Slight.
Ad	Alluvial land, wet	20	Medium	Moderate to slow.	None	None	High	Very severe.
Ba	Beckwith and Berwick silt loams:							
	Beckwith (associated with Weller soils).	6	Low	Very slow	None	None	High	Moderate to severe.
	Berwick (associated with Clinton soils).	6	Low	Very slow	None	None	High	Moderate to severe.
Bb	Beckwith and Berwick silt loams, bench position:							
	Beckwith (associated with Weller soils).	6	Low	Very slow	None	None	High	Moderate to severe.
	Berwick (associated with Clinton soils).	6	Low	Very slow	None	None	High	Moderate to severe.
Bc	Belinda silt loam	7	Medium low	Slow to very slow.	None	None	High	Moderate to severe.
Bd	Belinda silt loam, bench position.	7	Medium low	Slow to very slow.	None	None	High	Moderate to severe.
Be	Bertrand loam, 1 to 5 percent slopes.	10	Medium	Moderate	Slight	Sheet	High	Slight.

See footnote at end of table.

TABLE 1.—*Summary of major characteristics of the soils*—Continued

Map symbol	Soil	Thickness of A_1 horizon [1]	Organic matter content	Permeability of subsoil	Erosion		Capacity for available moisture	Wetness hazard
					Degree	Kind		
		Inches						
Bf	Bertrand loam, 5 to 10 percent slopes.	10	Medium	Moderate	Slight	Sheet	High	Slight.
Bg	Blockton silty clay loam	13	High	Slow to very slow.	None	None	High	Moderate to severe.
Ca	Cantril loam, 2 to 5 percent slopes.	10	Medium	Moderately slow.	Slight	Gully	High	Moderate.
Cb	Chelsea loamy fine sand, 5 to 8 percent slopes, moderately eroded.	4	Low	Very rapid	Moderate	Wind and water.	Low	None.
Cc	Chelsea loamy fine sand, 14 to 18 percent slopes.	5	Very low	Very rapid	Slight	Wind and water.	Low	None.
Cd	Chelsea loamy fine sand, 25 to 50 percent slopes.	4	Very low	Very rapid	Slight	Wind and water.	Low	None.
Ce	Chelsea loamy fine sand-Lamont sandy loam, 2 to 5 percent slopes.	5	Low	Very rapid	Slight	Wind	Low	None.
Cf	Chelsea loamy fine sand-Lamont sandy loam, 5 to 10 percent slopes.	4	Low	Very rapid	Slight	Wind and water.	Low	None.
Cg	Chelsea loamy fine sand-Lamont sandy loam, 10 to 17 percent slopes.	4	Low	Very rapid	Slight	Wind and water.	Low	None.
Ch	Clarinda soils, 5 to 8 percent slopes, severely eroded.	2	Very low	Extremely slow.	Severe	Sheet	Moderate	Severe.
Ck	Clinton silt loam, 2 to 5 percent slopes.	6	Medium	Moderately slow.	Slight	Sheet	High	Slight.
Cm	Clinton silt loam, 5 to 13 percent slopes.	6	Medium	Moderately slow.	Slight	Sheet	High	Slight.
Cn	Clinton silt loam, 5 to 13 percent slopes, moderately eroded.	4	Medium	Moderately slow.	Moderate	Sheet	High	Slight.
Co	Clinton silt loam, 13 to 25 percent slopes.	6	Medium	Moderately slow.	Slight to moderate.	Sheet and gully.	High	Slight.
Cp	Clinton soils, 5 to 13 percent slopes, severely eroded.	2	Low	Moderately slow.	Severe	Sheet and gully.	High	Slight.
Cr	Coppock silt loam	10	Medium	Moderately slow to moderate.	None	None	High	Moderate.
Cs	Curran silt loam, 0 to 2 percent slopes.	6	Low	Slow	None	None	High	Moderate to severe.
Ct	Curran silt loam, thick A_2 variant, 2 to 4 percent slopes.	9	Low	Slow	None	None	High	Moderate.
Ea	Edina silt loam	8	Medium	Slow to very slow.	None	None	High	Moderate to severe.
Ga	Gara loam, 9 to 14 percent slopes.	7	Medium	Slow	Slight	Sheet	High	Slight.
Gb	Gara loam, 9 to 14 percent slopes, moderately eroded.	5	Medium low	Slow	Moderate	Sheet	High	Slight.
Gd	Gara loam, 14 to 24 percent slopes.	5	Medium low	Slow	Slight	Sheet	High	Slight.
Ge	Gara loam, 14 to 24 percent slopes, moderately eroded.	5	Medium low	Slow	Moderate	Sheet	High	Slight.
Gc	Gara soils, 9 to 14 percent slopes, severely eroded.	2	Low	Slow	Severe	Sheet and gully.	Moderate	Slight.
Gf	Givin silt loam, 0 to 2 percent slopes.	8	Medium	Moderately slow.	None	None	High	Slight to moderate.
Gg	Givin silt loam, 2 to 4 percent slopes.	8	Medium	Moderately slow.	Slight	Sheet	High	Slight to moderate.
Gh	Gosport silt loam, 9 to 14 percent slopes.	6	Low	Extremely slow.	Slight to moderate.	Sheet and gully.	Moderate	Slight.
Gk	Gosport silt loam, 14 to 24 percent slopes.	4	Very low	Extremely slow.	Slight to moderate.	Sheet and gully.	Moderate	Slight.

See footnote at end of table.

TABLE 1.—*Summary of major characteristics of the soils*—Continued

Map symbol	Soil	Thickness of A_1 horizon[1]	Organic matter content	Permeability of subsoil	Erosion		Capacity for available moisture	Wetness hazard
					Degree	Kind		
		Inches						
Gm	Gravity silty clay loam, 2 to 4 percent slopes.	22	High	Slow to moderate.	Slight	Gully	High	Moderate.
Gn	Grundy silty clay loam, 0 to 2 percent slopes.	12	High	Slow	None	None	High	Slight to moderate.
Go	Grundy silty clay loam, 2 to 5 percent slopes.	10	Medium high.	Slow	Slight	Sheet	High	Slight to moderate.
Gp	Grundy silty clay loam, 5 to 9 percent slopes.	8	Medium high.	Slow	Slight	Sheet	High	Slight to moderate.
Gr	Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded.	5	Medium	Slow	Moderate	Sheet	High	Slight to moderate.
Ha	Hagener loamy fine sand, 2 to 5 percent slopes.	20	Low	Very rapid	Slight	Wind and water.	Low	None.
Hb	Hagener loamy fine sand, 5 to 15 percent slopes.	16	Low	Very rapid	Slight	Wind and water.	Low	None.
Hc	Haig silty clay loam	12	High	Slow to very slow.	None	None	High	Moderate to severe.
Ja	Jackson loam, 0 to 2 percent slopes.	10	Medium	Moderate	None	None	High	Slight to moderate.
Jb	Jackson loam, 2 to 5 percent slopes.	9	Medium	Moderate	Slight	Sheet	High	Slight to moderate.
Ka	Kato silty clay loam, deep over sand.	15	Medium	Moderate	None	None	High	Slight to moderate.
Kb	Keomah silt loam, 2 to 5 percent slopes.	5	Medium	Moderately slow.	Slight	Sheet	High	Moderate.
Kc	Keomah silt loam, bench position, 2 to 5 percent slopes.	5	Medium	Moderately slow.	Slight	Sheet	High	Moderate.
La	Ladoga silt loam, 2 to 5 percent slopes.	8	Medium	Moderately slow.	Slight	Sheet	High	Slight.
Lb	Ladoga silt loam, 5 to 8 percent slopes.	7	Medium	Moderately slow.	Slight	Sheet	High	Slight.
Lc	Ladoga silt loam, 5 to 8 percent slopes, moderately eroded.	5	Medium low	Moderately slow.	Moderate	Sheet	High	Slight.
Lf	Lindley loam, 9 to 14 percent slopes.	7	Medium	Slow to very slow.	Slight	Sheet	High	Slight.
Lg	Lindley loam, 9 to 14 percent slopes, moderately eroded.	5	Medium low	Slow to very slow.	Moderate	Sheet	High	Slight.
Lh	Lindley loam, 14 to 25 percent slopes.	6	Medium low	Slow to very slow.	Slight	Sheet	High	Slight.
Lk	Lindley loam, 14 to 25 percent slopes, moderately eroded.	3	Low	Slow to very slow.	Moderate	Sheet	High	Slight.
Lm	Lindley loam, 25 to 35 percent slopes.	5	Low	Slow to very slow.	Slight to moderate.	Sheet and gully.	Moderate to high.	Slight.
Ld	Lindley soils, 9 to 14 percent slopes, severely eroded.	2	Low	Slow to very slow.	Severe	Sheet and gully.	Moderate	Slight.
Le	Lindley soils, 14 to 25 percent slopes, severely eroded.	2	Very low	Slow to very slow.	Severe	Sheet and gully.	Moderate	Slight.
Ma	Mahaska silty clay loam, 0 to 2 percent slopes.	14	High	Moderately slow.	None	None	High	Slight.
Mb	Mahaska silty clay loam, 2 to 4 percent slopes.	11	High	Moderately slow.	Slight	Sheet	High	Slight.
Na	Nodaway silt loam	20	Medium high.	Moderate	None	None	High	Slight to severe.

See footnote at end of table.

TABLE 1. *Summary of major charactoristics of the soils*—Continued

Map symbol	Soil	Thickness of A_1 horizon[1]	Organic matter content	Permeability of subsoil	Erosion		Capacity for available moisture	Wetness hazard
					Degree	Kind		
		Inches						
Nb	Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes.	16	Medium high.	Slow to moderate.	Slight	Gully	High	Slight to severe.
Oa	Otley silty clay loam, 2 to 4 percent slopes.	10	High	Moderately slow.	Slight	Sheet	High	Slight.
Ob	Otley silty clay loam, 4 to 8 percent slopes.	8	Medium	Moderately slow.	Slight	Sheet	High	Slight.
Oc	Otley silty clay loam, 4 to 8 percent slopes, moderately eroded.	5	Medium	Moderately slow.	Moderate	Sheet	High	Slight.
Pa	Pershing silt loam, 2 to 4 percent slopes.	8	Medium low	Slow to very slow.	Slight	Sheet	High	Moderate.
Pb	Pershing silt loam, 4 to 10 percent slopes.	6	Medium low	Slow	Slight	Sheet	High	Slight.
Pc	Pershing silt loam, 4 to 10 percent slopes, moderately eroded.	4	Low	Slow	Moderate	Sheet	High	Slight.
Ra	Rough broken and rock land.	5	Very low	Slow to rapid	Slight to severe.	Sheet and gully.	Moderate	None.
Rb	Rubio silt loam	7	Medium	Slow to very slow.	None	None	High	Moderate to severe.
Sb	Shelby loam, 9 to 14 percent slopes.	9	Medium	Slow	Slight	Sheet	High	Slight.
Sc	Shelby loam, 9 to 14 percent slopes, moderately eroded.	5	Medium	Slow	Moderate	Sheet	High	Slight.
Sd	Shelby loam, 14 to 20 percent slopes.	7	Medium	Slow	Slight	Sheet	High	Slight.
Se	Shelby loam, 14 to 20 percent slopes, moderately eroded.	4	Medium low	Slow	Moderate	Sheet	High	Slight.
Sa	Shelby soils, 9 to 14 per cent slopes, severely eroded.	2	Medium low	Slow	Severe	Sheet and gully.	Moderate to high.	Slight.
Sf	Sogn silt loam, 8 to 18 percent slopes.	6	Low	Moderate to slow.	Slight	Sheet	Low to moderate.	None.
Sg	Sogn silt loam, 8 to 18 percent slopes, moderately eroded.	4	Low	Moderate to slow.	Moderate	Sheet	Low to moderate.	None.
Sh	Sogn silt loam, 18 to 35 percent slopes.	6	Very low	Moderate to slow.	Slight	Sheet and gully.	Low to moderate.	None.
Sk	Sperry silt loam	7	Medium	Slow	None	None	High	Severe.
Ta	Taintor silty clay loam	11	High	Moderately slow.	None	None	High	Moderate to severe.
Wa	Wabash silty clay	16	High	Very slow	None	None	High	Very severe.
Wb	Waukegan loam, deep over sand.	10	Medium	Moderately rapid	None	None	High to moderate.	Slight.
Wc	Weller silt loam, 2 to 5 percent slopes.	6	Low	Slow	Slight	Sheet	High	Moderate.
Wd	Weller silt loam, 5 to 12 percent slopes.	5	Low	Slow	Slight	Sheet	High	Slight.
We	Weller silt loam, 5 to 12 percent slopes, moderately eroded.	3	Low	Slow	Moderate	Sheet	High	Slight.
Wf	Weller soils, 5 to 12 percent slopes, severely eroded.	2	Very low	Slow	Severe	Sheet and gully.	High	Slight.

[1] The A_1 horizon is the surface layer of uneroded soils. It is nearly always darker and higher in organic matter than the layer directly below.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*

[Estimated yield figures not available for truck crops; otherwise, absence of a yield figure indicates the soil is not suited to the specified crop or is not under cultivation. Principal supporting practices given only for general crops and for meadow]

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Estimated average acre yields: Corn	Oats	Hay	Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Adair clay loam, 5 to 12 percent slopes.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow.	Contouring	38	19	2.0	----
			1 year of corn, 1 year of oats, 2 years of meadow.	Terracing				
			Woods, pasture	----	----	----	----	----
Adair clay loam, 5 to 12 percent slopes, moderately eroded.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow.	Contouring	30	17	2.0	----
			1 year of corn, 1 year of oats, 2 years of meadow.	Terracing				
			Woods, pasture	----	----	----	----	----
Adair soils, 5 to 12 percent slopes, severely eroded.	IVe	Control of sheet and gully erosion; low fertility.	Woods, pasture	----	----	----	----	----
Alluvial land, wet	V	Flooding	Pasture, wildlife	----	----	----	----	----
Beckwith and Berwick silt loams:								
Beckwith (associated with Weller soils).	IIw	Maintenance of organic matter and soil structure; internal drainage.	1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow; pasture.	Drainage	45	24	1.3	16
Berwick (associated with Clinton soils).	IIw	Maintenance of organic matter and soil structure; internal and external drainage.	2 years of corn, 1 year of oats, 1 year of meadow.	Drainage	50	27	2.0	20
			1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage				
Beckwith and Berwick silt loams, bench position:								
Beckwith (associated with Weller soils).	IIw	Maintenance of organic matter and soil structure; internal drainage.	1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage	45	24	1.3	16
Berwick (associated with Clinton soils).	IIw	Maintenance of organic matter and soil structure; internal and external drainage.	2 years of corn, 1 year of oats, 1 year of meadow.	Drainage	50	27	2.2	20
			1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage				
Belinda silt loam	IIw	Maintenance of organic matter and soil structure; internal and external drainage.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage	52	25	2.0	20
Belinda silt loam, bench position.	IIw	Maintenance of organic matter and soil structure; internal and external drainage.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage	54	25	2.0	20
Bertrand loam, 1 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow.	Contouring	60	38	2.5	24
			2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Terracing				
Bertrand loam, 5 to 10 percent slopes.	IIIe	Maintenance of organic matter; control of sheet erosion.	1 year of corn, 1 year of oats, 3 years of meadow.	Contouring	55	34	2.5	----
			1 year of corn, 1 year of oats, 2 years of meadow.	Stripcropping				
			2 years of corn, 1 year of oats, 2 years of meadow.	Terracing				
Blockton silty clay loam	IIw	Drainage; maintenance of organic matter.	2 years of corn, 1 year of oats, 1 year of meadow.	Drainage	65	30	1.5	20
			1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage				

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Estimated average acre yields: Corn	Oats	Hay	Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Cantril loam, 2 to 5 percent slopes.	IIe	Runoff water from hills above; control of sheet and gully erosion.	Farm same as adjacent soils [1]		55	35	2. 5	24
Chelsea loamy fine sand, 5 to 8 percent slopes, moderately eroded.	IVs	Droughtiness; maintenance of fertility; control of wind and water erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping	30	20	1. 5	
			Woods, pasture					
Chelsea loamy fine sand, 14 to 18 percent slopes.	VIIs	Droughtiness; maintenance of fertility; control of wind and water erosion.	Wildlife, woods, pasture					
Chelsea loamy fine sand, 25 to 50 percent slopes.	VIIs	Droughtiness; maintenance of fertility; control of wind and water erosion.	Wildlife, woods, pasture					
Chelsea loamy fine sand-Lamont sandy loam, 2 to 5 percent slopes.	IVs	Droughtiness; maintenance of fertility; control of wind erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping	45	30	1. 5	
			Truck crops, pasture, woods					
Chelsea loamy fine sand-Lamont sandy loam, 5 to 10 percent slopes.	IVs	Droughtiness; maintenance of fertility; control of wind and water erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping	40	25	1. 5	
			Woods, pasture					
Chelsea loamy fine sand-Lamont sandy loam, 10 to 17 percent slopes.	VIs	Droughtiness; maintenance of fertility; control of wind and water erosion.	Wildlife, woods, pasture					
Clarinda soils, 5 to 8 percent slopes, severely eroded.	IVe	Control of sheet and gully erosion; very low fertility.	Wildlife, pasture					
Clinton silt loam, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Terracing	58	40	2. 8	
Clinton silt loam, 5 to 13 percent slopes.	IIIe	Maintenance of organic matter; control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	53	38	2. 2	
Clinton silt loam, 5 to 13 percent slopes, moderately eroded.	IIIe	Control of sheet erosion	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	50	30	2. 2	
Clinton silt loam, 13 to 25 percent slopes.	IVe, VIe	Control of sheet erosion	Wildlife, woods, pasture, permanent meadow.					
Clinton soils, 5 to 13 percent slopes, severely eroded.	IVe	Control of sheet and gully erosion; low fertility.	1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow.	Contouring Stripcropping Terracing	48	30	2. 5	
			Woods, pasture, permanent meadow.					
Coppock silt loam	IIw	Flooding; internal and external drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	65	35	2. 0	24

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Estimated average acre yields: Corn	Oats	Hay	Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Curran silt loam, 0 to 2 percent slopes.	IIw	Internal and external drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	45	30	1. 5	20
Curran silt loam, thick A_2 variant, 2 to 4 percent slopes.	IIw	Internal and external drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	55	35	2. 0	22
Edina silt loam	IIw	Internal and external drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	50	25	2. 0	24
Gara loam, 9 to 14 percent slopes.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow.	Stripcropping Terracing	38	32	2. 2	----
Gara loam, 9 to 14 percent slopes, moderately eroded.	IVe	Control of sheet erosion.	1 year of corn, 1 year of oats, 3 years of meadow. Woods, pasture	Stripcropping	35	30	2. 2	----
Gara loam, 14 to 24 percent slopes.	IVe, VIe	Control of sheet erosion.	Wildlife, woods, pasture	----	----	----	----	----
Gara loam, 14 to 24 percent slopes, moderately eroded.	IVe, VIe	Control of sheet erosion.	Wildlife, woods, pasture	----	----	----	----	----
Gara soils, 9 to 14 percent slopes, severely eroded.	VIe	Control of sheet and gully erosion; low fertility.	Wildlife, woods, pasture	----	----	----	----	----
Givin silt loam, 0 to 2 percent slopes.	I	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow	None needed None needed	65	35	2. 8	24
Givin silt loam, 2 to 4 percent slopes.	IIe	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	62	36	2. 8	24
Gosport silt loam, 9 to 14 percent slopes.	VIe	Low in organic matter; control of sheet and gully erosion.	Wildlife, woods, pasture	----	----	----	----	----
Gosport silt loam, 14 to 24 percent slopes.	VIIe	Very low in organic matter; control of sheet and gully erosion.	Wildlife, woods, pasture	----	----	----	----	----
Gravity silty clay loam, 2 to 4 percent slopes.	IIe	Runoff water from hills above; control of sheet and gully erosion.	Farm same as adjacent soil [1]	----	65	40	3. 0	28
Grundy silty clay loam, 0 to 2 percent slopes.	IIw	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	64	35	2. 5	24
Grundy silty clay loam, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet and gully erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	60	38	2. 5	28

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Estimated average acre yields: Corn	Oats	Hay	Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Grundy silty clay loam, 5 to 9 percent slopes.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	57	40	2.5	-----
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded.	IVe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	52	30	2.5	-----
			Woods, pasture, permanent meadow.	-----	-----	-----	-----	-----
Hagener loamy fine sand, 2 to 5 percent slopes.	IIIs	Droughtiness; maintenance of fertility; control of wind erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping	34	25	1.0	-----
			Truck crops, pasture, woods	-----	-----	-----	-----	-----
Hagener loamy fine sand, 5 to 15 percent slopes.	IIIs, IVs, VIs	Droughtiness; maintenance of organic matter; control of wind and water erosion.	1 year of corn, 1 year of oats, 2 years of meadow.[2] 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping	25	20	1.0	-----
			Woods, pasture	-----	-----	-----	-----	-----
Haig silty clay loam	IIw	Drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	64	35	2.2	28
Jackson loam, 0 to 2 percent slopes.	I	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	65	38	2.5	26
Jackson loam, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	62	36	2.5	25
Kato silty clay loam, deep over sand.	IIw	Maintenance of organic matter; internal drainage.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	75	45	2.8	30
Keomah silt loam, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	60	34	2.5	22
Keomah silt loam, bench position, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	58	34	2.5	24
Ladoga silt loam, 2 to 5 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	60	36	2.8	22

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Estimated average acre yields: Corn	Oats	Hay	Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Ladoga silt loam, 5 to 8 percent slopes.	IIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	55	35	2. 5	-----
Ladoga silt loam, 5 to 8 percent slopes, moderately eroded.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	53	33	2. 5	-----
Lindley loam, 9 to 14 percent slopes.	IVe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 3 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	35	25	1. 8	-----
			Woods, pasture, permanent meadow.	-----	-----	-----	-----	-----
Lindley loam, 9 to 14 percent slopes, moderately eroded.	IVe	Control of sheet erosion.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 3 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	30	23	1. 8	-----
			Woods, pasture, permanent meadow.	-----	-----	-----	-----	-----
Lindley loam, 14 to 25 percent slopes.	VIe, VIIe	Control of sheet erosion.	Wildlife, woods, pasture	-----	-----	-----	-----	-----
Lindley loam, 14 to 25 percent slopes, moderately eroded.	VIe, VIIe	Control of sheet erosion; low fertility.	Wildlife, woods, pasture	-----	-----	-----	-----	-----
Lindley loam, 25 to 35 percent slopes.	VIIe	Control of sheet and gully erosion; low fertility.	Wildlife, woods, pasture	-----	-----	-----	-----	-----
Lindley soils, 9 to 14 percent slopes, severely eroded.	VIe	Control of sheet and gully erosion; low fertility.	Woods, pasture	-----	-----	-----	-----	-----
Lindley soils, 14 to 25 percent slopes, severely eroded.	VIIe	Control of sheet and gully erosion; very low fertility.	Wildlife, woods, pasture	-----	-----	-----	-----	-----
Mahaska silty clay loam, 0 to 2 percent slopes.	I	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	None needed None needed	80	44	3. 0	30
Mahaska silty clay loam, 2 to 4 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	78	45	3. 0	28
Nodaway silt loam	I	Flooding	2 years of corn, 1 year of oats seeded with a legume for green manure. 1 year of corn, 1 year of soybeans, 1 year of rye, 1 year of corn, 1 year of oats seeded with a legume for green manure.	Drainage Drainage	65	35	2. 5	24

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Principal supporting practices	Corn	Oats	Hay	Soybeans
					Bu.	Bu.	Tons	Bu.
Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes.	IIw	Flooding; drainage; control of gully erosion.	Farm same as the adjacent soil [1] or use for wildlife, woods, pasture.	----	65	35	2.5	24
Otley silty clay loam, 2 to 4 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	76	40	3.0	26
Otley silty clay loam, 4 to 8 percent slopes.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	67	42	3.0	----
Otley silty clay loam, 4 to 8 percent slopes, moderately eroded.	IIIe	Control of sheet erosion.	1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 3 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow.	Contouring Stripcropping Terracing	64	39	3.0	----
Pershing silt loam, 2 to 4 percent slopes.	IIe	Maintenance of organic matter; control of sheet erosion.	2 years of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Contouring Terracing	56	33	2.4	18
Pershing silt loam, 4 to 10 percent slopes.	IIIe, IVe	Control of sheet erosion; medium low fertility.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	50	30	2.4	----
Pershing silt loam, 4 to 10 percent slopes, moderately eroded.	IVe	Control of sheet erosion; low fertility.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	47	28	2.4	----
Rough broken and rock land.	VIIe	Droughtiness; control of sheet and gully erosion; very low fertility.	Wildlife, woods, pasture	----	----	----	----	----
Rubio silt loam	IIw	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	58	32	2.2	22
Shelby loam, 9 to 14 percent slopes.	IIIe	Control of sheet erosion.	2 years of corn, 1 year of oats, 3 years of meadow. 1 year of corn, 1 year of oats, 1 year of meadow.	Stripcropping Terracing	40	28	2.5	----
Shelby loam, 9 to 14 percent slopes, moderately eroded.	IVe	Control of sheet erosion.	1 year of corn, 1 year of oats, 3 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Stripcropping Terracing	35	28	2.5	----
Shelby loam, 14 to 20 percent slopes.	IVe, VIe, VIIe	Control of sheet erosion.	Wildlife, woods, pasture	----	----	----	----	----

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops on the soils under superior management*—Continued

Soil	Capability class and subclass	Principal management problems	Superior management: Suitable rotations or other uses	Superior management: Principal supporting practices	Estimated average acre yields: Corn	Estimated average acre yields: Oats	Estimated average acre yields: Hay	Estimated average acre yields: Soybeans
					Bu.	*Bu.*	*Tons*	*Bu.*
Shelby loam, 14 to 20 percent slopes, moderately eroded.	IVe, VIe, VIIe	Control of sheet erosion; medium low fertility.	Wildlife, woods, pasture					
Shelby soils, 9 to 14 percent slopes, severely eroded.	IVe, VIe	Control of sheet and gully erosion; medium low fertility.	Pasture, woods, permanent meadow.					
Sogn silt loam, 8 to 18 percent slopes.	IVe, VIe	Control of sheet erosion; low fertility.	Wildlife, woods, pasture					
Sogn silt loam, 8 to 18 percent slopes, moderately eroded.	VIe, VIIe	Control of sheet erosion; low fertility.	Wildlife, woods, pasture					
Sogn silt loam, 18 to 35 percent slopes.	VIIe	Control of sheet erosion; very low fertility.	Wildlife, woods, pasture					
Sperry silt loam	IIw	Internal and external drainage.	Farm same as adjacent soil [1]		50	25	2.0	24
Taintor silty clay loam	IIw	Drainage; maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage Drainage	78	46	3.0	30
Wabash silty clay	IIIw	Flooding; internal drainage.	2 years of corn, 1 year of oats, 1 year of meadow or 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	Drainage	45	25	2.0	22
Waukegan loam, deep over sand.	I	Maintenance of organic matter and soil structure.	2 years of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of soybeans, 1 year of oats, 1 year of meadow.	None needed None needed	75	42	2.5	26
Weller silt loam, 2 to 5 percent slopes.	IIIe	Maintenance of organic matter; control of sheet erosion.	1 year of corn, 1 year of oats, 1 year of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	50	30	2.0	
Weller silt loam, 5 to 12 percent slopes.	IIIe, IVe	Control of sheet erosion; medium low fertility.	1 year of corn, 1 year of oats, 3 years of meadow.[2] 1 year of corn, 1 year of oats, 2 years of meadow. 2 years of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.[3]	Contouring Stripcropping Terracing Terracing	45	26	2.0	
Weller silt loam, 5 to 12 percent slopes, moderately eroded.	IIIe, IVe	Control of sheet erosion; low fertility.	1 year of corn, 1 year of oats, 4 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow. 1 year of corn, 1 year of oats, 2 years of meadow.	Contouring Stripcropping Terracing	42	24	2.0	
Weller soils, 5 to 12 percent slopes, severely eroded.	IVe, VIe	Control of sheet and gully erosion; very low fertility.	Wildlife, woods, pasture, permanent meadow.					

[1] Consult soil map at back of report to determine names of adjacent soils.
[2] Rotation suitable only on fields that have slopes of between 5 and 8 percent.
[3] Rotations needed on fields that have slopes of more than 9 percent.

Superior management consists of the following: (1) Conservation practices as required to control erosion—a maximum proportion of row crops commensurate with adequate erosion control; (2) adequate drainage; (3) timely cultural operations; (4) control of weeds, insects, and plant diseases; (5) application of lime and fertilizer according to the needs indicated by soil tests and field trials; and (6) use of suitable crop varieties and adequate rates of planting.

In arriving at the estimated yields for grain crops, the soil scientists considered the fact that in the north-central part of the county the areas of Mahaska, Clinton, and associated soils are transitional to areas of Grundy, Weller, and associated soils. As a result the estimated yields on the Mahaska and Clinton soils are slightly lower than the yields on areas of these soils in counties to the north of Jefferson. The yield figures for the Grundy and Weller soils are based on estimated yields on these soils along the southern edge of the county.

Under superior management alfalfa and bromegrass constitute the grass-legume mixture, even though the rotation includes only 1 year of meadow. The yields of hay refer to hay harvested from second-year meadow grown in a rotation that includes 2 or more years of meadow.

How Soils Are Mapped and Described

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 bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern but are located according to the lay of the land. Usually, they are not more than a quarter of a mile apart, and sometimes they are much closer. In most soils such a boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about the soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. In the lower layers the presence of gray colors alone or as spots or streaks with brown colors generally indicates poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

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.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; and the acidity or alkalinity of the soil as measured by chemical tests.

Classification.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified by series, types, and phases.

As an example of soil classification, consider the Pershing series of Jefferson County, Iowa. This series is made up of one soil type, subdivided into phases, as follows:

Series	*Type*	*Phase*
Pershing	Silt loam	2 to 4 percent slopes. 4 to 10 percent slopes. 4 to 10 percent slopes, moderately eroded.

Soil series.—Soils similar in kind, thickness, and arrangement of soil layers are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Soil type.—Soils having the same texture in the surface layers and similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices, therefore, can be specified more easily than for soil series or yet broader groups that contain more variation.

Miscellaneous land types.—Rough, stony, and severely gullied land or fresh stream deposits are of variable texture. They have little true soil and are not classified by types and series but are identified by descriptive names. An example is Rough broken and rock land.

Soil complex.—When two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. An example of this is the Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes.

Undifferentiated soils.—Two or more soils that are not regularly associated geographically may be mapped as an undifferentiated group—a single unit—if the differences between them are too slight to justify a separation. In Jefferson County the Beckwith and Berwick soils are mapped as undifferentiated soils.

Descriptions of the Soils

In this section the soils mapped in Jefferson County are described and suggestions are given for their use and management. The approximate acreage and proportionate extent of each mapping unit are shown in table 3.

TABLE 3.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Adair clay loam, 5 to 12 percent slopes	5, 046	1. 8
Adair clay loam, 5 to 12 percent slopes, moderately eroded	2, 775	1. 0
Adair soils, 5 to 12 percent slopes, severely eroded	310	. 1
Alluvial land, wet	318	. 1
Beckwith and Berwick silt loams	1, 767	. 6
Beckwith and Berwick silt loams, bench position	1, 038	. 4
Belinda silt loam	4, 410	1. 6
Belinda silt loam, bench position	373	. 1
Bertrand loam, 1 to 5 percent slopes	267	. 1
Bertrand loam, 5 to 10 percent slopes	36	(1)
Blockton silty clay loam	164	. 1
Cantril loam, 2 to 5 percent slopes	583	. 2
Chelsea loamy fine sand, 5 to 8 percent slopes, moderately eroded	43	(1)
Chelsea loamy fine sand, 14 to 18 percent slopes	35	(1)
Chelsea loamy fine sand, 25 to 50 percent slopes	15	(1)
Chelsea loamy fine sand-Lamont sandy loam, 2 to 5 percent slopes	105	(1)
Chelsea loamy fine sand-Lamont sandy loam, 5 to 10 percent slopes	100	(1)
Chelsea loamy fine sand-Lamont sandy loam, 10 to 17 percent slopes	38	(1)
Clarinda soils, 5 to 8 percent slopes, severely eroded	36	(1)
Clinton silt loam, 2 to 5 percent slopes	341	. 1
Clinton silt loam, 5 to 13 percent slopes	2, 289	. 8
Clinton silt loam, 5 to 13 percent slopes, moderately eroded	3, 365	1. 2
Clinton silt loam, 13 to 25 percent slopes	261	. 1
Clinton soils, 5 to 13 percent slopes, severely eroded	251	. 1
Coppock silt loam	2, 468	. 9
Curran silt loam, 0 to 2 percent slopes	690	. 2
Curran silt loam, thick A_2 variant, 2 to 4 percent slopes	418	. 1
Edina silt loam	147	. 1
Gara loam, 9 to 14 percent slopes	2, 377	. 9
Gara loam, 9 to 14 percent slopes, moderately eroded	2, 033	. 7
Gara loam, 14 to 24 percent slopes	507	. 2
Gara loam, 14 to 24 percent slopes, moderately eroded	345	. 1
Gara soils, 9 to 14 percent slopes, severely eroded	280	. 1
Givin silt loam, 0 to 2 percent slopes	33	(1)
Givin silt loam, 2 to 4 percent slopes	1, 854	. 7
Gosport silt loam, 9 to 14 percent slopes	125	(1)
Gosport silt loam, 14 to 24 percent slopes	173	. 1
Gravity silty clay loam, 2 to 4 percent slopes	793	. 3
Grundy silty clay loam, 0 to 2 percent slopes	711	. 3
Grundy silty clay loam, 2 to 5 percent slopes	17, 147	6. 1
Grundy silty clay loam, 5 to 9 percent slopes	8, 711	3. 1
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded	5, 803	2. 1
Hagener loamy fine sand, 2 to 5 percent slopes	51	(1)
Hagener loamy fine sand, 5 to 15 percent slopes	24	(1)
Haig silty clay loam	31, 124	11. 2
Jackson loam, 0 to 2 percent slopes	73	(1)
Jackson loam, 2 to 5 percent slopes	344	0. 1
Kato silty clay loam, deep over sand	222	. 1
Keomah silt loam, 2 to 5 percent slopes	884	. 3
Keomah silt loam, bench position, 2 to 5 percent slopes	384	. 1
Ladoga silt loam, 2 to 5 percent slopes	150	. 1
Ladoga silt loam, 5 to 8 percent slopes	2, 173	. 8
Ladoga silt loam, 5 to 8 percent slopes, moderately eroded	1, 551	. 6
Lindley loam, 9 to 14 percent slopes	6, 012	2. 2
Lindley loam, 9 to 14 percent slopes, moderately eroded	7, 194	2. 6
Lindley loam, 14 to 25 percent slopes	23, 853	8. 5
Lindley loam, 14 to 25 percent slopes, moderately eroded	5, 179	1. 9
Lindley loam, 25 to 35 percent slopes	931	. 3
Lindley soils, 9 to 14 percent slopes, severely eroded	2, 298	. 8
Lindley soils, 14 to 25 percent slopes, severely eroded	1, 519	. 5
Mahaska silty clay loam, 0 to 2 percent slopes	1, 625	. 6
Mahaska silty clay loam, 2 to 4 percent slopes	9, 895	3. 5
Nodaway silt loam	13, 605	4. 9
Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes	11, 942	4. 3
Otley silty clay loam, 2 to 4 percent slopes	321	. 1
Otley silty clay loam, 4 to 8 percent slopes	8, 330	3. 0
Otley silty clay loam, 4 to 8 percent slopes, moderately eroded	2, 102	. 8
Pershing silt loam, 2 to 4 percent slopes	7, 713	2. 8
Pershing silt loam, 4 to 10 percent slopes	5, 595	2. 0
Pershing silt loam, 4 to 10 percent slopes, moderately eroded	6, 463	2. 3
Rough broken and rock land	307	. 1
Rubio silt loam	445	. 2
Shelby loam, 9 to 14 percent slopes	2, 540	. 9
Shelby loam, 9 to 14 percent slopes, moderately eroded	2, 234	. 8
Shelby loam, 14 to 20 percent slopes	351	. 1
Shelby loam, 14 to 20 percent slopes, moderately eroded	186	. 1
Shelby soils, 9 to 14 percent slopes, severely eroded	185	. 1
Sogn silt loam, 8 to 18 percent slopes	10	(1)
Sogn silt loam, 8 to 18 percent slopes, moderately eroded	27	(1)
Sogn silt loam, 18 to 35 percent slopes	519	. 2
Sperry silt loam	93	(1)
Taintor silty clay loam	8, 015	2. 9
Wabash silty clay	145	. 1
Waukegan loam, deep over sand	345	. 1
Weller silt loam, 2 to 5 percent slopes	9, 591	3. 4
Weller silt loam, 5 to 12 percent slopes	16, 819	6. 0
Weller silt loam, 5 to 12 percent slopes, moderately eroded	15, 499	5. 6
Weller soils, 5 to 12 percent slopes, severely eroded	1, 577	. 6
Mines and pits	14	(1)
Total	279, 040	100. 0

(1) Less than 0.1 percent.

Adair Series

The soils of the Adair series have a dark-colored clay loam or loam surface soil and a mottled silty clay subsoil that is very firm and gritty. They occupy strips on slopes that border drainageways in areas of the county in which dark-colored soils predominate. They have developed primarily from leached and oxidized Kansan till, but the surface layer commonly contains some loess.

The capacity of the Adair soils to supply plant nutrients is moderate to low. Need for fertilizer and lime should be determined by soil tests. Erosion is a serious problem in cultivated areas.

Representative profile.—The first layer, 7 inches thick, is very dark grayish-brown, friable clay loam that contains some grit. The next 33 inches is brown to grayish-brown, firm, gritty silty clay. There are many, medium, prominent mottles of yellowish brown and strong brown in this layer. Below a depth of 40 inches is gray and strong-brown, firm sandy clay to clay loam containing many, coarse, distinct mottles of yellowish brown to strong brown.

Adair clay loam, 5 to 12 percent slopes (Aa).—The profile of this soil is similar to the representative profile described for the Adair series, except that the surface layer is as much as 12 inches thick in places where little or no erosion has occurred. Like the other members of the Adair series, this soil has medium to slow internal drainage because the subsoil is heavy textured.

This soil is highly erodible if it is cultivated. Rotations that include 2 or more years of meadow, along with contouring and terracing, are needed to control runoff and to check gully erosion.

Adair clay loam, 5 to 12 percent slopes, moderately eroded (Ab).—This soil is similar in profile to the representative profile described for the Adair series. It is used and managed in about the same way as Adair clay loam, 5 to 12 percent slopes.

Adair soils, 5 to 12 percent slopes, severely eroded (Ac).—Severe erosion has caused the surface layer of this mapping unit to vary considerably in color and texture. In most places the surface soil is only about 4 inches thick. In other ways the profile resembles the representative profile given for the Adair series.

This mapping unit is so erodible that it should not be cultivated. It is best used for meadow or pasture. The soil needs organic matter because much of the original supply of organic matter has been lost through cropping and erosion.

Alluvial Land

Alluvial land, wet (Ad).—Most of this miscellaneous land type occurs as bottom lands along the Skunk River. The areas were formerly channels of the river and are nearly as low as the streambed. Consequently, they are almost impossible to drain. They are frequently flooded and remain wet except during extended dry periods. The ground cover consists of swamp vegetation and some willow and cottonwood saplings. Alluvial land, wet, has formed from material deposited by streams.

Although the capacity of the soil to supply plant nutrients is moderate, the areas are too wet to be used for crops. They can be used for pasture or as habitats for wildlife.

No representative profile can be described for this miscellaneous land type. The soil material is predominantly medium textured and poorly drained to very poorly drained.

Beckwith and Berwick Soils

Beckwith and Berwick silt loams (Ba).—This mapping unit consists of two soils that are shown on the soil map as a single unit. Each of these soils can be identified on the map because each is associated with different soils—the Beckwith with Weller soils, and the Berwick with Clinton soils.

Beckwith silt loam (associated with Weller soils) occurs on level, broad, tabular divides in the uplands of the southern part of the county. It was formed under forest from moderately thick loess. The capacity of this soil to supply plant nutrients is moderate. Need for lime and fertilizer should be determined regularly by soil tests. This soil is not well suited to cultivated crops, because the subsoil is very slowly permeable. It is difficult to improve internal drainage. A profile of Beckwith silt loam is shown in figure 6.

Figure 6.—**Profile of Beckwith silt loam.**

Representative profile of Beckwith silt loam.—The two uppermost layers, which combined are 16 inches thick, consist of dark grayish-brown to light grayish-brown or grayish-brown, friable silt loam. Between depths of 16 and 45 inches is grayish-brown, medium silty clay with many yellowish-brown mottles; this material is plastic when wet and very firm when moist. Below a depth of 45 inches is a mottled light brownish-gray and yellowish-brown, friable, light silty clay loam with streaks of dark gray. There are some dark concretions of iron and manganese.

Berwick silt loam (associated with Clinton soils) occurs on small, narrow, tabular divides in the northeastern part of the county, primarily in Penn, Walnut, and Lockridge Townships. It was formed under forest from moderately thick loess.

The capacity of this soil to supply plant nutrients is moderate to low. The need for fertilizer and lime should be determined by soil tests. The subsoil is only moderately favorable for the growth of plants. Because water does not move readily through the subsoil, adequate drainage is needed. The cropping system should include legumes grown as meadow crops. Erosion is not a problem.

Representative profile of Berwick silt loam.—The surface and subsurface layers, which are very dark gray and gray, respectively, are a friable silt loam and have a combined thickness of 13 inches. Between depths of about 13 inches and about 38 inches is gray and dark grayish brown to grayish-brown, firm, medium to light silty clay that is mottled with brownish yellow and strong brown; some iron-manganese concretions occur in the lower 10 inches of this layer. Below a depth of 38 inches is grayish-brown, firm, medium silty clay loam that has strong-brown to brownish-yellow mottles. There are some iron-manganese concretions, but they are softer than those in the 13- to 38-inch layer.

Beckwith and Berwick silt loams, bench position (Bb).—This mapping unit is similar to Beckwith and Berwick silt loams except that it occupies bench or terrace positions along the rivers and large streams.

Beckwith silt loam, bench position, occupies benches in the part of the county in which the Weller soils occur, and Berwick silt loam, bench position, occupies the area in which the Clinton soils occur. These soils are used and managed in about the same way as the Beckwith and Berwick silt loams.

Belinda Series

The soils of the Belinda series occur mainly in the southern part of the county, mostly on nearly level tabular divides and benches between areas of forest and prairie. They have developed from moderately thick, relatively fine-textured loess under the influence of a mixed vegetation of forest and grass. Although the forest encroached on the prairie, the influence of the forest was not great enough to result in soils having characteristics similar to those of the Beckwith and Berwick soils.

The capacity of the Belinda soils to supply plant nutrients is moderately low. Need for fertilizer and lime should be determined by soil tests.

Representative profile.—The 7-inch surface layer is very dark gray, friable silt loam. The 7- to 16-inch layer is very dark gray or grayish-brown, friable silt loam. The upper part of the 16- to 39-inch layer is dark grayish-brown, very firm, medium silty clay in which light olive-brown mottles are common. The lower 10 inches of this layer consists of a mixture of olive-brown and yellowish-brown silty clay loam.

Belinda silt loam (Bc).—The profile of this soil is similar to the representative profile described for the Belinda series. The principal management needs are to improve drainage and to follow a rotation that includes 1 year of a legume and grass. Tile drains do not work well because of the tight subsoil. Surface drainage should be maintained. Erosion is not a problem.

Belinda silt loam, bench position (Bd).—In general, the profile of this soil is similar to the representative profile described for the Belinda series. This soil is on old terraces that are covered by a mantle of loess. It occurs at lower elevations than Belinda silt loam and is used and managed in about the same way.

Bertrand Series

The soils of the Bertrand series occur on second bottoms along the Skunk River and Cedar Creek. They lie above areas that ordinarily overflow. These soils are between the streambanks and the foothills, mostly on undulating to gently rolling terraces. They have developed from alluvium under a cover of forest.

The capacity of the Bertrand soils to supply plant nutrients is moderate. Need for fertilizer and lime should be determined by soil tests.

Representative profile.—The uppermost 10 inches is dark grayish-brown, friable loam. The 10- to 17-inch layer is grayish-brown, friable loam. The 17- to 45-inch layer is dark yellowish-brown, slightly firm loam or light clay loam that contains a few gray mottles in the lower part. Below a depth of 45 inches is mottled gray and strong-brown, friable silt loam.

Bertrand loam, 1 to 5 percent slopes (Be).—This soil occurs on terraces that are adjacent to streams. The relief is undulating. The profile is similar to the representative profile described for the Bertrand series.

Erosion, if a serious hazard, can be controlled by contour tillage. A grass-legume meadow, grown 1 or 2 years in the rotation, helps prevent the structure of the soil from deteriorating.

Bertrand loam, 5 to 10 percent slopes (Bf).—This soil occurs on gently rolling terraces that lie next to the uplands. Except that the surface layer is not so thick in most places, the profile of this soil is similar to the representative profile described for the Bertrand series.

A cropping system that includes the growing of a grass-legume meadow helps to maintain the tilth and structure of the soil. Diversion terraces may be needed in places to prevent damage by runoff from higher areas. Tilling on the contour, stripcropping, and establishing grassed waterways are necessary in some places.

Blockton Series

The soils of the Blockton series have formed from fine-textured alluvium. This material is finer textured than that of the surrounding soils. The natural vegetation was prairie grasses and scattered trees.

Representative profile.—The first layer, 13 inches thick, is very dark gray, friable, medium silty clay loam. Between depths of 13 and 38 inches is black to very dark gray or dark gray, firm, heavy to light silty clay that contains some dark yellowish-brown to yellowish-brown mottles. Below a depth of 38 inches is gray, very firm silty clay loam.

Blockton silty clay loam (Bg).—This is the only soil of the Blockton series mapped in Jefferson County. It occurs in a few areas along Cedar Creek. The areas are only a few feet above the bottom lands and are therefore subject to occasional overflow. Some of the soil occurs in depressions. The profile of this soil is the same as the representative profile described for the Blockton series.

The capacity of this soil to supply plant nutrients is moderate. Need for fertilizer and lime should be determined by soil tests. Surface ditches are needed to drain off excess water because water penetrates the subsoil too slowly for tile drainage to be effective. Bedding will also help to remove excess surface water.

Cantril Series

The soils of the Cantril series have formed under a mixed vegetation of prairie and forest. They have developed from alluvial material that washed down from upland soils derived from till and loess.

Representative profile.—The first layer, 6 inches thick, consists of very dark grayish-brown, friable loam that is relatively recent overwash material. The next 19 inches is very dark gray to grayish brown, friable loam that contains a few, fine, faint mottles of dark brown and strong brown. Below a depth of 25 inches is grayish-brown, firm, medium to heavy silty clay loam material having yellowish-brown and strong-brown mottles.

Cantril loam, 2 to 5 percent slopes (Ca).—This soil is the only member of the Cantril series mapped in Jefferson County. It occurs as narrow bands on gentle slopes and as alluvial fans at the foot of steep slopes along Cedar Creek and the Skunk River. Its profile is the same as the representative profile described for the Cantril series.

The principal management problem is the control of runoff from the uplands. Unless runoff is controlled, this soil will be damaged by sheet and gully erosion. The areas are narrow so it is best to farm them in the same way as adjacent soils. (Consult the soil map at the back part of this report to find out what soils are located next to Cantril loam, 2 to 5 percent slopes, which is identified by the symbol Ca.)

Chelsea Series

The soils of the Chelsea series occupy stabilized sand dunes, mostly on the crest of escarpments along the eastern edge of the valleys of large streams. Relief ranges from gently rolling to steep. The areas are all in Lockridge Township; all except one are east of the Skunk River.

Droughtiness and the control of erosion are the major management problems on these soils. Yields of crops are not high, even in the wetter years, because the water-holding capacity is limited. Crops require liberal applications of lime, manure, and commercial fertilizer. This treatment is costly, however, and it may not be so practical as on soils having fewer limitations. Water and wind erosion are likely to damage these soils if they are planted to intertilled crops such as corn. Crops should be grown in contour strips if practical. In general, the Chelsea soils are probably best suited to permanent pasture and trees.

Representative profile in a forested area.—The first 3 to 5 inches is very dark grayish-brown, loose loamy fine sand containing many roots of trees. The next layer, between 3 and about 30 inches, is dark-brown, noncoherent fine sand. Between 30 and 45 inches is dark yellowish-brown, loose fine sand. In the 45- to 55-inch layer is dark yellowish-brown, loose fine sand that contains a few, weak, thin bands of strong brown.

Chelsea loamy fine sand, 5 to 8 percent slopes, moderately eroded (Cb).—This soil occurs on the west side of the Skunk River. It occupies gently rolling areas on benches that lie next to the bottom lands. Its profile is similar to that of the Chelsea series.

This soil occurs in one small area. Contouring or stripcropping will help to control erosion. Areas of this soil may need to be kept in meadow more of the time than the areas of adjacent soils that occur in the same field.

Chelsea loamy fine sand, 14 to 18 percent slopes (Cc).—This soil occupies two hilly areas on the east side of the Skunk River. Its profile is similar to that of the Chelsea series.

Low fertility, droughtiness, and the risk of erosion by wind and water make this soil poorly suited to corn, oats, and other field crops. It is best used for permanent pasture, as woodland, or to provide habitats for wildlife.

Chelsea loamy fine sand, 25 to 50 percent slopes (Cd).—This soil occurs in one large steep area above the bottom lands on the east side of the Skunk River. Its profile is similar to that of the Chelsea series. It is best used for permanent pasture, as woodland, or to provide habitats for wildlife.

Chelsea-Lamont Complexes

The Chelsea and Lamont soils are so intricately associated in small areas that they are mapped together as soil complexes. They occur on the steeper areas that border Cedar Creek. These areas consist of stabilized dunes that lie next to the bottom lands, or they are on the crests of uplands that are covered by till or loess. Relief ranges from undulating to hilly. These soils have developed under forest from loose eolian (windblown) sands that contain some silt. They are low in organic matter.

The Chelsea soils are sandy throughout; the Lamont soils have a subsoil of sandy loam or sandy clay loam. The surface layer of both of these soils varies in texture, color, and thickness because of differences in the degree of slope and in the kind of soil material.

Representative profile of Chelsea loamy fine sand.—The surface layer consists of 3 to 5 inches of dark-brown to dark yellowish-brown, loose loamy fine sand. Between depths of 6 and 32 inches is strong-brown, loose loamy fine sand. In the 32- to 60-inch layer are thick bands of brownish-yellow sandy clay loam containing fine sand between the bands. Below a depth of 60 inches is yellowish-brown, noncoherent sand.

Representative profile of Lamont sandy loam.—The surface layer consists of 5 inches of brown, friable sandy loam. Between depths of 5 and 28 inches is dark-brown to yellowish-red, friable sandy clay loam or sandy loam. Below a depth of 28 inches are strong-brown to brownish-yellow bands of friable sandy clay loam.

Chelsea loamy fine sand-Lamont sandy loam, 2 to 5 percent slopes (Ce).—This mapping unit occupies undulating areas on the crests of uplands that are covered by till or loess. Its profile is similar to the representative profile described for the Chelsea-Lamont complexes.

The soils of this complex do not produce well, because of their low natural fertility and low water-holding capacity. Even in wet years, yields are low. For improved yields, liberal applications of lime, manure, and commercial fertilizer are needed. Applying these amendments, however, will probably not give as good results on these soils as on soils that are less sandy and have fewer management problems.

If a field of these soils has some small sandy areas, the same rotation is generally used for the entire field.

Meadows seeded to a mixture that includes alfalfa should be maintained for at least 2 years. These soils are likely to be damaged by wind and water erosion, so they should be cultivated on the contour where practical; large areas should be stripcropped. Terraces may be difficult to maintain in the sandier areas.

Chelsea loamy fine sand-Lamont sandy loam, 5 to 10 percent slopes (Cf).—This mapping unit occupies the crests of gently rolling areas or the places between the crests and the areas of till below. The profiles of the soils are similar to the profiles described for the Chelsea-Lamont complexes. Except that some of the areas are used as woodland, this mapping unit is used and managed in about the same way as Chelsea loamy fine sand-Lamont sandy loam, 2 to 5 percent slopes.

Chelsea loamy fine sand-Lamont sandy loam, 10 to 17 percent slopes (Cg).—This mapping unit occurs on rolling to hilly areas that border streams. The soils have profiles similar to the ones described for the Chelsea-Lamont complexes.

These soils are not suited to cultivation, because of droughtiness and the risk of erosion. They can be used for pasture, as woodland, or for wildlife.

Clarinda Series

The soils of the Clarinda series have a light-gray, very firm or plastic clay subsoil that is known locally as gumbotil. In virgin areas the surface soil is a mixture of loess and glacial till materials. Most of the surface soil has been removed through sheet erosion, leaving the gumbotil at or near the surface. These soils have developed under grass and were derived from glacial till.

Representative profile.—The uppermost 4 inches is dark grayish-brown, light silty clay loam. The next 11 inches is gray, firm clay that has a few, fine, prominent mottles of yellowish brown to strong brown. Below a depth of 15 inches is gray, firm clay that lacks the bright mottling present in the layer immediately above.

Clarinda soils, 5 to 8 percent slopes, severely eroded (Ch).—These soils comprise the only mapping unit of the Clarinda series in this county. Their profiles are similar to the profile described for the series. Most of the soils are on gentle slopes at the heads of drainageways where areas of glacial till are transitional to areas of loess.

The capacity of these soils to supply plant nutrients is low. Need for fertilizer and lime should be determined by soil tests. The water-holding capacity is moderate. The plastic subsoil clods easily after plowing, and the soils are often too wet to be cultivated when the surrounding soils are ready to work. Control of erosion is a serious problem. In many places the surface layer has eroded away and it is difficult to establish and maintain a plant cover. The areas are best used for pasture.

Clinton Series

The soils of the Clinton series occur along the edges of tabular divides on areas of undulating to hilly relief. They are in the northeastern part of the county, mostly in Walnut, Penn, Black Hawk, and Lockridge Townships. These soils lie just above the soils of the Gara and Lindley series, which are on the side slopes. They have developed from moderately thick loess under a cover of deciduous forest, whereas the Gara and Lindley soils have developed from glacial till.

The capacity of these soils to supply plant nutrients ranges from moderate to low. Need for lime and fertilizer is best determined by soil tests. The subsoil is moderately favorable for the best growth of plants.

Representative profile.—The uppermost 8 inches is very dark gray to dark grayish-brown, friable silt loam. Between depths of 8 and 42 inches is dark yellowish-brown, firm, heavy to medium silty clay loam; there are a few black iron-manganese concretions and a few, fine, faint mottles of strong brown and gray. Below a depth of 42 inches is a layer of mottled yellowish-brown and light-gray, friable silty clay loam that contains a few black iron-manganese concretions.

Clinton silt loam, 2 to 5 percent slopes (Ck).—This soil occurs on or near the crests of ridges in the forested areas. The soil profile is similar to the representative profile described for the Clinton series.

Control of erosion is a major problem on this soil. All practical methods should be used to prevent losses of soil and water. A good rotation consists of 1 year of row crops to 2 years of grasses and alfalfa. If terraces are constructed or stripcropping is used, row crops may be grown for 2 years in a 4- or 5-year rotation.

Clinton silt loam, 5 to 13 percent slopes (Cm).—This soil generally occurs in long, narrow areas. Its profile is similar to the representative profile described for the Clinton series.

This soil is low in organic matter and is subject to damage by erosion. To prevent runoff and to control erosion, farmers should use all practical conservation practices. The rotation should consist of only 1 year of row crops to 2 years of grasses and legumes. If terraces are constructed or the fields are stripcropped, however, row crops can be grown for 2 consecutive years.

Clinton silt loam, 5 to 13 percent slopes, moderately eroded (Cn).—Except that the surface layer is only about 5 inches thick, this soil has a profile similar to the profile described for the Clinton series. Although it has been damaged more by erosion, it is used and managed in about the same way as Clinton silt loam, 5 to 13 percent slopes.

Clinton silt loam, 13 to 25 percent slopes (Co).—In most places this soil occurs just above the soils of the terraces and bottom lands, but in some places it lies immediately above the Lindley soils. Its profile is similar to the representative profile described for the Clinton series, but in places the surface layer is between 6 and 10 inches thick. Also, the layer corresponding to the 8- to 42-inch layer of the representative profile is likely to be not more than 14 inches thick, and in places it contains less clay.

The control of erosion is the principal management problem. Most of this soil is too steep to be cultivated and can best be used for permanent pasture or as woodland.

Clinton soils, 5 to 13 percent slopes, severely eroded (Cp).—The soils of this mapping unit have profiles similar to the representative profile described for the Clinton series. The surface layer is not more than 4 inches thick, however, and is variable in texture. The soils are used and managed in somewhat the same way as Clinton silt loam, 5 to 13 percent slopes, but are less suitable for cultivated crops.

Coppock Series

The soils of the Coppock series have developed from alluvium. The natural vegetation consisted of prairie grasses and trees.

Representative profile.—The uppermost 18 inches is very dark brown to dark gray, friable silt loam. Between depths of 18 and 32 inches is light brownish-gray, friable silt loam showing common, medium, distinct brown mottles. Below a depth of 32 inches is light brownish-gray, slightly firm medium silty clay loam that has common, medium, distinct brown mottles.

Coppock silt loam (Cr).—This level to nearly level soil, the only member of the Coppock series in the county, occurs along Cedar Creek and the Skunk River. The profile is the same as the representative profile described for the Coppock series. The areas of this soil lie a few feet above the bottom lands. They are subject to occasional flooding when the water level is extremely high.

The capacity of this soil to supply plant nutrients is moderate. Need for lime and fertilizer is best determined by soil tests. Erosion is not a problem, but this soil may need to be artificially drained and protected against flooding. For best crop yields, the 4- or 5-year rotation should include 1 year of a grass-legume meadow.

Curran Series

The soils of the Curran series are on terraces along the larger streams, principally along the Skunk River and Cedar Creek. They have developed from silty alluvium under a cover of forest.

Representative profile.—The dark grayish-brown surface layer and the grayish-brown subsurface layer have a combined thickness of about 18 inches. Both are friable silt loams except for the lower part of the subsurface layer, which in places is a light silty clay loam. Below this layer, to a depth of 48 inches, is grayish-brown to dark grayish-brown, firm silty clay loam that has faint yellowish-brown mottles. Below a depth of 48 inches is light brownish-gray, friable loamy material showing strong-brown mottles.

Curran silt loam, 0 to 2 percent slopes (Cs).—This soil is on level to nearly level terraces next to the larger streams. Its profile is similar to the representative profile described for the Curran series.

The principal management need is to improve drainage. The subsoil is tight; therefore, surface drains may be more practical than tile. The need for lime and fertilizer is best determined by soil tests.

Curran silt loam, thick A_2 variant, 2 to 4 percent slopes (Ct).—This soil is not typical of the Curran series. The A_2 horizon, which is part of the surface layer, is thicker than that of the typical Curran soil. This soil was placed in the Curran series because it occupied too small an acreage to justify mapping it in a new series. It differs from Curran silt loam, 0 to 2 percent slopes, in that it occurs on undulating relief. It also has a thicker, grayish-brown or brownish-gray layer immediately below the upper surface, or A_1, layer.

Representative profile.[1]—The uppermost 11 inches is dark-gray, friable silt loam. The 11- to 22-inch layer, which is the A_2 horizon, is also friable silt loam but is grayish brown to brown and mottled with dark brown to dark yellowish brown. Between depths of 22 and 60 inches is grayish-brown, heavy silty clay loam or light silty clay that has many dark-brown to yellowish-brown mottles. Below a depth of 60 inches is gray, friable to firm, light silty clay that has many dark yellowish-brown mottles.

Control of runoff from higher lying areas is a problem during wet years. Diversion terraces, constructed at the foot of the uplands just above this soil, will protect it from runoff and seepage waters.

[1] See the section, Formation and Classification of Soils, for a more detailed description of the profile of this soil.

Edina Series

The soils of the Edina series occur on tabular divides in association with soils of the Haig series. The relief is level to slightly depressed. These soils have developed from moderately thick loess under a cover of grass.

Representative profile.—The 8-inch surface layer is very dark brown, friable silt loam. The 8- to 18-inch layer is very dark gray to dark gray, friable silt loam. Between depths of 18 and 32 inches is very dark gray to dark grayish brown, very firm, medium silty clay that has a few, medium, distinct mottles of strong brown. Below a depth of 32 inches is olive-gray, firm, heavy silty clay loam, but there is a gradual transition, with depth, to friable, light silty clay loam. Many iron-manganese concretions and yellowish-brown mottles are in this layer.

Edina silt loam (Ea).—This soil, the only member of the Edina series in Jefferson County, occurs in most of the townships. The profile is the same as that described for the Edina series.

The capacity of this soil to supply plant nutrients is moderate to low. Need for lime and fertilizer should be determined by soil tests. The subsoil is often wet and is not well suited to the best growth of plants. Improved drainage is the principal management need. Ordinary tile drains may not work well because of the tight subsoil. It is well to use surface drains where feasible. The rotation should include 1 year of legume-grass meadow. Erosion is not a problem.

Gara Series

The soils of the Gara series are moderately dark colored and are well drained to moderately well drained. They occur on rolling to hilly topography. They have developed from glacial till under two types of vegetation, grass during the early stage of their development and trees during the later stage. Most of the Gara soils lie between the loessal soils of the interstream divides and the soils of the Nodaway-Gravity-Wabash complex.

The capacity of the Gara soils to supply plant nutrients ranges from moderate to low. Need for lime and fertilizer is best determined by soil tests. The subsoil is only moderately favorable for the growth of plants. Keeping the soil fertile and preventing losses of soil and water are the principal management requirements. In areas that are cropped, it is best to include at least 2 years of grass-alfalfa meadow in the rotation and only 1 year of corn and 1 year of oats, even if erosion control practices are applied.

Representative profile.—The uppermost layer, 11 inches thick, is friable loam that is colored black in the upper part and is a mixture of very dark gray and dark brown in the lower part. The 11- to 35-inch layer is very firm, gritty, medium silty clay loam to light silty clay. It is predominantly dark brown and dark grayish brown, but in places it has mottles of reddish brown or strong brown in the lower part. Below a depth of 35 inches is mottled yellowish-brown, gray, and strong-brown, firm, medium clay loam containing some black iron-manganese concretions.

Gara loam, 9 to 14 percent slopes (Ga).—This soil occurs on rolling areas next to drainageways. The profile is similar to the representative profile described for the Gara series.

Control of erosion is the main management problem because the subsoil is fine textured and slowly permeable. A system of terraces should be established, the fields stripcropped, and a suitable rotation used to prevent erosion and to conserve water.

Gara loam, 9 to 14 percent slopes, moderately eroded (Gb).—In some places the surface layer of this soil has been removed through erosion and the yellowish-brown subsoil is exposed. Otherwise, the profile is similar to the profile described for the Gara series. This soil is used and managed in about the same way as Gara loam, 9 to 14 percent slopes, but it requires more intensive use of good management practices.

Gara loam, 14 to 24 percent slopes (Gd).—Except that the surface layer is only about 8 inches thick in most places, the profile of this soil is similar to the profile described for the Gara series.

This soil is best used for pasture, as woodland, or as habitats for wildlife. Areas on the lesser slopes that must be cultivated require careful management to prevent erosion. The management should include stripcropping and tilling on the contour. At least 3 years of alfalfa-bromegrass meadow are needed in the rotation.

Gara loam, 14 to 24 percent slopes, moderately eroded (Ge).—The profile of this soil is similar to the profile described for the Gara series except that the surface layer is only about 4 to 6 inches thick in most places. The soil is used and managed in about the same way as Gara loam, 14 to 24 percent slopes.

Gara soils, 9 to 14 percent slopes, severely eroded (Gc).—In general, the profile of this soil is similar to the profile described for the Gara series, but much of the surface layer has eroded away. Only about 1 to 4 inches of surface soil remains. Because of the risk of further erosion, this soil is best used for pasture, as woodland, or as habitats for wildlife. In areas that must be cultivated, it is well to include several years of meadow in the rotation, to stripcrop, and to till on the contour. For good yields the fertility of the soil must be improved.

Givin Series

The soils of the Givin series occur on nearly level divides, primarily in Polk, Black Hawk, Penn, and Walnut Townships. The relief is nearly level to undulating. These soils were formed from moderately thick loess under a mixture of grass and forest. The forest encroached on the original vegetation of prairie grasses.

The capacity of the Givin soils to supply plant nutrients is high. Need for lime and fertilizer should be determined by soil tests. These soils are well suited to crops, and the subsoil favors good root growth.

Representative profile.—The uppermost 8 inches is black to very dark gray, friable silt loam. The 8- to 14-inch layer is dark-gray, friable silt loam that has a few, fine, faint mottles of strong brown. Between depths of 14 and 40 inches is dark grayish-brown to grayish-brown, firm, heavy silty clay loam mottled with strong brown and yellowish brown and containing black iron-manganese concretions. Below a depth of 40 inches is olive-gray, slightly firm, light silty clay loam mottled with strong brown and yellowish brown and containing black iron-manganese concretions.

Givin silt loam, 0 to 2 percent slopes (Gf).—This soil occurs on nearly level tabular divides. The profile is similar to the representative profile described for the Givin series except that in places the surface layer is somewhat thicker and the subsoil is darker gray.

Keeping the soil fertile and preventing the structure of the soil from deteriorating are the main management needs. The control of erosion is not a problem.

Givin silt loam, 2 to 4 percent slopes (Gg).—This soil occupies undulating areas on the tabular divides. The profile is similar to the profile described for the Givin series.

Maintaining the fertility and structure of the soil are the principal management needs. In addition, erosion should be controlled by tilling on the contour, terracing, and using a rotation that includes the growing of a meadow crop once every 3 or 4 years.

Gosport Series

The soils of the Gosport series have a thin surface layer and a slowly permeable clay subsoil. They occupy rolling to hilly areas along some of the large streams. The soils have developed from shale under a cover of forest. The shale is modified in the upper soil layers by a mixture of loess and glacial drift. In places, lenses of sandstone and limestone occur. Most of these lenses are thin, and they constitute only a small part of the soil material, except in small localized areas.

The capacity of the Gosport soils to supply plant nutrients is low. Need for lime and fertilizer is best determined by soil tests. Some rolling areas are cultivated, but most of the areas are used for pasture or forest. The soil is erodible, and cultivated fields require erosion control measures that will keep losses of soil and water at a minimum.

Representative profile.—The uppermost 6 inches is very dark gray to dark gray, friable silt loam that contains a considerable amount of fine sand. The 6- to 15-inch layer is dark grayish-brown to yellowish-brown, firm silty clay or clay that has some yellowish-brown mottlings on the peds.[2] The 15- to 30-inch layer is brown, very firm clay showing strong-brown or yellowish-brown to dark reddish-brown mottles. Below this layer is clay shale.

Gosport silt loam, 9 to 14 percent slopes (Gh).—The profile of this soil is similar to the representative profile described for the series. The soil is relatively shallow, however, and has a high proportion of clay in the subsoil. Some areas are cultivated, but the soil is not suited to row crops. It is best used for permanent pasture or as woodland.

[2] Structural aggregates, or lumps, of soil.

Gosport silt loam, 14 to 24 percent slopes (Gk).—Except that this soil has little or no subsoil, it is similar to the profile described for the Gosport series. The soil is generally underlain by shale parent material at a depth of about 20 inches. Most of this soil is used for permanent pasture or as woodland.

Gravity Series

In the Gravity series are dark-colored prairie soils that have developed on alluvial fans. The parent material was washed from soils that were derived from till and loess.

Representative profile.—The topmost 10 inches of the 32-inch surface layer is very dark grayish-brown, friable silt loam that represents recent overwash. The next 22 inches of the surface layer is black, friable to slightly firm, light to medium silty clay loam. From depths of 32 inches to below 45 inches is black to very dark gray, firm, heavy silty clay loam that has a few, fine, faint mottles of dark brown.

Gravity silty clay loam, 2 to 4 percent slopes (Gm).—This soil occurs along drainageways in all of the townships except Polk. Its profile is the same as the representative profile described for the Gravity series.

The capacity of this soil to supply plant nutrients is moderate to high. Need for lime and fertilizer should be determined by soil tests. Since this soil is undulating, sheet erosion is not a serious problem, but gully erosion is more difficult to control. The areas occur at the bases of slopes and are sometimes wet. Most of the excess water runs off the surface or drains down through the soil, but in some cultivated fields artificial drainage is needed. Diversion terraces will intercept runoff from the higher lying areas and prevent the soil from becoming too wet. These terraces, along with grassed waterways, help to prevent gully erosion.

The few large areas of this soil can be cropped intensively if suitable practices are used to maintain productivity. Most of the areas, however, are too narrow to be used and managed separately, and they are farmed in the same way as the surrounding soils. (Consult the soil map at the back of the report to determine what soils are adjacent to Gravity silty clay loam, 2 to 4 percent slopes, identified by map symbol Gm).

Grundy Series

The soils of the Grundy series have a dark-colored surface layer and a mottled, light to medium silty clay subsoil (fig. 7). Relief is nearly level to gently sloping. The soils occur on the edges of flat-topped divides and on side slopes just above the Adair and Shelby soils. The Grundy soils have formed from moderately thick loess.

Where these soils occur on the nearly level ridgetops, little of the dark-colored surface layer has been lost through erosion. On some of the more sloping areas, however, much of the original surface layer has washed away. The fine-textured subsoil somewhat restricts the development of roots and the movement of air and water that is needed for the best growth of plants. The capacity of these soils to supply plant nutrients is high. Need for lime and fertilizer should be determined by soil tests.

Control of erosion and improvement of drainage are primary management problems on some of the soils. Much of the erosion has resulted from the practice of cultivating up and down the slope. Contour tillage, along with the use of appropriate supporting practices, could prevent much of the yearly loss of soil. Contour lines should be given a slight grade so that excess water will drain off.

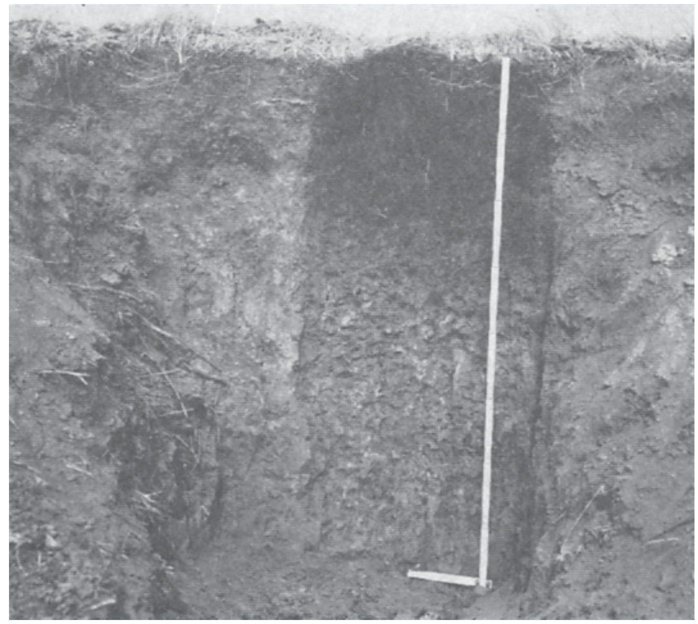

Figure 7.—**Profile of a Grundy silty clay loam.**

Representative profile.—The 12-inch surface layer is very dark brown, friable, light silty clay loam. The 12- to 28-inch layer is very dark grayish-brown to dark grayish-brown, firm to very firm, light silty clay to medium silty clay that is mottled with dark yellowish brown, light olive brown, and strong brown. Below a depth of 28 inches is grayish-brown, firm, heavy silty clay loam that is transitional with depth to friable, light silty clay loam; there are many, coarse, prominent mottles and stains of light olive brown and olive brown.

Grundy silty clay loam, 0 to 2 percent slopes (Gn).—This soil occurs on the edges of narrow, irregular tabular divides in association with the Haig soil. The profile is similar to the representative profile described for the Grundy series except that in places the dark surface layer is as much as 15 inches thick.

This soil is well suited to the crops commonly grown. In wet years adequate drainage is needed. Control of erosion is not a problem.

Grundy silty clay loam, 2 to 5 percent slopes (Go).—This soil occurs on the edges of the tabular divides. It has a profile similar to that described for the Grundy series except that in places the surface layer is only 9 to 12 inches thick.

This soil is well suited to crops. Erosion can be controlled by contour tillage, but the contour lines should be given a slight grade to permit excess water to drain away and to prevent waterlogging in the wetter seasons.

Grundy silty clay loam, 5 to 9 percent slopes (Gp).—This soil is on side slopes just above soils formed from glacial till. The profile is similar to the profile described for the Grundy series except that the surface layer is not so thick. Erosion has removed some of the surface soil, but about 8 inches of surface soil remains. This soil is well suited to crops, but terracing and contouring should be used to prevent further loss of soil.

Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded (Gr).—This soil occurs on side slopes just above soils formed from glacial till. Except that erosion has removed all but 4 to 6 inches of the surface layer, the profile of this soil is similar to the profile described for the Grundy series. When the soil is plowed, the remaining part of the surface layer is mixed with the upper part of the subsoil, causing the plow layer to be lighter colored than that of the less eroded Grundy soils.

This soil is well suited to crops, but it requires terracing and contouring to keep the remaining surface soil from eroding.

Hagener Series

The soils of the Hagener series lie on or next to bottom lands of the Skunk River. They also occur at the bases of slopes where relief is rolling to hilly. They have developed largely from loose eolian (windblown) sand, but in some areas the sand is mixed with silt. The soils formed under a cover of grass.

The Hagener soils are subject to erosion by wind and water. They have a low water-holding capacity and are droughty.

Representative profile.—The uppermost 20 inches is very dark grayish-brown, loose, noncoherent loamy fine sand. The 20- to 30-inch layer is dark-brown, loose, noncoherent fine sand. Between depths of 30 and 50 inches is dark yellowish-brown loose fine sand.

Hagener loamy fine sand, 2 to 5 percent slopes (Ha).—This soil has a profile similar to the representative profile described for the Hagener series except that in places the surface layer is thicker.

The soil is droughty, and it is likely to be damaged by wind erosion. Maintenance of organic matter is a problem. Management practices needed are contouring, stripcropping, and the growing of meadow crops for at least 2 years in a 4- to 5-year rotation.

Hagener loamy fine sand, 5 to 15 percent slopes (Hb).—The profile of this soil is similar to the representative profile described for the Hagener series.

This droughty soil is subject to erosion by wind and water. Maintaining the supply of organic matter is a problem. Suggested management practices are contouring, stripcropping, and the growing of meadow crops for at least 2 years in a 4- to 5-year rotation. This soil requires more intensive use of good management practices than Hagener loamy fine sand, 2 to 5 percent slopes.

Haig Series

The soils of the Haig series have developed under a cover of grass. The parent material was loess.

Representative profile.—The uppermost 14 inches is black, slightly firm, light silty clay loam. Between depths of 14 and 34 inches is very dark gray to olive gray, very firm, medium to light silty clay with a few mottles of yellowish brown to dark grayish brown or olive brown. Below a depth of 34 inches is olive to light olive-gray, firm, medium to light silty clay loam that has a few dark olive-gray to olive-gray stains on root channels and a few yellowish-brown mottles.

Haig silty clay loam (Hc).—This dark-colored, poorly drained soil occurs on nearly level uplands. It is in all the townships, but in the northwestern part of the county it occurs only on the narrower irregular ridges. The occurrence of the Haig soil on the upland flats in the Taintor-Mahaska general soil area (see fig. 2 in the section, General Soil Areas) represents a deviation from the general distribution of the Haig soil. Haig silty clay loam is the only soil of the Haig series mapped in Jefferson County. The profile of this soil is the same as the profile described for the Haig series (fig. 8).

***Figure 8.*—Profile of Haig silty clay loam.**

The capacity of this soil to supply plant nutrients is high. Need for lime and fertilizer is best determined by soil tests. The subsoil is often too wet for the best growth of plants; the development of roots is somewhat restricted.

Improvement of fertility and drainage are the chief management problems. Tile drains do not work well, because the soil is slowly to very slowly permeable at depths between 17 and 34 inches. Control of erosion is not a problem.

Jackson Series

The soils of the Jackson series occur on terraces, or second bottoms, along the larger streams in Jefferson County. The relief is nearly level to undulating. These soils have developed under forest from materials deposited by water.

The capacity of these soils to supply plant nutrients is moderate. Their need for lime and fertilizer is best determined by soil tests.

Representative profile.—The 10-inch surface layer is very dark gray, friable loam. Below this is about 6 inches of grayish-brown, friable silt loam showing yellowish-brown mottles. Between depths of 16 and 40 inches is dark grayish-brown to strong-brown, firm, heavy to light silty clay loam that, when removed, breaks to blocky pieces, coated with gray material; yellowish-brown to olive-gray mottles are present. Below a depth of 40 inches is gray, friable loam that has many, coarse, prominent mottles of yellowish brown and olive gray.

Jackson loam, 0 to 2 percent slopes (Ja).—This soil occurs on nearly level areas of the second bottoms. The profile is similar to the representative profile described for the Jackson series except that in places the surface layer is slightly thicker and the subsoil is slightly finer in texture.

A good rotation for this soil will include 1 year of legume-grass meadow. Adequate drainage systems are needed. Erosion control is not a problem.

Jackson loam, 2 to 5 percent slopes (Jb).—This soil is on undulating areas of the second bottoms. The profile is similar to the profile described for the Jackson series.

Control of erosion is the primary management need. This can be done by contouring and terracing. A legume-grass meadow should be used for 1 or 2 years in the rotation.

Kato Series

The soils of the Kato series are dark colored and imperfectly drained. They have developed from alluvial parent materials of loam to light silty clay loam texture, generally underlain by sand. These soils were formed under prairie grasses.

Representative profile.—The 15-inch surface layer is very dark gray, friable, light silty clay loam. The 15- to 45-inch layer is very dark gray to dark brown, slightly firm, light silty clay loam showing many, medium, prominent mottles of yellowish brown; there are a few dark iron-manganese concretions in the lower 13 inches. Below a depth of 45 inches, the soil material is transitional to brown, slightly firm, light silty clay loam that has many, fine, prominent mottles of yellowish brown.

Kato silty clay loam, deep over sand (Ka.)—This soil is the only member of the Kato series in this county. Most of it occurs on terraces along Cedar Creek. The profile is the same as the one described for the Kato series. The areas are level to nearly level and lie only a few feet above the first bottoms. They are flooded occasionally when the water is high.

The capacity of this soil to supply plant nutrients is moderate to high. Lime and fertilizer are best applied according to needs determined by soil tests. Surface ditches will provide drainage for areas that are inadequately drained. A 4-year rotation, including 1 year of meadow, is desirable to keep yields of crops high. Erosion control is not a problem.

Keomah Series

The soils of the Keomah series have undulating relief. They are in the northeastern part of the county, primarily in Penn and Walnut Townships. These soils occur on long, narrow tabular divides and on terraces, or benches, along the larger streams. They have developed from moderately thick loess under a cover of deciduous forest.

The capacity of these soils to supply plant nutrients is moderate to low. Need for lime and fertilizer should be determined by soil tests. The subsoil is favorable for the best growth of plants, but it is not so favorable as that of the Mahaska, Kato, and Waukegan soils. Erosion is not difficult to control.

Representative profile.—The surface layer, 5 inches thick, is very dark gray, friable silt loam. Beneath this layer is 6 inches of dark grayish-brown, friable silt loam that has a few, fine, faint mottles of strong brown and yellowish brown and a few, fine iron-manganese concretions. Between depths of 10 and 40 inches is dark grayish-brown and grayish-brown, firm, light silty clay to heavy silty clay loam; this material breaks to blocklike aggregates when removed. These aggregates are coated with gray, and they have common, medium, prominent mottles of strong brown. Below a depth of 40 inches is gray, friable, light silty clay loam that has many, medium, prominent mottles of strong brown and many black iron-manganese concretions.

Keomah silt loam, 2 to 5 percent slopes (Kb).—This soil has a profile similar to the profile described for the Keomah series. Controlling erosion and maintaining the supply of organic matter are the primary management needs. Simple contouring and terracing will help prevent erosion. Meadow crops grown 1 year in a 4-year rotation or 2 years in a 5-year rotation are desirable for this soil.

Keomah silt loam, bench position, 2 to 5 percent slopes (Kc).—This soil is similar to Keomah silt loam, 2 to 5 percent slopes, except that it occurs on benches above the flood plains. It lies along the larger streams. The profile is similar to the profile described for the series. This soil is used and managed in about the same way as Keomah silt loam, 2 to 5 percent slopes.

Ladoga Series

The soils of the Ladoga series are on the slopes that border the flat-topped divides or form the rounded crests and flanks of ridges. They occur in small, scattered areas in the northern part of the county in Polk, Black Hawk, Penn, and Walnut Townships. Most of the Ladoga soils are undulating to rolling. These soils have developed from moderately thick loess under the influence of a mixed grass and forest vegetation.

The capacity of the Ladoga soils to supply plant nutrients is moderate. Need for lime and fertilizer is best determined by soil tests. The control of erosion is difficult on the more strongly sloping areas.

Representative profile.—The uppermost 8 inches is very dark gray, friable, heavy silt loam. The 8- to 42-inch layer is transitional from dark yellowish-brown, light to medium silty clay loam to dark yellowish-brown to dark-brown, heavy silty clay loam or light silty clay; this material breaks to blocky pieces that are coated with light brownish gray. The lower part of this layer is mottled strong-brown and olive-gray, slightly firm, light silty clay loam. Below a depth of 42 inches is olive-gray, friable, heavy silt loam that has many, coarse, distinct mottles of strong brown.

Ladoga silt loam, 2 to 5 percent slopes (La).—This soil occurs on the edges of the tabular divides or on the rounded ridgetops. The profile is similar to the representative profile described for the Ladoga series.

Contour farming will help prevent the loss of soil and water through erosion. The areas of this soil are small and scattered; consequently, the rotation used will depend largely on the other soils that occur in the same fields. At least 1 year of alfalfa-grass meadow, however, is needed in the rotation.

Ladoga silt loam, 5 to 8 percent slopes (Lb).—This soil occurs in small areas just above areas of Gara and Lindley soils. It has a profile similar to the one described for the Ladoga series.

Terracing, stripcropping, and contouring, along with the use of suitable rotations, are needed to help prevent losses of soil and water. Although the crops to be grown will depend largely on the other soils in the field, at least 1 year of alfalfa-grass meadow is needed in the rotation.

Ladoga silt loam, 5 to 8 percent slopes, moderately eroded (Lc).—The profile of this soil is similar to the profile described for the Ladoga series except that in most places the surface layer is only 3 to 6 inches thick. The plow layer now consists of a mixture of dark-gray surface soil and yellowish-brown subsoil material. The use and management suggestions described for Ladoga silt loam, 5 to 8 percent slopes, apply to this soil.

Lindley Series

The soils of the Lindley series occur in all the townships. The larger areas are in the eastern and southern parts of the county. The soils have developed on the slopes that border drainageways in the timbered part of the county. They are associated with the higher lying Clinton and Weller soils, which lie on the ridgetops and upper slopes. The relief is rolling to steep. These soils have formed under forests from moderately fine textured Kansan till.

The capacity of these soils to supply plant nutrients is low. Need for lime and fertilizer is best determined by soil tests. The control of erosion is a major problem.

Representative profile.—The surface layer, 8 inches thick, is dark grayish-brown to pale-brown, very friable loam. Beneath this is 22 inches of yellowish-brown, firm clay loam showing a few, fine, faint mottles of very pale brown in the lower part of the layer. Below a depth of 30 inches is yellowish-brown, firm clay loam that has many, medium, faint mottles of pale brown to pale yellow.

Lindley loam, 9 to 14 percent slopes (Lf).—In general, the profile described for the Lindley series applies to this soil. The slopes range from 9 to 14 percent, but the dominant range is 10 to 12 percent. This soil, like other Lindley soils that have rolling relief, is well drained.

The control of erosion is the primary management need. Contouring, stripcropping, and terracing will help check the loss of soil. Suitable rotations of 4 to 5 years will include at least 2 years of meadow crops.

Lindley loam, 9 to 14 percent slopes, moderately eroded (Lg).—Except that the surface layer is only about 4 to 6 inches thick, the profile of this soil is similar to the profile described for the Lindley series. The use and management needs for this soil are about the same as those described for Lindley loam, 9 to 14 percent slopes.

Lindley loam, 14 to 25 percent slopes (Lh).—The profile of this soil differs from the profile described for the Lindley series in that the surface layer is only about 7 inches thick.

Because this soil occurs on steep slopes and is subject to erosion, it is best used for pasture, woods, or as habitats for wildlife.

Lindley loam, 14 to 25 percent slopes, moderately eroded (Lk).—The profile of this soil is similar in most characteristics to the profile described for the Lindley series, but the surface layer is only about 3 inches thick. Use and management suggested for Lindley loam, 14 to 25 percent slopes, apply to this soil.

Lindley loam, 25 to 35 percent slopes (Lm).—The profile of this soil is similar to the profile described for the Lindley series, but the surface layer is only about 5 inches thick. This soil occurs on steep slopes that are unsuited to cultivation. It can be used for permanent pasture, woods, or as habitats for wildlife.

Lindley soils, 9 to 14 percent slopes, severely eroded (Ld).—In general, the profile description of the Lindley series applies to this soil, but much of the surface layer has been lost through erosion. Only about 1 to 4 inches of the surface soil remains.

This soil is not suited to crops and is best used for woods or pasture. Areas that must be cultivated need maximum protection against further erosion, and the fertility of the soil must be improved. The slopes need to be cultivated on the contour and stripcropped.

Lindley soils, 14 to 25 percent slopes, severely eroded (Le).—In most characteristics the profile of this soil is similar to the profile described for the Lindley series. Most of the original surface layer, however, has been removed through erosion. The areas are steep and severely eroded. They are best used for permanent pasture, woods, or as habitats for wildlife.

Mahaska Series

The soils of the Mahaska series have a thick, dark-colored surface soil of light silty clay loam and a subsoil of grayish-brown, heavy silty clay loam. They occur on tabular divides and on undulating areas next to the divides. The areas are in the northern part of the county. The Mahaska soils have formed under prairie grasses from moderately thick loess.

These soils are among the most productive in the State of Iowa. Their capacity to supply plant nutrients is high. They have a good supply of organic matter and nitrogen. The subsoil is favorable for the best growth of plants. Need for lime and fertilizer is best determined by soil tests.

Representative profile of uneroded soil.—The 14-inch surface layer is very dark brown, friable, light silty clay loam. Between depths of 14 and 40 inches is very dark grayish-brown to olive-gray, firm, heavy silty clay loam to light silty clay with light olive-brown mottling. Below a depth of 40 inches is light olive-gray, friable silt loam.

Mahaska silty clay loam, 0 to 2 percent slopes (Ma).—This soil occurs on narrow tabular divides in association with the Taintor soils. The profile is similar to the representative profile described for the Mahaska series except that the surface layer is 12 to 16 inches thick.

This productive soil has rather simple management requirements. The supply of organic matter should be maintained, and the structure of the soil kept from deteriorating. It is desirable to include 1 year of legume-grass meadow in the rotation. Erosion control is not a problem on this soil.

Mahaska silty clay loam, 2 to 4 percent slopes (Mb).—This soil occupies undulating areas adjacent to the tabular divides. The profile is similar to that described for the Mahaska series except that the surface layer is 10 to 15 inches thick. Although some of the surface soil has been removed through erosion, it still extends below plow depth.

This soil is well suited to the crops commonly grown. The control of erosion is necessary. A short rotation that includes meadow crops is required. If erosion is controlled, corn will produce high yields in a rotation consisting of 2 years of corn, 1 year of oats, and 1 year of meadow.

Nodaway Series

The soils of the Nodaway series have developed from silty or loamy water-laid materials. They are moderately light to moderately dark colored, friable soils. The Nodaway soils are relatively young and show characteristics inherited from their parent materials. Layers of alluvial deposits can be seen in exposed vertical sections of these soils.

Representative profile.—The uppermost 20 inches is very dark grayish-brown to dark grayish-brown, friable silt loam with traces of yellowish-brown mottling in the lower 8 inches. Between depths of 20 and 40 inches is very dark grayish-brown or grayish-brown, friable silt loam or very fine sandy loam that has some yellowish-brown mottling and a few splotches of light gray or pale brown.

Nodaway silt loam (Na).—This soil occurs on the bottom lands of Cedar Creek and the Skunk River and along the smaller streams. The profile is the same as the representative profile described for the Nodaway series.

Much of the acreage is in one area, not more than one-fourth mile wide, that lies next to the original channel of Cedar Creek. Broader areas are on the flood plain of the Skunk River.

Streams often overflow onto this soil. Flooding has been controlled in many places by straightening the stream channels and constructing levees and drainage ditches. Internal drainage is good in most places, but in others open ditches are needed to remove the excess surface water. Where surface drainage and flooding are no longer a problem, this soil is suited to cultivation. Need for lime and fertilizer can be determined by soil tests. Areas that are still frequently flooded are best used for pasture or timber.

Nodaway-Gravity-Wabash Complex

Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes (Nb).—The soils of this complex are intermingled in such an intricate pattern that they cannot be separated at the scale of mapping used on the soil map. This soil complex occurs in all parts of the county, principally along the smaller drainageways. The soils have formed from material washed down from light-colored and dark-colored areas of loess and till. Some of the material was deposited recently—some of it centuries ago. The color, texture, and thickness of the soil layers and the degree of mottling are variable.

The capacity of these soils to supply plant nutrients is moderate to high. Gully erosion is a serious problem because the drainageways carry large amounts of water during heavy rains, and gullying results. Most areas need grass sod in the waterways. Where gullies have already formed, it may be difficult to establish an effective grass waterway. Areas of these soils are too small to be managed separately and are best used in the same way as the adjacent soils. (Consult the soil map in the back of the report to determine what soils lie next to Nodaway-Gravity-Wabash complex, 2 to 4 percent slopes, which is identified by map symbol Nb.)

Representative profile of the Nodaway soil.—The uppermost 24 inches is very dark brown, friable material that contains lenses of dark-gray to gray silt loam, one-fourth inch thick. Below a depth of 24 inches is black or very dark gray, friable, light silty clay loam.

Representative profile of the Gravity soil.—The uppermost 18 inches is brown to very dark brown, friable, light to medium silty clay loam that has a few dark-brown mottles in the lower 10 inches. Below a depth of 18 inches is dark-gray to light olive-brown, friable, medium silty clay loam with some grayish-brown and yellowish-brown mottles.

Representative profile of the Wabash soil.—The uppermost 10 inches consists of stratified very dark gray, friable silt loam that has recently been deposited. Between depths of 10 and 35 inches is black, firm, medium to light silty clay. Below a depth of 35 inches is very dark gray, firm, medium silty clay.

Otley Series

In the Otley series are moderately well drained, dark-colored soils that have a subsoil of firm, heavy silty clay loam. They are on undulating to gently rolling uplands in the northern part of the county. Most of the areas lie on slopes below or alongside the Mahaska soils and above the Adair and Shelby soils. The soils have formed under prairie from a moderately thick layer of loess.

The capacity of these soils to supply plant nutrients is high. Need for lime and fertilizer is best determined by periodic soil tests. The subsoil is favorable for the growth of plants. The control of erosion is necessary.

Representative profile.—The surface layer, 9 to 12 inches thick, is very dark brown to dark brown, friable, light silty clay loam. Between depths of 12 and 42 inches is brown to light brownish-gray, firm, heavy silty clay loam that has some strong-brown and olive-brown mottles. Below a depth of 42 inches is light brownish-gray, friable silt loam or light silty clay loam with dark yellowish-brown mottles.

Otley silty clay loam, 2 to 4 percent slopes (Oa).—This soil occurs on or near the crests of ridges, generally adjacent to the Mahaska soils. The profile is similar to the representative profile described for the Otley series except that the surface layer is 12 to 15 inches thick.

This soil is well suited to crops. Erosion is a problem, but it can be controlled by contouring and terracing.

Otley silty clay loam, 4 to 8 percent slopes (Ob).—This soil occupies side slopes just above soils of either the Adair or Shelby series. The profile is similar to the profile described for the Otley series, but the surface layer is not so thick.

This soil is well suited to crops, but it needs to be protected from erosion. Terracing, contouring, or stripcropping are needed, and meadow crops should be grown for at least 1 year in a 4-year rotation.

Otley silty clay loam, 4 to 8 percent slopes, moderately eroded (Oc).—This soil lies on side slopes just above either the Adair or Shelby soils. Except that most of the surface layer has been removed through erosion, the profile is similar to that described for the Otley series.

Erosion is a serious problem. Terracing, contouring, or stripcropping is needed, and meadow crops should be grown for at least 1 year in a 4-year rotation.

Pershing Series

The soils of the Pershing series occur in all the townships but principally in those in the southern part of the county. They are on tabular divides and on slopes that extend either to the waterways or to areas of Lindley, Gara, or Shelby soils, which have formed on glacial till. The Pershing soils have developed from moderately thick loess under the influence of a mixture of sparse forest and grass vegetation.

The capacity of these soils to supply plant nutrients is moderately low to low. Need for lime and fertilizer is best determined by soil tests. The subsoil is only moderately favorable for the growth of plants. The control of sheet erosion is a problem, especially on the more strongly sloping areas.

Representative profile.—The 8-inch surface layer is very dark grayish-brown to grayish-brown, very friable silt loam. The 8- to 13-inch layer is brown, friable silty clay loam. Between depths of 13 and 30 inches is mottled yellowish-brown, firm, medium silty clay. The 30- to 45-inch layer is grayish-brown, friable, light silty clay that, with depth, becomes transitional to heavy silty clay loam; there are many, medium, distinct mottles of yellowish brown and brownish yellow. Below a depth of 45 inches is mottled grayish-brown and brownish-yellow, friable, light silty clay loam.

Pershing silt loam, 2 to 4 percent slopes (Pa).—This soil occurs on tabular divides in areas that are transitional between timber and prairie. The relief is undulating. The profile of this soil is similar to the representative profile described for the Pershing series.

Tilth is not a problem on this soil if the rotation includes at least 1 year of a grass-alfalfa meadow. Contouring and terracing will help to keep to a minimum the losses of soil through erosion. If the annual rainfall is above normal, wetness is a problem.

Pershing silt loam, 4 to 10 percent slopes (Pb).—This soil occurs on gently rolling to rolling side slopes that are just below the tabular divides. The side slopes extend to the waterways or to areas of Lindley, Gara, or Shelby soils. The profile of this soil is similar to the representative profile described for the Pershing series except that, in places, the surface layer is only 4 to 6 inches thick.

The control of erosion is a serious problem. To prevent erosion, farmers should use a rotation that includes 1 or 2 years of alfalfa-grass meadow for each year of corn. Terracing, contouring, stripcropping, and using grassed waterways will help keep losses of soil and water at a minimum.

Pershing silt loam, 4 to 10 percent slopes, moderately eroded (Pc).—Except that much of the surface soil has eroded away and only 2 to 6 inches of it remains, the profile of this soil is similar to the profile described for the Pershing series. The management suggested for Pershing silt loam, 4 to 10 percent slopes, applies to this soil. The control of erosion, however, is a more serious problem.

Rough Broken and Rock Land

Rough broken and rock land (Ra).—Locally this miscellaneous land type is known as rough land or waste land. In some places it consists of outcrops of limestone and other rocks or of boulders from glacial till. In other places a thin layer of loess overlies the limestone or glacial till. Here, the soil material is light colored, shallow, and stony. The slopes range from 25 to 40 percent. Some areas of Lindley, Shelby, and Sogn soils are included in this mapping unit.

Nearly all of this land is in forest, but some of it is in grass. It is poor for pasture and trees. None of it is cultivated. In areas that are pastured, grazing must be controlled. The land is too steep and stony for farmers to apply fertilizer or mow weeds. No representative profile can be described for this miscellaneous land type.

Rubio Series

In the Rubio series are moderately dark soils that have predominantly grayish-brown, firm to very firm, medium silty clay subsoils. They have developed from moderately thick loess under a mixture of grass and forest.

Representative profile.—The 7-inch surface layer is very dark gray to dark gray, friable silt loam. The 7- to 18-inch layer is very dark gray to dark gray, friable silt loam. The 18- to 37-inch layer is dark-gray to grayish-brown, very firm, medium silty clay that has many yellowish-brown mottles and some iron-manganese concretions. Below a depth of 37 inches is firm, heavy silty clay loam that is transitional, with depth, to friable, light silty clay loam. This layer is colored with various shades of light brownish gray, light olive gray, and light gray; there are many yellowish-brown mottles and a few dark iron-manganese concretions.

Rubio silt loam (Rb).—This soil, the only one of the Rubio series mapped in the county, occupies small, nearly level areas. It occurs in the northern part of the county. Most of it is associated with the Keomah and Givin soils. It lies on small tabular divides, mainly in areas between dark-colored and light-colored soils. The profile is the same as the profile described for the Rubio series.

The capacity of this soil to supply plant nutrients is moderate. Need for lime and fertilizer is best determined by soil tests. The subsoil is only moderately favorable for the best growth of plants. Artificial drainage is needed, but it is difficult to improve the drainage because the subsoil is slowly to very slowly permeable. The supply of organic matter should be maintained. A 4-year rotation that includes 1 year of meadow is needed.

Shelby Series

In the Shelby series are dark-colored, well drained to moderately well drained soils on slopes. The soils have developed under grass. Where they are uneroded, they have a surface soil of loam or silt loam. The subsoil is clay loam or clay. Free lime occurs at depths of 2 to 8 feet. Most of the Shelby soils lie between the Grundy or Otley soils, which are on the interstream divides, and the soils of the Nodaway-Gravity-Wabash complex or other alluvial soils. The Shelby soils have developed from weakly weathered to strongly weathered glacial till, principally of the Kansan age.

The capacity of the Shelby soils to supply plant nutrients is moderate. Need for fertilizer and lime should be determined by soil tests. Erosion control is a major problem, so these soils have limited value for cultivated crops.

Representative profile.—The uppermost 8 to 10 inches is very dark brown to very dark grayish-brown, very friable loam. Beneath this is 21 inches of dark-brown to dark yellowish-brown or light brownish-gray, firm clay loam showing some mottles of very dark brown to very dark grayish brown. Below a depth of 34 inches is light brownish-gray to yellowish-brown, firm clay loam. Pebbles occur throughout the profile.

Shelby loam, 9 to 14 percent slopes (Sb).—In most characteristics the profile of this soil is similar to the profile described for the Shelby series. Most of the slopes are between 10 and 12 percent, though the range is from 9 to 14 percent. This soil, like other Shelby soils on similar slopes, is well drained to moderately well drained.

The control of erosion is the principal management problem. Even if contouring, stripcropping, and terracing are practiced and meadow crops are included in the cropping system, row crops should not be grown oftener than about 1 year in 3.

Shelby loam, 9 to 14 percent slopes, moderately eroded (Sc).—The surface layer of this soil is only about 4 to 6 inches thick. Otherwise the profile is like that described for the Shelby series.

Even if erosion is controlled through contouring and terracing and if meadow crops are part of the rotation, row crops can be grown safely only about 1 year in 4. The rotation should include more meadow crops than are used for Shelby loam, 9 to 14 percent slopes.

Shelby loam, 14 to 20 percent slopes (Sd).—The profile of this soil differs from the profile described for the Shelby series in that the surface soil is only about 10 inches thick and the subsoil is less developed.

Because of the strong slopes, this soil is likely to be damaged by erosion. It is best suited to pasture, forest, or as habitats for wildlife and should not be cropped unless measures are taken to control erosion. If row crops are grown, the fields need to be stripcropped and tilled on the contour. The rotation should include at least 3 years of alfalfa-bromegrass meadow.

Shelby loam, 14 to 20 percent slopes, moderately eroded (Se).—Except that the surface soil is only 3 to 6 inches thick, this soil has a profile similar to the profile described for the Shelby series.

This soil is best suited to pasture, forest, and as habitats for wildlife. Areas that must be used for row crops need to be protected against further erosion. The fields should be tilled on the contour and stripcropped. A higher proportion of meadow crops is needed than on Shelby loam, 14 to 20 percent slopes.

Shelby soils, 9 to 14 percent slopes, severely eroded (Sa).—The profile of this soil is similar to the profile described for the Shelby series except that most of the original surface layer has been removed through erosion.

This soil is so eroded that it is best used for permanent meadow, pasture, or as woodland. Even if contouring, stripcropping, and terracing are practiced and if meadow crops are grown in the cropping system, row crops should not be grown oftener than 1 year in 5 or 6.

Sogn Series

The soils of the Sogn series occur in scattered areas on the steep slopes that border streams. In most places they lie below the Clinton or Weller soils. They have formed in a thin layer of loess or till that is underlain by limestone, which generally occurs at depths of between 10 and 15 inches. In some places the bedrock is limy shale. The native vegetation was a mixture of tall grasses and trees.

These soils should be used mainly for permanent pasture or trees. They are too shallow to be cultivated. Except in wet years, tilled crops are subject to severe damage by drought.

Representative profile.—The 6-inch surface layer is very dark gray, friable silt loam or loam. The next 6 inches, unlike the conventional subsoil layer, consists of parent material intermixed with fragments of soil and rock; it is dark yellowish-brown, friable silt loam that contains fragments of limestone. Below a depth of 12 inches is limestone bedrock.

Sogn silt loam, 8 to 18 percent slopes (Sf).—This rolling to hilly soil occurs in areas that are transitional between prairie and forest. The areas lie along the Skunk River and the adjacent creeks. The profile of this soil is similar to the representative profile described for the Sogn series except that the surface layer is as much as 10 inches thick.

This soil is not suitable for cultivation. It can be used for pasture, as woodland, or as habitats for wildlife.

Sogn silt loam, 8 to 18 percent slopes, moderately eroded (Sg).—The profile of this soil is similar to the profile described for the Sogn series, except that it is somewhat more eroded. The soil is unsuited to cultivation, but it is suitable for pasture, as woodland, or as habitats for wildlife.

Sogn silt loam, 18 to 35 percent slopes (Sh).—This soil has hilly to steep relief. It occurs in areas that are transitional between prairie and forest. The profile is similar to the profile described for the Sogn series.

This soil is too steep and too shallow to be cultivated and is best used for pasture, woodland, or as habitats for wildlife.

Sperry Series

The soils of the Sperry series have formed from moderately thick loess under prairie vegetation. They occupy shallow depressions.

Representative profile.—The surface layer is black to very dark brown or very dark gray, friable silt loam; the subsurface layer is dark gray. The combined thickness of these two layers is about 18 inches. Between depths of 18 and 42 inches is very dark gray to gray, firm to very firm, medium silty clay that has some yellowish-brown mottling. Below a depth of 42 inches is a mixture of gray and strong-brown, friable to slightly firm, light silty clay loam containing a few, soft, dark iron-manganese concretions.

Sperry silt loam (Sk).—This is the only Sperry soil mapped in the county. It has a moderately dark surface

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soil and a firm to very firm, medium silty clay subsoil. It resembles the Edina soil. The profile is the same as the representative profile described for the Sperry series.

This soil occurs in small depressions, chiefly in association with the soils of the Taintor series. The areas are small; few of them exceed 2 acres, and most are less than one-half acre in size. A number of the areas were too small to map separately. Some of the areas are near the heads of drainageways, and others are in the center of large flat areas.

Because this soil occurs in depressions and its medium silty clay subsoil is slowly permeable, the areas are often wet in spring. Many spots are still under shallow water when the surrounding soils are dry enough to be worked. This may delay cultivation, but since the areas are small, the problem is generally not serious.

This soil is not well suited to cultivated crops. Because the areas are located in fields that contain soils suited to cultivation, however, this soil is used for the same crops as the adjacent soils. If the total annual rainfall is not too great, fairly good yields are produced. (Consult the soil map at the back of the report to determine what soils are adjacent to Sperry silt loam, which is identified by map symbol Sk.)

Taintor Series

The soils of the Taintor series have developed from moderately thick loess under a cover of prairie grasses.

Representative profile.—The 15-inch surface layer is black, friable to slightly firm, heavy to light or medium silty clay loam. The 15- to 35-inch layer is very dark gray to dark gray, firm, light silty clay; the lower part is slightly coarser in texture. The colors of the mottles in this layer are dark grayish brown, very dark grayish brown, olive brown, light olive brown, and yellowish brown. Below a depth of 35 inches is light olive-gray, massive (structureless), slightly firm, light silty clay loam that has a few yellowish-brown stains.

Taintor silty clay loam (Ta).—This soil, the only Taintor soil mapped in the county, has a dark, moderately thick surface soil of silty clay loam and a dark-gray, light silty clay subsoil. The profile is the same as the profile described for the Taintor series. Most of this soil occurs in the northwestern, central, and southern parts of the county. It lies mainly on the broad, level tabular divides between the Skunk River and Cedar Creek.

If fields are tile drained, the subsoil is favorable for the growing of plants. The areas in the northern part of the county differ from those in the southern part in having slightly less clay in the subsoil. As a result, the northern areas are slightly more favorable for plant growth.

The capacity of this soil to supply plant nutrients is moderately high. Need for lime and fertilizer is best determined by periodic soil tests. The principal management needs are to maintain adequate drainage systems, to keep good tilth in the surface soil, and to keep the soil fertile. Control of erosion is not a problem.

Wabash Series

The soils of the Wabash series have formed from fine-textured materials deposited by streams.

Representative profile.—The surface layer, 16 inches thick, is black, firm to very firm, medium silty clay. The 16- to 35-inch layer is black, firm, medium to light silty clay that has a few dark-brown, strong-brown, and brown mottles and a few black iron-manganese concretions. Below a depth of 35 inches is a layer of very dark gray, firm, light silty clay showing brown mottling.

Wabash silty clay (Wa).—This is the only Wabash soil mapped in Jefferson County. Its profile is the same as the profile described for the Wabash series. This soil is not extensive. It lies in small flats or depressions on the bottom lands. A few areas are along Cedar Creek in the southwestern corner of Locust Grove Township. Others lie along the Skunk River in the extreme southeastern part of Walnut Township and in the extreme northeastern corner of Lockridge Township.

The areas are frequently flooded and are often wet. Draining the soil is a problem because tile drains do not work efficiently. Most of the areas are nearly as low as the stream so that drainage outlets are poor or lacking.

The capacity of this soil to supply plant nutrients is moderately high. The soil is not used much for crops, however, because of wetness and the risk of flooding. If it is cropped, the rotation that is used for adjoining soils probably will be used. A rotation consisting of 2 years of corn, 1 year of oats, and 1 year of meadow is suitable.

Waukegan Series

The soils of the Waukegan series have formed from alluvium. The native vegetation was prairie grasses.

Representative profile.—The 10-inch surface layer is very dark gray, friable loam. Beneath this is 23 inches of dark grayish-brown to brown, friable, heavy silt loam or loam that has some yellowish-brown mottling in the lower 9 inches. Below a depth of 33 inches is stratified dark yellowish-brown to yellowish-brown, friable loam and sandy loam.

Waukegan loam, deep over sand (Wb).—This is the only soil of the Waukegan series mapped in the county. The profile is the same as the representative profile described for the Waukegan series. The total acreage is small, and most of it is concentrated along the bottom lands of the Skunk River, in sections 1, 2, and 12 of Lockridge Township. The relief is level to nearly level; slopes range from 0 to 2 percent. Although the soil lies only a few feet above the stream, it is flooded only when the water is extremely high.

The capacity of this soil to supply plant nutrients is moderate. Need for lime and fertilizer is best determined by soil tests. For good yields, a rotation that includes 1 year of a grass-legume meadow is suitable. Erosion control is not a problem.

Weller Series

The soils of the Weller series occur mainly in the southern part of the county. They occupy the slopes adjacent to the level ridgetops just above the Lindley soils, which were formed from glacial till. In some places the Weller soils extend from the tabular divides to the streams. These soils have undulating to rolling relief. They have developed under forest from moderately thick, fine-textured loess (fig. 9).

The capacity of these soils to supply plant nutrients is low. In general the upper soil layers are strongly acid.

Figure 9.—**Upper part of this roadcut shows a profile of a Weller silt loam, a soil derived from loess. In lower part the loess is underlain by Kansan till.**

Need for lime and fertilizer is best determined by soil tests.

Representative profile.—The uppermost 6-inch layer is very dark gray to dark brown, friable silt loam. The 6- to 15-inch layer is dark-gray to dark-brown, friable silt loam. Between depths of 15 and 48 inches is dark grayish-brown to dark-brown, very firm, medium to light silty clay that is mottled with dark brown and strong brown. Below a depth of 48 inches is mottled strong brown, firm, light silty clay loam.

Weller silt loam, 2 to 5 percent slopes (Wc).—This soil occurs on or near ridge crests in forested areas. The profile is similar to the representative profile described for the Weller series.

This soil needs practices such as contouring, stripcropping, and terracing to keep losses of soil and water at a minimum. In addition, an alfalfa-grass meadow should be included in the rotation at least once every 4 years. If the annual rainfall is above normal, wetness is a problem.

Weller silt loam, 5 to 12 percent slopes (Wd).—This soil is on slopes below the tabular divides in forested areas. Some areas extend down to areas of Lindley soils, and others extend to the streams. The profile is similar to the profile described for the Weller series except that in places the depth to the silty clay subsoil is only 10 inches.

For maximum protection against losses of soil and water, terracing, stripcropping, and contouring are needed. Grassed waterways should also be established and a rotation used that consists of 1 year of alfalfa-grass meadow for each year of corn.

Weller silt loam, 5 to 12 percent slopes, moderately eroded (We).—Except that the depth to the silty clay subsoil is only 6 inches, the profile of this soil is similar to the profile described for the Weller series. The suggestions made for the use and management of Weller silt loam, 5 to 12 percent slopes, apply to this soil.

Weller soils, 5 to 12 percent slopes, severely eroded (Wf).—The profile of this soil is similar to the profile described for the Weller series except that in places the surface soil is generally less than 3 inches thick. In many of these places the subsoil is exposed.

This soil is not suited to cultivation, because of very low fertility and the risk of erosion. It is best used for permanent meadow, pasture, as woodland, or as habitats for wildlife.

Formation and Classification of Soils

This section has three main parts. The first describes how the main factors of soil formation have acted to form the soils of the county. In the second, laboratory determinations are given for some of the soils. The third part explains the classification of soils by higher categories, places the soils of the county in soil orders and great soil groups, and gives a profile of a typical soil for each of the soil series.

Formation of the Soils

The influence of the five factors of soil formation—parent material, vegetation, climate, topography and natural drainage, and time—varies from place to place. In one place parent material may be the dominating factor; in another, natural drainage or climate may be important. In Jefferson County the action of the five factors is such that these following important results are evident:

1. In soils formed under prairie grasses, a thick, dark-colored surface layer, high in organic matter, has developed; in soils formed under forest, the surface layer is thin and light colored and is low in organic matter.
2. In soils formed under poor natural drainage, a gray and olive-gray subsoil has developed. The subsoil is mottled and contains yellowish-brown concretions of iron oxide. In soils formed under good natural drainage, a yellowish-brown subsoil has developed and the iron oxides are distributed throughout the matrix. In soils that have imperfect drainage or drainage that is about halfway between that of the poorly drained and well-drained soils, the color of the subsoil is intermediate between that of the subsoils in the poorly drained and well-drained soils.
3. In some soils, clay has formed in the A and B horizons; the clay has a high cation-exchange capacity.
4. In some soils, clay has accumulated in the B horizon by moving from the A horizon, by forming in place in the B horizon, or by both processes.
5. In some soils, bases have leached out of the A and B horizons, and these horizons have become acid.

Among other important results of the action of the five factors on soil formation is the transformation of phosphorus from inorganic to organic matter in the soils that have a thick surface layer containing a large amount of organic matter. This is not so evident, however, as the results previously mentioned.

The results of the action of the five factors of soil formation are more striking in some soils than in others. For example, table 5 in the section, Laboratory Determinations, shows that clay has accumulated in the B horizon, or at depths between 16 and 45 inches, in the

Beckwith soil. This was caused by the combined action of two soil-forming factors, restricted natural drainage and forest vegetation, which were more active in causing clay to accumulate in the B horizon of soils in the county than any other combination of soil-forming factors.

In the following pages is a brief discussion of the way in which each of the soil-forming factors has caused differences among the soils of the county.

PARENT MATERIAL

Parent material is an important factor that has caused differences among the soils in the county. The soil series are grouped according to parent material as follows:

Parent material	*Soil series*
Loess of light silty clay loam to silt loam texture.	Clinton, Keomah, Weller, Givin, Grundy, Ladoga, Mahaska, Otley, Pershing, Haig, Taintor, Belinda, Berwick, Edina, Beckwith, Rubio, Sperry.
Thin layer of silt loam or clay loam over partly weathered limestone or limestone rock.	Sogn.
Clay shale with a thin overburden of silty loess or clay loam glacial till.	Gosport.
Sandy loam or loamy fine sand over sand; deposited by wind or water.	Chelsea, Hagener, Lamont.
Loam or clay loam glacial till.	Gara, Adair, Lindley, Shelby, Clarinda.
Silt loam or loam deposited by water (alluvium).	Jackson, Kato, Bertrand, Cantril, Gravity, Waukegan, Coppock, Nodaway, Curran.
Silty clay deposited by water (alluvium).	Wabash, Blockton.

The soil materials in the miscellaneous land type, Rough broken and rock land, were formed on thin layers of loess over glacial till or limestone bedrock; Alluvial land, wet, was formed from silt loam or loam deposited by water.

Preglacial materials—limestone and shale—occur in the underlying materials of the soils of the Sogn and Gosport series. These materials restrict the development of plant roots.

Glacial till was the parent material of the soils of the Shelby, Lindley, and several other series. The oxidized and unleached (calcareous) till in the county is mainly clay loam in texture and is firm to very firm when moist. This till was deposited by either the Kansan or Nebraskan glaciers, or by both (*5*).[3]

Water-laid material, or alluvium, was the parent material of the soils of 10 series in the county. The alluvium ranges in texture from sand to silty clay.

Most of the parent materials of the Chelsea, Hagener, and Lamont soils were eolian (windblown) sands, although in some areas the materials were laid down by water. The Lamont soils were also developed, in part, from eolian silts (loess).

The parent material of the soils of 17 series in this county was loess. The loess, deposited during the early Wisconsin glacial period (*10*), was permeable and was friable to slightly firm when moist. It was high in silt-sized particles. Although, in general mineralogy it has been found that the loess in Iowa resembles glacial till (*6*), the glacial materials are high in sand-sized particles. The sand-sized particles release little potassium in exchangeable form (*3*). Therefore, it appears that the soils derived from loess supply more potassium to plants than the soils derived from till.

An additional factor in the formation of the loess-derived soils is the thickness of the loess. In southeastern Iowa, of which Jefferson County is a part, there is a general relationship between the thickness of the loess and the degree of textural development in the soil profile (*4* and *17*). As a rule, where the loess is thick, the texture of the profile does not vary so much from one horizon to another as it does where the layer of loess is thin.

The relationship between the thickness of the loess and the degree of textural development is most evident if a soil is compared to soils several counties away. For example, if a soil in northeastern Van Buren County, just south of Jefferson County, is compared to the soils in Marshall County, near the center of the State, differences caused by variations in the thickness of the loess become evident. Within Jefferson County, the relationship between the thickness of the loess and the degree of textural development is also fairly evident when the textural development of the loess-derived soils in the extreme northern part of the county is compared with that of the loess-derived soils in the extreme southern part. This relationship is less evident in soils near the borders between the general soil areas in which the Mahaska and Grundy soils predominate (fig. 2).

In table 4 the general relationship between the thickness of the loess, relative stage of development of the textural profile, natural vegetation, and topography is shown for the loess-derived soils. Though the soils of the Edina and Sperry series have formed from loess, they occur in depressions in this county. As a result their formation was apparently of a somewhat different aspect than that of the other loess-derived soils. Consequently, the Edina and Sperry series are not listed in table 4. The other loess-derived soils can be separated into two classes—those with medium textural development and those with moderately strong textural development. In general, this grouping corresponds with the general thickness of loess as indicated in table 4.

Exceptions to this relationship occur in soils of the Taintor and Haig series (*11*). In Jefferson County some areas of Haig soils are associated with Mahaska and Otley soils and some areas of Taintor soils are associated with Haig and Grundy soils. The Taintor soils occur in the middle of the broad flats of general soil areas in which the Grundy and Haig soils are predominant. It is believed that in these sites the water table was probably higher and more permanent than was normal in the remainder of the flats, and this might have reduced leaching and inhibited the translocation of clay from the A to the B horizon.

On some of the narrower upland flats of the Mahaska general soil areas, in the northern part of the county, the water table was probably lower and less permanent than in the lower flats. On these sites enough leaching was accompanied by some translocation of clay from the A horizon to the B horizon for the Haig soils to develop. These studies also show that the Haig soils that occur in association with the Mahaska and Otley soils had slightly less textural development than the Haig soils that occur in association with the Grundy soils. The Taintor soils

[3] Italic numbers in parentheses refer to Literature Cited, p. 62.

TABLE 4.—*Series made up of loess-derived soils arranged according to thickness of loess, stage of development, vegetation, and topography and natural drainage*

[Single-letter symbols in parentheses indicate great soil group: W = Wiesenboden, B = Brunizem, GBP = Gray-Brown Podzolic, P = Planosol, GBP-B = Gray-Brown Podzolic-Brunizem intergrades. Letter symbols with subscripts, for example, A_1, indicate significant horizons in soil profile]

Loess thickness [1]	Relative stage of textural profile development	Natural vegetation	Topography and natural drainage		
			Level (Poorly drained)	Gently sloping (Imperfectly drained)	Moderately sloping (Moderately well drained)
Inches					
200 to 100	Medium	Prairie	Taintor (W) (A_1, B_g, C_1).	Mahaska (B) (A_1, B, C_1).	Otley (B) (A_1 B, C_1).
		Forest-prairie.	Rubio (P) (A_1, A_2, B_g, C_1).	Givin (GBP-B) (A_1, A_2, B_b, C_1).	Ladoga (GBP-B) (A_1, A_2, B, C_1).
		Forest	Berwick (P) (A_1, A_2, B_g, C_1).	Keomah (GBP) (A_1, A_2, B, C_1).	Clinton (GBP) (A_1, A_2, B, C_1).
100 to 80	Moderately strong	Prairie	Haig (W) (A_1, B_g, C_1).	Grundy (B) (A_1, B, C_1).	Grundy (B) (A_1, B, C_1).
		Forest-prairie.	Belinda (P) (A_1, A_2, B_g, C_1).	Pershing (GBP-B) (A_1, A_2, B, C_1).	Pershing (GBP-B) (A_1, A_2, C_1).
		Forest	Beckwith (P) (A_1, A_2, B_g, C_1).	Weller (GBP) (A_1, A_2, B, C_1).	Weller (GBP) (A_1, A_2, B, C_1).

[1] General thickness of loess on major divides in the areas of these soils in southeastern Iowa. (See fig. 4, in the section, A Landscape May Contain Several Soils).

in the general soil areas in which Haig and Grundy soils predominate have more clay in the B horizon than the Taintor soils that are associated with the Mahaska and Otley soils.

VEGETATION

Except for the soils of the Edina and Sperry series, the soils of the county formed mainly under prairie vegetation generally have an almost black, thick A_1 layer that is moderately high in organic matter. In contrast, the soils formed under forest have a thin, light-colored A_1 layer. The color of the soils of Jefferson County, whether light or dark, is closely related to the amount of organic matter they contain. The amount of organic matter, in turn, is closely related to the amount of nitrogen present in the soil. This is illustrated in tables 5 and 7 in the section, Laboratory Determinations, which show the percentage of total nitrogen at increasing depths in the profiles of soils of the Beckwith and Taintor series. The Beckwith soils were formed under forest, and the Taintor was formed under prairie.

Studies also have been made on the effect of vegetation on other soil properties. In table 5 the distribution of exchangeable calcium (Ca), magnesium (Mg), potassium (K), and hydrogen (H) is shown for Beckwith silt loam, and in table 7 the same is shown for Taintor silty clay loam. In addition to these tables, consult table 6 to see how clay is distributed in the profiles of soils of the Beckwith, Taintor, and Haig series. Under forest the soil evidently becomes strongly acid to a greater depth than under prairie, and, other factors of soil formation presumably having been equal, there is a more distinct difference in texture between the A and B horizons in soils formed under forest.

In many parts of the upland landscape, the transition from prairie-formed soils to forest-formed soils is gradual. Therefore, an intermediate group of soils, having a moderately thick, moderately dark A_1 layer, has been mapped. These soils are classified as Gray-Brown Podzolic-Brunizem intergrades. Most of them are of minor extent. These soils probably are the result of the fairly recent encroachment of forest on a former prairie-formed soil, though there may have been more than one cycle of advance and retreat of the forests (*1*, *10*, *12*).

The soils of the Gray-Brown Podzolic great soil group (see table 4) probably were developed almost wholly under forest, and the soils of the Brunizem and Wiesenboden (Humic Gley) great soil groups, almost wholly under prairie. Of the Planosol great soil group, the Berwick, Beckwith, and Curran soils probably developed almost wholly under forest; the Blockton, Sperry, and Edina, under swampy prairie; the Rubio and Belinda, under forest-prairie; and the Coppock possibly also under forest-prairie.

CLIMATE

Climate apparently was not directly responsible for differences among the soils in Jefferson County, because rainfall and temperature probably have been about the same over all parts of the county over any given period of time. The climate, however, has been an important factor in causing the soils of this county to differ from those of extremely arid or extremely humid and hot areas.

Precipitation in Jefferson County evidently has been sufficient over the centuries to leach the parent materials of carbonates to depths of several feet or more, to hydrolyze and weather primary minerals to silicate clays, and to provide water for tall grasses and deciduous trees. The temperature evidently has been warm enough so that these soil-forming processes could proceed and plant life could be maintained. The precipitation has not been great enough, however, nor have the temperatures been warm enough, to cause a high rate of chemical weathering and leaching of many of the important plant nutrients.

TOPOGRAPHY AND NATURAL DRAINAGE

Topography has been an important factor in causing many of the soils of the county to differ from others. In the main, this influence was indirect because it affected the moisture regime in the soil profile. Under natural conditions, most of the rainfall soaked in in level areas and slight depressions. But in areas that had stronger slopes, more of the rainfall ran off and less soaked in. Indirectly, then, topography affected the moisture regime of the soil profile by causing some soils to receive less and others to receive more water from the same amount of rainfall.

The kind of parent material also affected the moisture regime of the soil. Many level areas on the natural stream terraces have a deep, sandy, porous substratum through which much of the rainwater drained away. On broad flat areas of the uplands, however, much of the rainwater probably remained for weeks or months in the lower subsoil and substratum. In sloping soils that have a fine-textured subsoil, such as the Clarinda and Adair, the water entering the soil profile drained downward very slowly. These soils, though sloping, are often too wet because of seepage for the best growth of crops.

There is a close relationship between the color of the subsoil and the moisture regime under which the soils presumably developed. For example, most of the soils classified as Wiesenbodens or Planosols have an olive-gray to dark grayish-brown subsoil with many mottles and concretions of iron oxides. In soils such as the Wabash, Blockton, and Haig, the gray colors are partly masked by the organic matter. In general, soils of the Wiesenboden and Planosol great soil groups, often referred to as having poor natural drainage, generally need artificial drainage for the best yields of alfalfa and corn.

In this county the soils classified in the Brunizem and Gray-Brown Podzolic great soil groups can be subdivided on the basis of their subsoil colors. A number of them have a dark-brown or yellowish-brown subsoil with few or no mottles or concretions of iron oxide. These soils are often referred to as being naturally well drained. They include the soils of the Chelsea, Bertrand, Clinton, Waukegan, and Hagener series.

A number of the Brunizem and Gray-Brown Podzolic soils of this county have a dark grayish-brown or yellowish-brown subsoil. They have few to common mottles, and most of them contain concretions of iron oxide. Such soils are often referred to as having somewhat poor or imperfect to moderately good natural drainage. Examples are soils of the Mahaska, Grundy, Weller, Keomah, Pershing, Kato, and Jackson series.

In the absence of long-time data concerning soil moisture, the best key to the interpretation of the natural drainage or to the hazard of wetness lies in the color of the subsoil. The color of the subsoil is not an infallible guide, however, because, in some places, it is a relict from a previous geological condition (*9*). Then too, there are other soil characteristics that can be used to supplement the color features of the profile in evaluating natural drainage or the hazard of wetness. In general, however, the color of the profile, and particularly that of the subsoil, is one of the most useful guides.

Iron oxides are one of the main coloring agents in soils. Soil scientists have studied the nature and distribution of iron oxides in some soil profiles in Jefferson and other counties of Iowa. These studies show that in the profiles of soils that are naturally well drained there is a close relationship between the content of free, or oxalate-soluble, iron oxides and the content of clay (*13*). In the Wiesenboden soils that were studied, however, the content of iron oxides is lower than in well-drained soils, and there is no especial relationship between the content of iron oxides and the content of clay. In several forest Planosols studied, there was no especial relationship between the iron oxides and clay in the profile; in these soils the iron oxides tended to accumulate in the A_2–B_1 layer.

TIME

Time is also a factor in the forming of soils. In this county the soils that have developed or weathered for the shortest period of time are the Nodaway. Most of their alluvial parent material has been deposited since they were first cultivated. Probably the soils that have been forming for the longest time are soils of the Taintor, Haig, Belinda, and Beckwith series that are on the broad upland flats. These and soils in similar positions on the landscape probably have been forming continually since between 14,000 and 16,000 years ago (*10*). The soils of upland slopes are presumably somewhat younger. The Adair, Clarinda, and some soils of the Lindley series apparently have acquired some of their characteristics during an earlier cycle of soil formation (*8*).

Laboratory Determinations

Physical and chemical data on soils of the Beckwith, Haig, and Taintor series are shown in tables 5, 6, and 7. Data and details of methods used in the analyses of these soils have been described by G. M. Schafer[4] and C. C. Cain.[5] Bulk density and porosity were determined by the undisturbed core method, with aeration porosity at 40 centimeters tension. The analysis of the size of the soil particles was made by the standard pipette method. Glass electrode was used for pH at 1:1 dilution. Exchangeable calcium (Ca), magnesium (Mg), and potassium (K) were determined by the ammonium acetate method; exchangeable hydrogen (H), by the barium acetate method; total nitrogen, by the Kjeldahl method; organic carbon, by the dry combustion method; and free iron (Fe), by a modified Jeffries method.

Physical data on Grundy and Mahaska soils are given in table 8. These determinations were made in the Soil Survey Laboratory of the United States Department of Agriculture at Beltsville, Md.

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[4] SCHAFER, G. M. PROFILE PROPERTIES OF A LOESS-DERIVED WIESENBODEN SEQUENCE OF SOUTHERN IOWA. 1954. [Unpublished Doctor's thesis. Copy on file at library of Iowa State College.]

[5] CAIN, C. C. PROFILE PROPERTIES AND SEQUENCE RELATIONSHIPS OF THE TRAER, BERWICK, AND MARION SERIES IN SOUTHEASTERN IOWA. 1956. [Unpublished Doctor's thesis. Copy on file at library of Iowa State College.]

TABLE 5.—*Physical and chemical data on Beckwith silt loam (profile 421)*

[Samples collected in 1952, 575 feet north and 30 feet west of the S¼ corner, sec. 15, T. 71 N., R. 9 W., by C. C. Cain, G. M. Schafer, F. F. Riecken, and E. M. White. Analyzed by C. C. Cain, Iowa State College. Absence of statistics indicates determinations not made]

Horizon	Depth	Clay [1] (less than 0.002 mm.)	Bulk density [2]	Aeration porosity [3]	Total porosity [3]	pH	Exchangeable cations (m. e. per 100 gm.)				Total N	Organic P	Free Fe
							Ca	Mg	K	H			
	Inches	*Percent*		*Percent*	*Percent*						*Percent*	*P. p. m.*	*Percent*
A_p	0–6	17.2	1.28	7.8	51.6	5.1	6.2	2.1	0.17	6.2	0.206	254	0.77
A_2	6–9	17.1				5.0	3.8	1.6	.12	4.0	.078	105	.96
A_2	9–14	17.7	1.31	8.0	50.6	5.1	3.4	2.2	.14	3.6	.050	75	1.07
A_3–B_1	14–16	30.5				4.5	6.7	5.8	.51	5.8	.053	48	1.33
B_2	16–19	49.3	1.30	6.5	51.0	4.2	11.9	10.5	1.15	8.2	.072	42	1.04
B_2	19–22	52.3				4.4	13.1	11.8	.89	8.3	.058	44	.91
B_{2g}	22–25	51.9	1.31	1.2	50.6	4.4	14.1	12.5	.92	8.2	.040	47	.90
B_{2g}	25–31	47.9				4.6	14.2	12.4	.77	6.7	.040	25	.88
B_{3g}	31–38	43.2				4.8	14.1	12.3	.69	5.6	.033	8	.96
B_{3g}	38–45	41.5	1.35	3.5	49.0	5.2	15.2	12.6	.66	3.6			.96
C	45–52	35.9				5.8	14.4	11.8	.57	2.9	.023	11	.82
C	52–65	32.2				5.9	13.2	10.6	.52	2.1			
C	[4] 75–85	28.4				6.2	11.4	9.0	.43	1.4	.021		

[1] Contains between 1 and 6 percent soil particles greater than 0.05 mm. in diameter. These are mostly in concretions of iron oxide and occur especially in the A_2 and the A_3–B_1 horizons.

[2] Core method used; soil moist.

[3] Core method used; undisturbed samples.

[4] Loess underlain by Kansan till at depth of 109 inches.

TABLE 6.—*Physical and chemical data on Haig silty clay loam (profile 413)*

[Samples collected in 1952 at S¼ corner of sec. 22, T. 71N., R. 10 W., by G. M. Schafer and F. F. Riecken and analyzed by G. M. Schafer at Iowa State College; absence of statistics indicates determinations not made]

Horizon	Depth	Clay [1] (less than 0.002 mm.)	Bulk density [2]	Aeration porosity [3]	Total porosity [3]	pH	C [4]	N
	Inches	*Percent*		*Percent*	*Percent*		*Percent*	*Percent*
A_{1p}	0–7	30.8				5.8	3.41	0.27
A_1	7–10	31.7				5.6	2.80	.21
A_1	10–14	35.1				5.8	2.10	.15
A_3	14–17	38.6				5.8	1.72	.12
B_2	17–20	42.5	1.37	5.4	48.5	5.8	1.47	.11
B_2	20–23	45.8	1.35	4.1	49.2	6.1	1.19	.09
B_{2g}	23–27	47.4	1.32	4.2	50.2	6.2	.85	.07
B_{2g}	27–33	44.4				6.6	.50	.05
B_{3g}	33–38	38.4				7.0	.31	.03
B_{3g}	38–44	37.2				7.0	.25	.03
C	44–52	26.7	1.40	5.0	46.9	7.6		
C	[5] 65–75					7.0		

[1] Horizon contains 1 to 2 percent material greater than 0.05 mm. in diameter—mostly concretions of iron oxide.

[2] Core method used; soil moist.

[3] Core method used; undisturbed samples.

[4] Amount of organic carbon determined by dry combustion method.

[5] Loess to a depth of 95 inches.

TABLE 7.—*Physical and chemical data on Taintor silty clay loam (profile 412)*

[Sample collected in 1952, 100 yards south of the E¼ corner of sec. 13, T. 73 N., R. 11 W., by G. M. Schafer, F. F. Riecken, B. A. Barnes, L. H. Grant, and J. Worster; analyzed by G. M. Schafer at Iowa State College; absence of statistics indicates determinations not made]

Horizon	Depth	Clay [1] (less than 0.002 mm.)	Bulk density [2]	Aeration porosity [3]	Total porosity [3]	pH	Exchangeable cations m. e. per 100 gm.				C [4]	N
							Ca	Mg	K	H		
	Inches	*Percent*		*Percent*	*Percent*						*Percent*	*Percent*
A_{1p}	0–7	36. 9				6. 2	27. 3	7. 7	0. 46	4. 6	3. 04	0. 24
A_1	7–11	39. 8				6. 2	27. 4	9. 2	. 47	3. 6	2. 34	. 18
A_3	11–15	40. 4				6. 2	25. 5	9. 3	. 48	3. 0	1. 70	. 14
B_1	15–18	41. 4	1. 31	9. 1	50. 4	6. 4	24. 3	10. 3	. 46	2. 6	1. 19	. 10
B_{2g}	18–21	43. 2	1. 31	8. 8	50. 8	6. 5	23. 9	10. 6	. 46	2. 2	. 81	. 07
B_{2g}	21–24	41. 3	1. 33	8. 0	50. 0	6. 8	23. 2	10. 4	. 44	1. 9	. 58	. 05
B_2–B_{3g}	24–28	39. 7				6. 7	22. 2	10. 9	. 43	1. 6	. 39	. 05
B_{3g}	28–35	35. 9				6. 8	20. 6	10. 1	. 41	1. 5	. 29	. 04
C	35–42	32. 5	1. 36	11. 0	48. 8	7. 0	18. 1	8. 5	. 44	. 9	. 17	. 03
C	[5] 54–66	26. 6				7. 7						

[1] Horizons contain 1 to 3 percent material greater than 0.05 mm. in diameter—mostly concretions of iron oxide.
[2] Core method used; soil moist.
[3] Core method used; undisturbed samples.
[4] Amount of organic carbon determined by dry combustion method.
[5] Loess underlain by buried A_1 horizon of Kansan till at depth of 102 inches.

TABLE 8.—*Physical analyses of two soils*

Soil name and sample number	Horizon	Depth	pH	Organic carbon	Size class and diameter of particles (in mm.)						
					Very coarse sand, 2–1	Coarse sand, 1–0.5	Medium sand, 0.5–0.25	Fine sand, 0.25–0.1	Very fine sand, 0.1–0.05	Silt, 0.05–0.002	Clay, less than 0.002
Mahaska silty clay loam: Located in Polk Township at NW¼NW¼ sec. 10, T. 73 N., R. 11 W.:		*Inches*		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
52Io-51-7-1	A	0–6	5. 2	2. 23	0	0. 1	0. 2	0. 4	1. 0	66. 2	32. 1
52Io-51-7-2	A	6–11	5. 3	1. 80	0	. 1	. 1	. 4	1. 0	64. 0	34. 4
52Io-51-7-3	A_3	11–14	5. 3	1. 51	0	. 1	. 1	. 3	. 7	61. 2	37. 6
52Io-51-7-4	B_1	14–18	5. 4	1. 14	0	. 2	. 1	. 3	. 6	60. 0	38. 8
52Io-51-7-5	B_2	18–24	5. 5	. 68	. 1	. 2	. 1	. 2	. 7	60. 1	38. 6
52Io-51-7-6	B_2	24–31	5. 6	. 20	0	. 2	. 1	. 2	. 5	63. 0	36. 0
52Io-51-7-7	B_3	31–40	5. 6	. 18	0	. 3	. 2	. 3	. 6	64. 0	34. 6
52Io-51-7-8	C	40–60	6. 0	0	0	. 1	. 1	. 1	. 6	69. 8	29. 3
Grundy silty clay loam: Located in Round Prairie Township in south-central part of SW¼SW¼ sec. 22, T. 71N., R. 8 W.:											
S51Io-51-6-1	A_1	0–7	6. 3	3. 18	. 1	. 6	. 5	. 4	. 4	71. 3	26. 7
S51Io-51-6-2	A_3	7–12	5. 8	1. 94	. 2	. 8	. 5	. 4	. 4	69. 7	28. 0
S51Io-51-6-3	B_1	12–17	5. 3	1. 56	. 4	. 9	. 5	. 4	. 4	64. 0	33. 4
S51Io-51-6-4	B_2	17–22	5. 5	1. 04	. 3	1. 2	. 8	. 9	. 7	51. 7	44. 4
S51Io-51-6-5	B_3	22–28	5. 6	. 77	. 2	. 7	. 5	. 7	. 5	51. 6	45. 8
S51Io-51-6-6	Upper C	28–38	6. 0	. 44	. 1	. 2	. 1	. 2	. 3	60. 0	39. 1
S51Io-51-6-7	C	38–50	6. 1	. 27	. 2	. 4	. 1	. 2	. 4	66. 1	32. 6

Classification of Soils by Higher Categories

The lower categories of soil classification—phases, types, and series—are explained in the section, How Soils are Mapped and Described. Briefly, a soil type consists of one or more phases and a soil series of one or more soil types. Soil types or phases are the units shown on the detailed soil map.

Soil series are classified into the next broader category, the great soil groups. Each great soil group is made up of soils that have certain internal characteristics in common (7). The broadest categories of soil classification are the three soil orders—zonal, intrazonal, and azonal—in which all of the great soil groups are placed.

The soil series of Jefferson County are classified by great soil groups and soil orders in table 9.

TABLE 9.—*Soil series classified by order and great soil group*

Order	Great soil group	Series
Zonal	Gray-Brown Podzolic	Bertrand.
		Chelsea.
		Clinton.
		Jackson.
		Keomah.
		Lamont.
		Lindley.
		Weller.
	Gray-Brown Podzolic-Brunizem intergrades.	Cantril.
		Gara.
		Givin.
		Ladoga.
		Pershing.
	Brunizem	Adair.
		Gravity.
		Grundy.
		Hagener.
		Kato.
		Mahaska.
		Otley.
		Shelby.
		Waukegan.
Intrazonal	Wiesenboden (Humic Gley)	Clarinda.
		Haig.
		Taintor.
		Wabash.
	Planosol	Beckwith.
		Belinda.
		Berwick.
		Blockton.
		Coppock.
		Curran.
		Edina.
		Rubio.
		Sperry.
Azonal	Alluvial	Nodaway.
	Lithosol	Gosport.
		Sogn.

Zonal soils

Soils of the zonal order have well-developed characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms (chiefly vegetation) (*15*). In Jefferson County the zonal soils are (1) the Gray-Brown Podzolic, (2) the Brunizem, and (3) a subgroup, the Gray-Brown Podzolic-Brunizem intergrades.

The Gray-Brown Podzolic-Brunizem intergrades are not very extensive in this county. They are recognized, however, because they are helpful in obtaining an understanding of the effect vegetation has had on soil genesis (*17*). The zonal soils of the county differ from the Wiesenboden and Planosol soils of the intrazonal order because the Wiesenboden and Planosol soils are currently subject to prominent gleying. Another distinguishing feature is that the Planosols have an abrupt boundary between the A_2 and the B_2 layers.

Gray-Brown Podzolic soils.—The Gray-Brown Podzolic soils, which belong to the zonal order, are the forested counterpart of the Brunizems. They have a thin organic covering and a thin organic-mineral layer over a grayish-brown leached layer. This leached layer rests upon a brown B horizon that is richer in clay than the horizon above. These soils are well drained and have well-developed profiles. They have formed under deciduous forests in a moist, temperate climate.

The middle-of-the-range, virgin Gray-Brown Podzolic soils have the following features: (1) An A_0 horizon of leaf litter and twigs; (2) a thin (2- to 6-inch), dark A_1 horizon; (3) an A_2 horizon that has a weak to strong platy structure; and (4) a yellowish-brown B horizon that has a blocky structure.

The soils of the Bertrand, Clinton, Jackson, Keomah, Lindley, and Weller series are typical Gray-Brown Podzolic soils. The Chelsea and Lamont are transitional to the Regosols in that their parent materials are sandy and certain profile features of the typical Gray-Brown Podzolic soils are less evident. In this county the Lamont soils are not mapped separately but in complexes with the Chelsea soils. Profile descriptions of Gray-Brown Podzolic soils in Jefferson County follow:

BERTRAND LOAM (slope of about 2 percent)

A_1 0 to 10 inches very dark grayish-brown (10YR 3/2,[6] moist) loam; granular [7] structure; friable.

A_2 10 to 17 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2, moist) loam; moderate thin platy structure; friable.

B_{21} 17 to 30 inches, dark-brown (10YR 4/3, moist) loam; moderate medium subangular blocky structure; discontinuous clay skins; slightly firm to friable.

B_{22} 30 to 45 inches, dark-brown (10YR 4/3, moist) heavy loam to light clay loam; weak medium subangular blocky structure; a few, fine, faint mottles of gray (5Y 5/1, moist); a few clay skins; slightly firm to friable.

C_1 45 to 60 inches, brown (10YR 5/3, moist) silt loam; massive (structureless); common, medium, distinct mottles of gray (5Y 5/1, moist) and strong brown (7.5YR 5/8, moist); friable.

Variations.—In some areas the A_1 horizon is sandy loam.

CHELSEA LOAMY FINE SAND (slope of about 3 percent)

A_1 0 to 10 inches, dark-brown (10YR 4/3, moist) loamy fine sand; single grain (structureless); loose to friable when moist.

A_2 10 to 14 inches, dark yellowish-brown (10YR 4/4, moist) loamy fine sand; single grain (structureless); loose to friable when moist.

B_1 14 to 32 inches, strong-brown (7.5YR 5/8, moist) loamy fine sand; single grain (structureless); loose to friable when moist.

B_2 32 to 60 inches, strong-brown (7.5YR 5/8, moist) loamy fine sand; single grain (structureless); loose to friable when moist.

C 60 inches +, brown to strong-brown (7.5YR 5/4 to 5/6, moist) noncoherent sand.

Variations.—The thickness of the A_1 horizon varies according to the degree of slope and the previous cultivation practices. Small, but variable, amounts of silt occur in this horizon.

CHELSEA LOAMY FINE SAND (slope of about 16 percent)

A_1 0 to 3 inches, very dark grayish-brown (10YR 3/2, moist) loamy fine sand; single grain (structureless); loose when moist.

A_2 3 to 30 inches, dark-brown (10YR 4/3, moist) fine sand; single grain (structureless); loose when moist.

B_1 30 to 45 inches, dark yellowish-brown (10YR 4/4, moist) fine sand; single grain (structureless); loose when moist.

B_2 or C_1. 45 to 55 inches, dark yellowish-brown (10YR 4/4, moist) fine sand with a thin band of strong brown (7.5YR 4/6, moist); single grain (structureless); loose when moist.

Variations.—The thickness of the A_1 horizon varies according to the degree of slope and the previous cultivation practices. Small, but variable, amounts of silt occur in this horizon.

[6] Symbols express Munsell color notations, which are explained in the Soil Survey Manual, Agriculture Handbook No. 18.

[7] The term *granular* is used to describe the shape of the soil aggregates. Other similar descriptive terms used to describe structure are *platy, prismatic, columnar, blocky, subangular blocky,* and *crumb*. If other terms are used, with reference to structure, to describe the distinctness and size of the soil aggregates, the terms are arranged in the following sequence: Distinctness, size, and shape. An example of this sequence is "weak fine granular."

CLINTON SILT LOAM (slope of about 7 percent)

A_1 0 to 5 inches, very dark gray (10YR 3/1, moist) silt loam; fine granular structure; friable.

A_{21} 5 to 10 inches, dark grayish-brown to dark-brown (10YR 4/2 to 4/3, moist) medium silt loam; very weak platy to fine granular structure; friable.

A_{22} 10 to 14 inches, dark grayish-brown (10YR 4/2, moist) silt loam; very weak platy to very weak subangular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); friable.

B_1 14 to 16 inches, transition layer.

B_2 16 to 28 inches, dark-brown (10YR 4/3, moist) heavy silty clay loam; strong medium blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); faces of peds gray (10YR 5/1 to 6/1, dry); clay skins continuous; a few black iron-manganese concretions; firm.

B_3 28 to 42 inches, dark-brown to dark yellowish-brown (10YR 4/3 to 4/4, moist) medium silty clay loam; coarse blocky structure; a few, fine, faint mottles of gray and strong brown (5Y 5/1 to 7.5YR 5/6, moist); a few black iron-manganese concretions; prominent clay skins; firm.

C_1 42 to 52 inches, dark yellowish-brown to yellowish-brown (10YR 4/4 to 5/4, moist) light silty clay loam; massive (structureless); a few black iron-manganese concretions; a few clay skins; faces of a few peds show root channels; friable.

Variations.—Generally the surface layer becomes progressively thinner as the degree of slope increases. The subsoil contains slightly more clay and the depth to mottled material is generally slightly less in the more gently sloping phase of this soil than in the strongly sloping phases.

JACKSON LOAM (slope of about 1 percent)

A_1 0 to 10 inches, very dark gray (10YR 3/1, moist) loam; weak fine granular structure; friable.

A_2 10 to 16 inches, dark grayish-brown (10YR 4/2, moist) silt loam; weak medium platy structure; a few, fine, faint yellowish-brown (10YR 5/6, moist) mottles; friable.

B_2 16 to 28 inches, dark grayish-brown (10YR 4/2, moist) medium to heavy silty clay loam; strong fine subangular blocky structure; common, fine, faint yellowish-brown mottles (10YR 5/6, moist); faces of peds are gray (10YR 6/1, moist); firm.

B_3 28 to 40 inches, strong-brown (7.5YR 5/8, moist) light silty clay loam; weak coarse blocky structure; common, medium, distinct olive-gray (5Y 5/2, moist) mottles; slightly firm.

C 40 to 50 inches, gray (5Y 5/1, moist) loam; coarse blocky structure; many, coarse, prominent strong-brown (7.5YR 5/8, moist) mottles; some concretions; friable.

Variations.—The color and thickness of the A horizons vary, and the texture ranges from silt loam to sandy loam. The texture and the degree of mottling in the B horizons vary.

KEOMAH SILT LOAM (slope of about 3 percent)

A_1 0 to 4 inches, very dark gray (10YR 3/1, moist) silt loam; moderate medium platy to fine granular structure; friable.

A_2 4 to 10 inches, dark grayish-brown (10YR 4/2, moist) silt loam; moderate thin platy to weak fine subangular blocky structure; a few, fine, faint mottles of yellowish brown to strong brown (10YR 5/8 to 7.5YR 5/8, moist); lower plates have fine iron-manganese concretions; friable.

B_1 10 to 16 inches, dark-brown (10YR 4/3, moist) medium silty clay loam; moderate medium subangular blocky structure; a few, medium, distinct mottles of strong brown (7.5YR 5/8, moist); slightly firm.

B_2 16 to 26 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay to heavy silty clay loam; strong fine blocky structure; structural peds gray (10YR 5/1, moist); common, medium, prominent mottles of strong brown (7.5YR 5/6, moist); coatings on peds very dark gray to dark gray (10YR 3/1 to 4/1, moist); clay skins continuous; a few black iron-manganese concretions; firm.

B_3 26 to 40 inches, grayish-brown to dark grayish-brown (2.5Y 5/2 to 4/2, moist) heavy to medium silty clay loam; moderate fine subangular blocky structure; common, medium, prominent mottles of strong brown (7.5YR 5/6, moist); firm.

C 40 to 50 inches, gray (2.5Y 5/1, moist) light silty clay loam; massive (structureless) but weak coarse blocky in places; many, medium, prominent mottles of strong brown (7.5YR 5/6, moist); many black iron-manganese concretions; friable.

Variations.—The thickness of the A_1 horizon ranges from 4 to 8 inches. In the more nearly level areas the A_1 horizon is thicker than elsewhere and the B horizon is grayer in color.

LAMONT SANDY LOAM (slope of about 3 percent)

A_1 0 to 5 inches, brown (7.5YR 4/2 to 5/2, moist) sandy loam; single grain (structureless); loose when moist.

A_2 5 to 10 inches, brown (7.5YR 5/2, moist) sandy loam; single grain (structureless); loose when moist.

B_{21} 10 to 16 inches, dark-brown (7.5YR 4/4, moist) sandy clay loam; moderate subangular blocky structure; friable when moist.

B_{22} 16 to 28 inches, yellowish-red (5YR 4/6 to 4/8, moist) sandy loam; single grain (structureless); friable when moist.

Banded B_2 28 to 40 inches, strong-brown to brownish-yellow (7.5YR 5/6 to 10YR 6/6, moist) bands of sandy clay loam; friable.

C_1 40 inches +, brownish-yellow (10YR 6/6, moist) loose loamy fine sand.

LINDLEY LOAM (slope of about 10 percent)

A_1 0 to 5 inches, dark grayish-brown (10YR 4/2, moist) loam; weak fine crumb structure; very friable.

A_2 5 to 9 inches, pale-brown (10YR 6/3, moist) loam; moderate thin platy structure; very friable.

B_1 9 to 13 inches, yellowish-brown (10YR 5/4, moist) clay loam; moderate very fine subangular blocky structure; sprinkling of light gray (10YR 7/2, moist) on surfaces of peds; friable.

B_2 13 to 24 inches, dark yellowish-brown (10YR 4/4, moist) heavy clay loam; moderate medium subangular blocky structure; a few, fine, faint, mottles of very pale brown (10YR 7/4, moist); firm.

B_3 24 to 30 inches, yellowish-brown (10YR 5/4, moist) sandy clay loam; weak coarse subangular blocky structure; firm.

C 30 inches +, yellowish-brown (10YR 5/4, moist) sandy clay loam; massive (structureless); many, medium, faint mottles of very pale brown to pale yellow (10YR 6/3 to 5Y 7/4, moist); firm; a calcareous layer begins at a depth of 50 inches.

Variations.—The thickness of the A horizons varies according to the amount of erosion that has taken place. In places the B horizons consist of mottled reddish-brown, gritty silty clay that is slowly permeable. In a small area along Cedar Creek, the B horizons consist of sandy clay loam. In many places the depth to calcareous material is more than 50 inches.

WELLER SILT LOAM (slope of about 5 percent)

A_1 0 to 3 inches, very dark gray (10YR 3/1, moist) silt loam; moderate medium platy structure; friable.

A_{21} 3 to 6 inches, very dark gray or dark gray (10YR 3.5/1, moist) silt loam; moderate thin platy structure; friable.

A_{22} 6 to 12 inches, dark-gray (10YR 4/1, moist) silt loam; moderate thin platy structure; some wormcasts noticeable; friable.

B_1 12 to 15 inches, dark-brown (10YR 4/3, moist) light silty clay; medium strong blocky structure; firm.

B_{21} 15 to 30 inches, dark grayish-brown to dark-brown (10YR 4/2 to 4/3, moist) medium silty clay; strong fine angular blocky structure; a few, fine, faint mottles of dark brown (7.5YR 4/4, moist); firm to very firm.

B_{22} 30 to 48 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay; medium to coarse subangular blocky structure; common, medium, distinct mottles of dark brown to strong brown (7.5YR 4/4 to 5/6, moist); firm.

C 48 inches +, light olive-brown (2.5Y 5/4, moist) heavy silty clay loam; massive (structureless); common, coarse, distinct mottles of strong brown (7.5YR 5/6, moist); firm.

Variations.—The degree of development of the A_{21} and A_{22} horizons varies. The degree of mottling in the B horizons varies.

Gray-Brown Podzolic-Brunizem intergrades.—The Cantril, Gara, Givin, Ladoga, and Pershing series are Gray-Brown Podzolic soils that intergrade to Brunizems. These soils were covered by prairie grasses during their early development and were later covered by trees. They generally have a thicker, darker A_1 horizon than the typical Gray-Brown Podzolic soils. Most of them have an A_2 horizon. In color and structure of their B horizon they are intermediate between the Gray-Brown Podzolic soils and Brunizems. Profile descriptions of Gray-Brown Podzolic soils that intergrade to Brunizems follow:

CANTRIL LOAM (slope of about 4 percent)

A_{1p} 0 to 6 inches, very dark grayish-brown (10YR 3/2, moist) medium loam (relatively recent overwash); weak fine granular structure; friable.

A_{11} 6 to 11 inches, very dark gray to black (10YR 3/1 to 2/1, moist) medium silt loam; very weak thin platy structure that breaks to moderate fine granular; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); dark brown (10YR 4/3, moist) when crushed; friable.

A_{21} 11 to 17 inches, very dark grayish-brown (10YR 3/2, moist) medium silt loam; weak thin platy structure but breaks to weak fine subangular blocky; medium distinct gray (10YR 6/1, dry) mottles; friable.

A_{22} 17 to 25 inches, dark grayish-brown (10YR 4/2, moist) medium silt loam; moderate fine subangular blocky with slight tendency toward platy structure; friable.

B_2 25 to 35 inches, grayish-brown (10YR 5/2, moist) medium silty clay loam; moderate medium subangular blocky structure; common, medium, distinct mottles of yellowish brown to strong brown (10YR 5/6 to 7.5YR 5/6, moist); some clay skins noticeable; slightly firm to firm.

B_3 or C_1 35 inches +, grayish-brown (10YR 5/2, moist) medium to heavy silty clay loam; massive (structureless); many, coarse, distinct mottles of yellowish brown to strong brown (10YR 5/6 to 7.5YR 6/6, moist); firm.

Variations.—In places the texture of the overwash material is sandy loam or silt loam; this material varies in color from light to moderately dark and in thickness from a few inches to 15 inches. The texture, color, and degree of mottling in the lower subsoil vary.

GARA LOAM (slope of about 10 percent)

A_1 0 to 6 inches, black (10YR 2/1, moist) gritty loam; moderate fine granular structure; friable.

A_2 6 to 11 inches, mixed very dark gray and dark brown (10YR 3/1 to 3/3, moist) heavy loam; very weak fine subangular blocky to fine granular structure; friable.

B_1 11 to 14 inches, dark-brown (7.5YR 4/4, moist) gritty clay loam; moderate fine subangular blocky structure; a few, fine, faint mottles of reddish brown (5YR 4/4, moist); some pebbles and coarse gravel; firm.

B_2 14 to 27 inches, dark grayish-brown (10YR 4/2, moist), gritty, medium silty clay; strong fine blocky structure; many, coarse, prominent mottles of yellowish red and dark red (5YR 4/6 to 2.5YR 3/6, moist); very firm.

B_3 27 to 35 inches, dark grayish-brown (10YR 4/2, moist) to dark-brown (7.5YR 4/4, moist), gritty, medium silty clay; moderate medium subangular blocky structure; many, coarse, prominent mottles of yellowish red to dark red (5YR 4/6 to 2.5YR 3/6, moist); very firm.

C_1 35 to 45 inches, yellowish-brown (10YR 5/6, moist), gray, and strong-brown (10YR 5/1 to 7.5YR 5/6, moist) medium clay loam; massive (structureless) to very coarse blocky structure; black iron-manganese concretions; firm.

Variations.—In some areas the A horizons consist of gritty silt loam or heavy loam. The color of the A horizons ranges from black to very dark gray. The color of the B horizons ranges from dark yellowish brown to grayish brown, and the texture, from clay loam to sandy clay. In the profile previously described, the B horizons have a higher content of clay and distinct, redder mottles occur at a shallower depth than is typical of the Gara soils mapped in Jefferson County.

GIVIN SILT LOAM (slope of about 3 percent)

A_1 0 to 9 inches, black to very dark gray (10YR 2.5/1, moist) silt loam with moderate fine granular structure; speckled with gray (10YR 6/1, dry); friable.

A_2 9 to 14 inches, dark-gray (10YR 4/1, moist) silt loam; weak thin platy to weak fine subangular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); friable.

B_1 14 to 17 inches, dark grayish-brown (10YR 4/2, moist) medium silty clay loam; moderate medium subangular blocky structure; coated with very dark gray (10YR 3/1, moist); black iron-manganese concretions; friable.

B_2 17 to 30 inches, dark grayish-brown (10YR 4/2, moist) light silty clay to heavy silty clay loam; moderate fine subangular blocky structure; a few, fine faint mottles of strong brown (7.5YR 5/8, moist); very dark gray (10YR 3/1, moist) coatings; firm.

B_3 30 to 40 inches, grayish-brown (2.5Y 5/2, moist) medium silty clay loam; weak fine subangular blocky structure; common, coarse, prominent mottles of yellowish brown (10YR 5/6, moist); black iron-manganese concretions; slightly firm.

C_1 40 to 50 inches, olive-gray (5Y 5/2, moist) light silty clay loam; massive (structureless); common, coarse, prominent mottles of strong brown and yellowish brown (7.5YR 5/6 to 10YR 5/6, moist); few faces have clay skins; black iron-manganese concretions; slightly firm.

Variations.—The color, texture, and thickness of the horizons vary.

LADOGA SILT LOAM (slope of about 7 percent)

A_p 0 to 8 inches, very dark gray (10YR 3/1, moist) heavy silt loam; weak medium platy to coarse granular structure; friable.

B_1 8 to 16 inches, dark yellowish-brown (10YR 4/4, moist) heavy silty clay loam; weak fine blocky structure; friable.

B_2 16 to 30 inches, dark-brown (10YR 4/3, moist) heavy silty clay loam; strong medium blocky structure; peds coated with light brownish gray (10YR 6/2, dry); firm.

B_3 30 to 42 inches, olive-gray (5Y 5/2, moist) light silty clay loam; weak coarse blocky structure; many, medium, distinct mottles of strong brown (7.5YR 5/6, moist); slightly firm.

C_1 42 to 50 inches, grayish-brown (2.5Y 5/2, moist) light silty clay loam; massive (structureless); many, coarse, distinct mottles of strong brown (7.5YR 5/8, moist); a few strong black iron-manganese concretions; friable.

Variations.—The color and thickness of the A_p horizon and the texture of the B horizons vary slightly according to the degree of slope.

PERSHING SILT LOAM (slope of about 3 percent)

A_1 0 to 7 inches, very dark grayish-brown (10YR 3/2, moist) silt loam; weak fine crumb structure; very friable.

A_2 7 to 10 inches, grayish-brown (10YR 5/2, moist) silt loam; weak thin platy structure; very friable.

B_1 10 to 13 inches, brown (10YR 5/3, moist) silty clay loam; weak medium granular structure; faint, gray coating on peds; friable.

B_{21} 13 to 20 inches, yellowish-brown (10YR 5/4, moist) medium silty clay; moderate very fine to fine subangular blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); peds coated with dark grayish brown (10YR 4/2, moist); firm.

B_{22} 20 to 30 inches, brown (10YR 5/3, moist) medium silty clay; moderate fine subangular blocky structure; common, medium, prominent mottles of yellowish brown (10YR 5/6, moist); firm.

B_3 30 to 45 inches, grayish-brown (2.5Y 5/2, moist) light silty clay that is transitional to heavy silty clay loam of weak medium subangular blocky structure; many, coarse, prominent mottles of yellowish brown to brownish yellow (10YR 5/6 to 6/6, moist); friable.

C_1 45 inches +, mixed grayish-brown (2.5Y 5/2, moist) and yellowish-brown (10YR 5/6, moist) light silty clay loam; massive (structureless); friable.

Variations.—Variations occur in the color and thickness of the A horizons, in the thickness of the B_1 horizon, and in the degree of mottling below a depth of 15 inches.

Brunizems.—The Brunizems (Prairie soils) are a zonal group of soils that have a very dark grayish-brown to black surface horizon that is transitional with depth to a dark-brown, dark yellowish-brown, or dark grayish-brown subsoil. In many soils the subsoil is mottled. The boundaries separating the various horizons are gradual. The solum ranges from 2 to 5 feet in thickness. The Brunizems have developed under tall grasses in a temperate, relatively humid climate.

In Jefferson County the Brunizems are the Adair, Gravity, Grundy, Hagener, Kato, Mahaska, Otley, Shelby, and Waukegan soils. Profile descriptions of these soils follow:

ADAIR CLAY LOAM (slope of about 7 percent)

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2, moist) clay loam; slightly gritty; weak fine granular structure; friable.

B_1 7 to 11 inches, brown (10YR 5/3, moist) silty clay loam; slightly gritty; weak very fine and fine subangular blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); mottles more prominent within peds; friable.

B_{21} 11 to 17 inches, grayish-brown (2.5Y 5/2, moist) gritty silty clay with some dark grayish brown (2.5Y 4/2, moist) on major cleavages; strong fine and medium angular blocky structure; most ped surfaces show many, fine, prominent mottles of yellowish brown (10YR 5/6, moist); cut surfaces are mainly yellowish brown (10YR 5/6, moist); firm.

B_{22} 17 to 28 inches, mixed grayish-brown (2.5Y 5/2, moist) and yellowish-brown (10YR 5/6, moist) gritty silty clay; moderate to strong, medium angular blocky structure; many, fine, prominent mottles of strong brown (7.5YR 5/6, moist); firm.

B_3 28 to 40 inches, grayish-brown (2.5Y 5/2, moist) gritty silty clay; massive to weak coarse angular blocky structure; many, medium, prominent mottles of yellowish brown (10YR 5/6, moist); a few coatings or seams of grayish brown (2.5Y 5/2, moist); firm.

C 40 to 50 inches, gray (2.5Y 5/1, moist) sandy clay; massive to weak coarse angular blocky structure; many, coarse, prominent mottles of yellowish brown (10YR 5/6, moist) and strong brown (7.5YR 5/6, moist); firm; more grit, fine gravel, and fragments of unweathered rock than in 28- to 40-inch layer.

C 50 inches +, strong-brown (7.5YR 5/6, moist) clay loam; massive (structureless); large seams, 2 to 3 inches wide, of silty clay showing many, coarse, distinct mottles of yellowish brown (10YR 5/6, moist); firm; contains many fragments of unweathered rock.

Variations.—The A horizon ranges in thickness from a few inches in many eroded areas to 12 inches in areas where no erosion has occurred. The B horizons vary in thickness, color, and density. They tend to be finer textured in the gently rolling areas than in the rolling areas.

GRAVITY SILTY CLAY LOAM (slope of about 3 percent)

A_1 0 to 10 inches, very dark grayish-brown (10YR 3/2, moist) silt loam (recent overwash); weak fine granular structure; friable.

A_{11} 10 to 22 inches, black (10YR 2/1 moist) light silty clay loam; moderate fine granular structure; friable to slightly firm.

A_3 22 to 32 inches, black (10YR 2/1, moist) silty clay loam; moderate very fine subangular blocky structure; friable to slightly firm; surfaces of peds are weak gray when dry, but gray coloring disappears when soil is moist; not enough eluviation to designate horizon as A_2.

B_2 32 to 45 inches, black (10YR 2/1, moist) heavy silty clay loam or light silty clay; moderate fine subangular blocky structure; a few, fine, faint mottles of dark brown (10YR 3/4, moist); firm.

B_3 45 inches +, very dark gray (10YR 3/1, moist) heavy silt loam; massive (structureless); a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); firm.

Variations.—The intensity of the mottling and the content of sand in the B horizons vary, and the texture ranges from clay loam to silty clay loam.

GRUNDY SILTY CLAY LOAM (slope of about 3 percent)

A_1 0 to 7 inches, very dark brown (10YR 2/2, moist) light silty clay loam; weak fine granular structure; friable.

A_3 7 to 12 inches, very dark brown (10YR 2/2, moist) silt loam; moderate very fine subangular blocky structure; friable.

B_1 12 to 17 inches, very dark gray (10YR 3/1, moist) silty clay loam; moderate very fine subangular blocky structure; firm.

B_{21} 17 to 22 inches, very dark grayish-brown (10YR 3/2, moist) light to medium silty clay; strong fine subangular blocky structure; a few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); color within peds is dark grayish brown (10YR 4/2, moist); firm to very firm.

B_{22} 22 to 28 inches, dark grayish-brown (2.5Y 4/2, moist) light to medium silty clay; moderate fine blocky structure; a few, fine, faint mottles of light olive brown (2.5Y 5/6, moist) and strong brown (7.5YR 5/6, moist); firm to very firm.

B_3 28 to 38 inches, grayish-brown (2.5Y 5/2, moist) heavy silty clay loam; weak fine blocky structure; many, coarse, prominent mottles of light olive brown (2.5Y 5/6, moist); firm.

C 38 inches +, grayish-brown (2.5Y 5/2, moist) light silty clay loam; massive (structureless); common, coarse, prominent mottles and stains of light olive brown (2.5Y 5/6 to 6/6, moist); a few, fine, dark iron-manganese concretions; friable.

Variations.—The thickness of the A horizons ranges from 6 to 15 inches. In areas that are waterlogged during the wetter season, the color of the B horizons is mixed olive brown or yellowish brown and very dark gray to grayish brown.

HAGENER LOAMY FINE SAND (slope of about 7 percent)

A 0 to 20 inches, very dark grayish-brown (10YR 3/2, moist) loamy fine sand; single grain (structureless); loose when moist.

B 20 to 30 inches, dark-brown (10YR 4/3, moist) fine sand; single grain (structureless); loose when moist.

C 30 to 45 inches, dark yellowish-brown (10YR 4/4, moist) fine sand; single grain (structureless); loose when moist.

Variations.—The thickness of the A horizon varies according to the degree of erosion.

KATO SILTY CLAY LOAM (slope of less than 1 percent)

A_{1p} 0 to 6 inches, very dark gray (10YR 3/1, moist) light silty clay loam or silt loam; slightly browner (10YR 3/1.5) when crushed; weak fine granular structure; friable.

A_{12} 6 to 15 inches, very dark gray (10YR 3/1, moist) light silty clay loam; very dark grayish brown (10YR 3/2) when crushed; weak fine subangular blocky structure that breaks to weak fine granular; friable.

B_1 15 to 21 inches, very dark gray (10YR 3/1 to 2.5Y 3/1, moist) light silty clay loam; weak fine subangular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); friable.

B_2 21 to 32 inches, very dark grayish-brown (10YR 3/2, moist) medium silty clay loam; weak fine subangular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); firm.

B_3 32 to 45 inches, dark grayish-brown (10YR 4/2, moist) light silty clay loam; very weak medium subangular blocky structure; many, medium, prominent mottles of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; firm.

C 45 inches +, brown (10YR 5/3, moist) light silty clay loam; massive (structureless); in places surfaces of peds dark gray (10YR 4/1, moist); many, fine, prominent mottles of yellowish brown (10YR 5/6 to 5/8, moist); firm.

Variations.—The thickness of the A horizons and the degree of mottling in the B horizons vary.

MAHASKA SILTY CLAY LOAM (slope of about 3 percent)

A_{11} 0 to 6 inches, very dark brown (10YR 2/2, moist) light silty clay loam; moderate fine crumb structure; friable.

A_{12} 6 to 11 inches, very dark brown (10YR 2/2, moist) light silty clay loam; moderate fine granular structure; friable.

A_3 11 to 14 inches, very dark brown (10YR 2/2, moist) medium silty clay loam; strong medium granular structure; friable.

B_1 14 to 18 inches, very dark grayish-brown (10YR 3/2, moist) heavy silty clay loam; moderate to strong fine subangular blocky structure; a few, fine, faint mottles of light olive brown (2.5Y 5/6, moist); firm.

B_{21} 18 to 24 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay to heavy silty clay loam; strong medium subangular blocky structure; a few, fine, faint mottles of light olive brown (2.5Y 5/6, moist); firm.

B_{22} 24 to 31 inches, olive-gray (5Y 5/2, moist) light silty clay to heavy silty clay loam; weak medium subangular blocky structure; many, coarse, prominent mottles of light olive brown (2.5Y 5/6, moist); firm.

B_3 31 to 40 inches, olive-gray (5Y 5/2, moist) light silty clay loam; weak coarse subangular blocky structure; many, coarse, prominent mottles of light olive brown (2.5Y 5/6, moist); firm.

C 40 inches +, light olive-gray (5Y 6/2, moist) silt loam; massive (structureless); common, coarse, prominent mottles of strong brown (7.5YR 5/8, moist); friable.

Variations.—On slopes of less than 2 percent, the combined A horizons are 12 to 16 inches thick.

OTLEY SILTY CLAY LOAM (slope of about 7 percent)

A_{11} 0 to 6 inches, very dark brown (10YR 2/2, moist) light silty clay loam; moderate fine crumb structure; very friable.

A_{12} 6 to 10 inches, very dark grayish-brown (10YR 3/2, moist) light silty clay loam; strong fine granular structure; very friable.

A_3 10 to 15 inches, dark-brown (10YR 3/3, moist) medium silty clay loam; strong medium granular structure; friable.

B_{21} 15 to 25 inches, brown (10YR 4/3, moist) heavy silty clay loam; strong fine blocky structure; friable.

B_{22} 25 to 35 inches, brown (10YR 5/3, moist) heavy silty clay loam; medium fine subangular blocky structure; common, medium, distinct mottles of strong brown (7.5YR 5/6, moist); firm.

B_3 35 to 42 inches, light brownish-gray (2.5Y 6/2, moist) light silty clay loam; weak coarse subangular blocky structure; many, coarse, prominent mottles of olive brown (2.5Y 4/4, moist) composing nearly 50 percent of the soil color; friable.

C 42 inches +, light brownish-gray (2.5Y 6/2, moist) silt loam; massive (structureless); many, coarse, prominent mottles of dark yellowish brown (10YR 4/4, moist) make up nearly 50 percent of the soil color; friable.

Variations.—In eroded areas the A horizons are not so thick as in the typical profile.

SHELBY LOAM (slope of about 10 percent)

A_1 0 to 9 inches, very dark brown (10YR 2/2, moist) loam; weak fine granular structure; very friable.

A_3 9 to 13 inches, very dark grayish-brown (10YR 3/2, moist) heavy loam; weak medium granular structure; friable.

B_1 13 to 17 inches, dark-brown (10YR 4/3, moist) clay loam; weak very fine subangular blocky structure; a few, fine, faint mottles of very dark brown (10YR 2/2, moist); friable.

B_2 17 to 24 inches, dark yellowish-brown (10YR 4/4, moist) clay loam of moderate fine subangular blocky structure; a few, fine, faint mottles of dark brown (10YR 4/3, moist) to very dark grayish brown (10YR 3/2, moist); firm.

B_3 24 to 34 inches, variable shades of light brownish-gray (2.5Y 6/2, moist) to yellowish-brown (10YR 5/6, moist) clay loam; weak medium subangular blocky structure; firm; some gravel.

C 34 inches +, light brownish-gray (10YR 6/2, moist) to yellowish-brown (10YR 5/4, moist) sandy clay loam; massive (structureless); firm; some gravel.

Variations.—The texture of the subsoil and the substratum ranges from heavy clay loam to sandy clay loam. The thickness of the dark-colored surface layer varies in proportion to the amount of erosion that has taken place.

Inclusions.—Small areas of Adair soils and Gravity soils, which occur as natural drainageways in the uplands, are mapped with Shelby soils.

WAUKEGAN LOAM (slope of less than 1 percent)

A_1 0 to 10 inches, very dark gray (10YR 3/1, moist) loam; weak fine granular structure; friable.

B_1 10 to 16 inches, dark grayish-brown (10YR 4/2, moist) silt loam to loam; weak fine granular structure; friable.

B_2 16 to 24 inches, dark grayish-brown to dark-brown (10YR 4/2 to 4/3, moist) heavy silt loam to loam; very weak fine subangular blocky structure; friable.

B_3 24 to 33 inches, brown (10YR 5/3, moist) silt loam to loam; weak fine subangular blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); friable.

C 33 inches+, dark yellowish-brown to yellowish-brown (10YR 4/4 to 5/6, moist) stratified loam and sandy loam; massive (structureless); friable.

Variations.—The thickness of the A_1 horizon and the color of the B_1 and B_2 horizons vary. The amount of sand in the A_1 and the B horizons varies; the texture ranges from loam to silt loam.

Intrazonal soils

The intrazonal order is made up of soils with well-developed characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the normal effect of climate and vegetation (*15*). In this county the intrazonal soils include the Wiesenboden and Planosol great soil groups.

Wiesenbodens.—The Wiesenbodens are an intrazonal group of soils that have a thick, black to very dark gray surface horizon that is high in organic matter and is underlain by a gleyed subsoil. They have developed under grasses and sedges, mostly in a humid or subhumid climate. They occur mainly in flat areas or depressions and under natural conditions were saturated with water much of the year.

In Jefferson County the Haig, Taintor, Clarinda, and Wabash soils are classified as Wiesenbodens. The Taintor soil can be adequately drained by tile. The soils of the Wabash, Clarinda, and Haig series, however, have finer textured, less permeable subsoils and are more difficult to drain. A profile description of a member of each of these series follows:

CLARINDA SOILS (slope of about 6 percent)

A_1 0 to 4 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay loam; weak fine granular structure; friable.

B_{21} 4 to 15 inches, gray (2.5Y 5/1, moist) clay; moderate medium angular blocky structure; a few, fine, prominent mottles of yellowish brown to strong brown (10YR 5/6 to 7.5YR 5/6, moist); peds adhere to each other when moist or wet; firm.

B_{22} 15 to 50 inches, gray (5Y 5/1, moist) clay; moderate medium angular blocky structure; lacks bright mottling of B_{21} horizon; firm.

Variations.—In places the B horizon consists of brownish-gray or olive-gray silty clay or clay ranging in thickness from a few feet to several feet.

HAIG SILTY CLAY LOAM (slope of less than 1 percent)

A_{1p} 0 to 6 inches, black (10YR 2/1, moist) light silty clay loam; strong fine granular structure; slightly firm.

A_{12} 6 to 10 inches, black (10YR 2/1, moist) light silty clay loam; strong medium granular structure; slightly firm.

A_3 10 to 14 inches, black (10YR 2/1, moist) heavy silty clay loam; strong very fine subangular blocky structure; firm.

B_1 14 to 17 inches, black to very dark gray (10YR 2.5/1, moist) light silty clay; strong very fine subangular blocky structure; a few, faint mottles of yellowish brown (10YR 5/6, moist); firm.

B_{21} 17 to 20 inches, very dark gray (10YR 3/1, moist) medium silty clay; strong fine subangular blocky structure; a few, fine, faint mottles of dark grayish brown (10YR 4/2, moist); very firm.

B_{22} 20 to 23 inches, very dark gray to very dark grayish brown (2.5Y 3/1.5, moist) medium silty clay; moderate medium subangular blocky structure; a few, fine, faint mottles of dark grayish brown (2.5Y 4/2, moist); very firm.

B_{23} 23 to 27 inches, very dark grayish-brown (2.5Y 3/2, moist) light silty clay; moderate medium subangular blocky structure; common, medium, distinct mottles of light olive brown (2.5Y 5/4, moist) and yellowish brown (10YR 5/6, moist); very firm.

B_3 27 to 34 inches, olive-gray (5Y 4/2, moist) heavy silty clay loam; olive-gray coloring is principally on structural surfaces, but the coloring within the peds is olive (5Y 5/3, moist); moderate medium subangular blocky structure that tends toward weak medium prismatic; a few, medium, distinct mottles of yellowish brown (10YR 5/6, moist); firm.

C_1 34 to 40 inches, olive (5Y 5/3, moist) medium silty clay loam; very weak medium blocky structure to massive; a few, fine, distinct mottles of yellowish brown (10YR 5/6, moist); a few dark stains of dark olive gray to olive gray (5Y 3/2 to 4/2, moist) on structural surfaces.

C 40 inches +, light olive-gray (5Y 6/2, moist) light silty clay loam; massive (structureless); a few, fine, faint mottles of yellowish brown (10YR 5/8, moist); a few olive-gray to dark olive-gray (5Y 4/2 to 3/2, moist) stains on root channels; a few pinholes; slightly firm.

Variations.—The Haig soils associated with Mahaska soils in the northern part of Jefferson County have less clay in the B horizon than the Haig soils associated with Grundy soils in the southern part of the county.

TAINTOR SILTY CLAY LOAM (slope of less than 1 percent)

A_{1p} 0 to 7 inches, black (10YR 2/1, moist) heavy silty clay loam; moderate fine granular structure; firm.

A_{12} 7 to 11 inches, black (10YR 2/1, moist) heavy silty clay loam (near silty clay); strong very fine subangular blocky structure; firm.

A_3 11 to 15 inches, black (10YR 2/1, moist) light silty clay; strong very fine subangular blocky structure; firm.

B_1 15 to 18 inches, black (2.5Y 2/1, moist) light silty clay; strong very fine subangular blocky structure; a few, fine, faint mottles of very dark grayish brown (2.5Y 3/2, moist) and very few specks of yellowish brown (10YR 5/6, moist); very firm.

B_{21g} 18 to 21 inches, very dark gray (2.5Y 3/1, moist) light silty clay; strong fine subangular blocky structure; a few, fine, faint mottles of dark grayish brown to very dark grayish brown (2.5Y 4/2 to 3/2, moist) and a few specks of yellowish brown (10YR 5/6. moist); very firm.

B_{22g} 21 to 24 inches, very dark gray (2.5Y 3/1, moist) light silty clay; light olive brown (2.5Y 5/3, moist) in center of the peds; weak medium prismatic structure that breaks to strong medium subangular blocky; a few, fine, faint mottles of dark grayish brown to olive brown (2.5Y 4/2 to 4/4, moist); common specks of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; firm.

B_{23g} or B_{3g} 24 to 28 inches, very dark gray (2.5Y 3/1, moist) heavy silty clay loam; moderate medium prismatic structure that breaks to moderate medium blocky; a few, fine, faint mottles of dark grayish brown to light olive brown (2.5Y 4/2 to 5/4, moist); specks of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; firm.

B_{3g} 28 to 35 inches, dark-gray (5Y 4/1, moist) silty clay loam; weak medium blocky and weak medium prismatic structure; a few, fine, faint mottles of olive (5Y 5/3, moist) and a few spots of yellowish brown (10YR 5/6 to 5/8, moist); small pinholes; some iron-manganese concretions; friable.

C 35 inches +, light olive-gray (5Y 6/2, moist) light silty clay loam; massive (structureless); a few, fine, faint stains of yellowish brown (10YR 5/8, moist); many small pinholes; friable.

Variations.—In the areas in the southern part of the county, the B horizons contain slightly more clay and are more slowly permeable than the B horizons in the areas in the northwestern part.

WABASH SILTY CLAY (slope of less than 1 percent)

A_{1p} 0 to 7 inches, black (10YR 2/1, moist) medium silty clay; very weak very fine granular structure to massive; firm to very firm.

A_{12} 7 to 16 inches, black (10YR 2/1 to 2.5Y 2/0, moist) medium silty clay; moderate very fine and fine subangular and angular blocky structure; a few hard iron-manganese concretions, 1 to 4 millimeters in diameter; firm to very firm.

B_1 16 to 21 inches, black (2.5Y 2/1, moist) medium silty clay; weak fine angular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/6, moist); a few dark iron-manganese concretions; firm to very firm.

B_2 21 to 28 inches, black (2.5Y 2/1, moist) medium silty clay; moderate fine and medium angular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/8, moist); a few dark iron-manganese concretions; firm to very firm.

B_3 28 to 35 inches, black (2.5Y 2/1, moist) light silty clay; weak fine and medium angular blocky structure; common, fine, prominent mottles of brown (10YR 4/3, moist); firm to very firm.

C_1 35 inches +, very dark gray (2.5Y 3/1, moist) light silty clay (near silty clay loam); weak medium angular blocky structure to massive; many, fine, prominent mottles of brown (10YR 4/3, moist); firm.

Planosols.—The Planosols belong to the intrazonal order. They have eluviated surface and subsurface horizons underlain by B horizons that are more strongly illuviated or compacted than the associated soils. The soils have formed in a humid climate under grass or forest vegetation, generally on nearly level or depressional topography.

In Jefferson County the soils of the Planosol great soil group have developed on nearly level areas or depressions. They have a claypan in the subsoil, and there is an abrupt boundary between the A and B horizons. The members of the Planosol group can be divided as follows: (1) Soils developed under prairie—Edina, Blockton, and Sperry; (2) soils developed under forest—Beckwith, Berwick, and Curran; and (3) soils developed under prairie that was invaded by forest—Belinda, Coppock, and Rubio.

The Blockton soils are not typical of the Planosols in Jefferson County because the A_2 horizon is very weakly expressed and the boundary between the A and B horizons is not abrupt. The Coppock soil was formed from stream alluvium and has less strongly developed B horizons than the other Planosols in Jefferson County. Profile descriptions of Planosols in Jefferson County follow:

BECKWITH SILT LOAM (slope of less than 1 percent)

A_1 0 to 6 inches, dark grayish-brown (10YR 4/2, moist) silt loam; weak thin platy structure that breaks to very fine crumb; a few, fine, distinct mottles of yellowish brown (10YR 5/6, moist); a few, fine, dark iron-manganese concretions; friable.

A_{21} 6 to 9 inches, grayish-brown (10YR 5/2, moist) silt loam; moderate very thin platy structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); a few, fine, dark iron-manganese concretions; friable.

A_{22} 9 to 14 inches, light brownish-gray (10YR 6/2, moist) silt loam; moderate thin platy structure; plates grayish brown (10YR 5/2, moist); a few, fine, dark iron-manganese concretions; many small pinholes; friable.

A_{23} 14 to 16 inches, grayish-brown (10YR 5/2, moist) silty clay loam; weak very fine blocky structure; aggregates coated with light brownish gray (10YR 6/2, dry); a few, fine, dark iron-manganese concretions; many small pinholes; friable.

B_{21} 16 to 19 inches, dark grayish-brown (10YR 4/2, moist) medium silty clay; moderate fine subangular blocky structure; a few, fine, faint mottles of dark brown to brown (10YR 4/3 to 5/3, moist); a few, dark, iron-manganese concretions; very firm.

B_{22} 19 to 22 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; strong fine subangular blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; very firm.

B_{23} 22 to 25 inches, grayish-brown (2.5Y 5/2, moist) medium silty clay; moderate fine angular blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/4, moist); a very few small, dark, iron-manganese concretions; very firm.

B_{24} 25 to 31 inches, grayish-brown (2.5Y 5/2, moist) to light brownish-gray (2.5Y 6/2, moist) medium silty clay; moderate strong blocky structure; a few, fine, faint mottles of yellowish brown (10YR 5/4, moist); a very few small, dark, iron-manganese concretions; very firm.

B_3 31 to 45 inches, light brownish-gray (2.5Y 6/2, moist) light silty clay; weak fine blocky structure; many, medium, distinct mottles of yellowish brown (10YR 5/4, moist); streaks of dark gray (10YR 4/1, dry); a few dark iron-manganese concretions; firm.

C 45 inches+, mottled light brownish-gray (2.5Y 6/2, moist) and yellowish-brown (10YR 5/6, moist) light silty clay loam with streaks of dark gray (10YR 4/1, dry); massive to weak fine blocky structure; soft, dark, iron-manganese concretions; a few root channels; friable.

Variations.—The thickness of the gray surface layer varies according to the width of the flats; it is thickest on the wider flats.

BELINDA SILT LOAM (slope of less than 1 percent)

A_{1p} 0 to 6 inches, very dark gray (10YR 3/1, moist) silt loam; weak fine crumb structure; very friable.

A_{12} 6 to 12 inches, very dark gray (10YR 3/1, moist) silt loam; weak fine granular structure; very friable.

A_2 12 to 16 inches, gray (10YR 5/1, moist) silt loam; moderate medium granular structure; friable.

B_{21} 16 to 20 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; moderate fine subangular blocky structure; a few, fine, faint mottles of light olive brown (2.5Y 5/6, moist); very firm.

B_{22} 20 to 25 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; strong medium subangular blocky structure; many, medium, distinct mottles of light olive brown (2.5Y 5/4, moist); very firm.

B_{23} 25 to 29 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; moderate coarse subangular blocky structure; many, coarse, prominent mottles of yellowish brown (10YR 5/6, moist); very firm.

B_3 29 to 39 inches, olive (5Y 5/6, moist) and yellowish-brown (10YR 5/6, moist) heavy silty clay loam; weak coarse subangular blocky structure; firm.

C 39 inches+, olive (5Y 5/6, moist) and yellowish-brown (10YR 5/6, moist) silty clay loam; massive (structureless); slightly firm.

Variations.—The A_1 layer ranges in color from very dark gray to grayish brown and in thickness from 4 to 12 inches.

BERWICK SILT LOAM (slope of about 1 percent)[8]

A_1 0 to 6 inches, very dark gray to dark gray (10YR 3/1 to 4/1, moist) silt loam; weak thin platy structure; a few, fine, faint mottles of yellowish brown (10YR 5/8, moist); friable.

A_2 6 to 13 inches, gray (10YR 5/1, moist) silt loam; moderate medium platy to weak fine subangular blocky structure; upper plates gray (10YR 5/1, moist), lower plates dark brown (10YR 4/3, moist); a few, fine faint mottles of strong brown (7.5YR 5/8, moist); a few iron-manganese concretions of pinhead size; friable.

B_1 13 to 16 inches, dark-gray and dark grayish-brown (10YR 4/1 to 4/2, moist) heavy silty clay loam; moderate medium subangular blocky structure; a few, fine, faint mottles of strong brown (7.5YR 5/8, moist); peds light brownish gray (10YR 6/2, dry); firm.

B_{21} 16 to 28 inches, grayish-brown and dark grayish-brown (2.5Y 5/2 to 4/2, moist) medium to light silty clay; moderate to strong fine blocky structure; common, medium, distinct mottles of strong brown to brownish yellow (7.5YR 5/8 to 10YR 6/8, moist); firm.

B_{22} 28 to 38 inches, grayish-brown (2.5Y 5/2, moist) light silty clay; weak coarse blocky structure; many, coarse, prominent mottles of strong brown (7.5YR 5/8, moist) to brownish yellow (10YR 6/8, moist); some iron-manganese concretions; firm.

C 38 inches+, grayish-brown (2.5Y 5/2, moist) medium silty clay loam; massive (structureless); mottled same as B_{22} horizon; concretions similar to those in B_{22} horizon but soft; firm.

Variations.—The color and degree of mottling in the subsoil vary according to the width of the areas of this soil. In the wider areas the subsoil tends to be grayer.

BLOCKTON SILTY CLAY LOAM (slope of less than 1 percent)

A_{1p} 0 to 7 inches, very dark gray (10YR 3/1, moist) light to medium silty clay loam; weak fine granular structure; friable.

A_{12} 7 to 13 inches, very dark gray (10YR 3/1, moist) medium silty clay loam; when crushed, peds are dark gray to dark grayish brown (10YR 4/1 to 4/2, moist); moderate fine subangular blocky structure; friable; slight graying in the lower part of the horizon, not prominent in most profiles, becomes more distinct when soil is dry (this appears to be a weak A_2 development).

B_1 13 to 18 inches, black (10YR 2/1, moist) heavy silty clay loam (near silty clay); moderate fine subangular blocky structure; friable.

B_{21} 18 to 24 inches, very dark gray (10YR 3/1, moist) medium silty clay; moderate fine subangular blocky structure; a few fine, faint mottles of dark yellowish brown to yellowish brown (10YR 4/4 to 5/4, moist); firm.

B_{22} 24 to 32 inches, very dark gray (2.5Y 3/1, moist) medium silty clay; moderate fine angular blocky structure; firm.

B_3 32 to 38 inches, dark-gray (2.5Y 4/1, moist) light silty clay; weak fine and medium angular blocky; firm.

C 38 inches +, gray (2.5Y 5/1, moist) silty clay loam; massive (structureless); very firm.

Variations.—The thickness of the combined A horizons ranges from 12 to 18 inches. In the lower part of the A_{12} horizon, the color ranges from a faint gray cast to a fairly prominent ashy gray.

COPPOCK SILT LOAM (slope of less than 1 percent)

A_1 0 to 12 inches, very dark brown (10YR 2/2, moist) silt loam; moderate fine crumb structure; friable.

A_2 12 to 18 inches, dark-gray (10YR 4/1.5, moist) silt loam; moderate medium granular structure; friable.

B 18 to 32 inches, light brownish-gray (2.5Y 6/2, moist) medium silty clay loam; weak fine subangular blocky structure; common, medium, distinct mottles of brown (10YR 5/3, moist); slightly firm.

C 32 inches +, light brownish-gray (2.5Y 6/2, moist) silt loam; massive (structureless); many, medium, distinct mottles of brown (10YR 5/3, moist); friable.

Variations.—The thickness of the A horizon varies. In some areas the material below a depth of 35 inches is light silty clay. The depth to the C horizon ranges from 25 to 40 inches.

CURRAN SILT LOAM (slope of less than 1 percent)

A_1 0 to 8 inches, dark grayish-brown (10YR 4/2, moist) silt loam or loam; weak very fine granular structure; friable.

A_2 8 to 18 inches, grayish-brown (10YR 5/2, moist) silt loam; strong medium platy structure; a few fine, faint mottles of yellowish brown (10YR 5/6, moist); friable.

B_1 18 to 25 inches, grayish-brown (10YR 5/2, moist) silty clay loam; moderate fine subangular blocky structure; a considerable amount of gray coloring extends from the A_2 horizon into this horizon; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); firm.

B_2 25 to 40 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay; moderate fine subangular blocky structure; many fine, faint mottles of yellowish brown (10YR 5/6, moist); firm to very firm.

B_3 40 to 48 inches, grayish-brown (2.5Y 5/2, moist) silty clay loam; weak fine subangular blocky structure; many medium, distinct mottles of yellowish brown (10YR 5/6, moist); firm.

C 48 inches +, light brownish-gray (2.5Y 6/2, moist) loam; massive (structureless), many, medium, distinct mottles of strong brown (7.5YR 5/6, moist); friable.

Variations.—The thickness of the A_1 horizon ranges from 6 to 10 inches. The color of the B horizon ranges from dark grayish brown to olive brown.

CURRAN SILT LOAM, THICK A_2 VARIANT (slope of about 2 percent)

A_{11} 0 to 6 inches, dark-gray (10YR 4/1, moist) silt loam; weak thin platy to weak fine granular structure; friable.

A_{12} 6 to 11 inches, dark-gray (10YR 4/1, moist) silt loam; distinctly browner (10YR 4/3, moist) when crushed; weak thin platy to weak fine subangular blocky; many, fine, faint mottles of dark grayish brown to dark brown (10YR 4/2 to 4/3, moist); friable.

A_{21} 11 to 16 inches, grayish-brown to brown (10YR 5/2 to 5/3, moist) silt loam; moderate thin platy structure but breaks readily to moderate fine subangular blocky, with a horizontal axis; many, fine, distinct mottles of dark brown (10YR 4/3, moist); distinct gray (10YR 5/1, dry) coatings on peds; dark brown (10YR 4/3, moist) when crushed; friable.

[8] Since this report was written, field studies have indicated that the soils called Berwick in Jefferson County are less well drained than the Berwick soils mapped in Illinois and more closely resemble the Rushville soils of that State.

A_{22} 16 to 22 inches, grayish-brown and light brownish-gray (10YR 5/2 and 6/2, moist) silt loam (contains considerable amount of fine sand); weak thin platy and moderate fine and medium subangular blocky structure; many, medium, prominent mottles of dark brown to dark yellowish brown (10YR 4/3 to 4/4, moist); friable.

B_1 22 to 28 inches, grayish-brown (10YR 5/2, moist) heavy silt loam; moderate medium subangular blocky structure; many, medium, prominent mottles of dark brown to dark yellowish brown (10YR 4/3 to 4/4, moist); distinct gray (10YR 5/1, dry) coatings; friable.

B_{21} 28 to 35 inches, dark yellowish-brown and yellowish-brown (10YR 4/4 to 5/6, moist) medium silty clay loam; moderate medium subangular blocky structure; many, medium, prominent mottles of grayish brown (10YR 5/2, moist); firm.

B_{22} 35 to 40 inches, grayish-brown (10YR 5/2, moist) heavy silty clay loam; moderate coarse and medium subangular blocky structure; many, medium, prominent mottles of dark yellowish brown and yellowish brown (10YR 4/4 to 5/6, moist); very firm.

B_{23} or B_3 40 to 60 inches, grayish-brown (10YR 5/2, moist) light silty clay; weak coarse subangular blocky structure; many, medium mottles of yellowish brown (10YR 5/6, moist); very firm.

C 60 inches +, gray (10YR 5/1, moist) light silty clay; weak medium and coarse subangular blocky structure; many, coarse, prominent mottles of dark yellowish brown (10YR 4/4, moist); friable to firm.

Variations.—The thickness of the combined A_{21} and A_{22} horizons ranges from 10 to 20 inches. In places the texture of the B_1 horizon is heavy silt loam to medium silty clay loam.

EDINA SILT LOAM (slope of less than 1 percent)

A_1 0 to 8 inches, very dark brown (10YR 2.5/2, moist) silt loam; weak very fine granular structure; friable.

A_2 8 to 18 inches, very dark gray to dark-gray (10YR 3.5/1, clay loam; moderate fine subangular blocky structure; distinct gray coatings on peds; friable.

B_1 18 to 21 inches, very dark gray (10YR 3/1, moist) heavy silty clay loam; moderate fine subangular blocky structure; distinct gray coatings on peds; friable.

B_{21} 21 to 32 inches, very dark gray (10YR 3/1, moist) medium silty clay; moderate fine subangular blocky structure; a few, medium, distinct mottles of strong brown (7.5YR 5/8, moist); some concretions; very firm.

B_{22} 32 to 48 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; weak fine subangular blocky structure; a few, medium, distinct mottles of strong brown (7.5YR 5/6 to 5/8, moist); very firm.

C 48 inches +, olive-gray (5Y 4/2, moist) light silty clay loam; massive (structureless); common, medium, distinct mottles of yellowish brown (10YR 5/8, moist); many iron-manganese concretions; friable.

Variations.—The gray layer is more strongly developed in depressions than in the typical profile, and it is less strongly developed in slightly sloping areas.

RUBIO SILT LOAM (slope of less than 1 percent)

A_{1p} 0 to 7 inches, very dark gray (10YR 3/1, moist) silt loam; weak fine crumb structure; friable.

A_{11} 7 to 12 inches, very dark gray (10YR 3/1, moist) silt loam; weak fine and medium granular structure; friable.

A_{21} 12 to 15 inches, dark-gray (10YR 4/1, moist) silt loam; moderate thin platy structure that breaks to moderate very fine angular blocky; firm.

A_{22} 15 to 18 inches, dark-gray (10YR 4/1, moist) heavy silt loam; strong very fine angular blocky structure; firm.

B_{21} 18 to 24 inches, dark-gray (10YR 4/1, moist) medium silty clay; weak coarse angular blocky but breaks readily to strong very fine angular blocky structure; many, fine, distinct mottles of yellowish brown (10YR 5/6, moist); very firm.

B_{22} 24 to 30 inches, dark grayish-brown (2.5Y 4/2, moist) medium silty clay; weak coarse angular blocky but breaks readily to strong fine and very fine angular blocky structure; common, medium, distinct mottles of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; a few pinholes; very firm.

B_{23} 30 to 37 inches, dark grayish-brown (2.5Y 4/2, moist) light silty clay; strong very fine angular blocky structure; common, medium, distinct mottles of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; surfaces of a few peds are grayish brown (2.5Y 5/2, moist), and surfaces of a very few peds are dark gray (2.5Y 4/1, moist); firm to very firm.

B_3 37 to 44 inches, grayish-brown (2.5Y 5/2, moist) medium silty clay loam; weak fine angular blocky structure with a few larger peds; many, medium, prominent mottles of yellowish brown (10YR 5/6, moist) on nearly half of the ped faces; other surfaces darker—dark grayish brown to very dark gray (2.5Y 4/2 to 3/1, moist); a few dark iron-manganese concretions; firm.

C_1 44 to 53 inches, light brownish-gray (2.5Y 6/2, moist) light silty clay loam; massive (structureless); many, medium and coarse, prominent mottles of yellowish brown (10YR 5/6, moist); a few very dark gray (10YR 3/1, moist) streaks; a very few dark iron-manganese concretions; firm.

C 53 to 58 inches, various shades of light brownish-gray to light olive-gray or light-gray (2.5Y 6/2 to 7/2 or 5Y 6/2 to 7/2, moist) light silty clay loam; massive (structureless); many, medium, prominent mottles of yellowish brown (10YR 5/6, moist); a few dark iron-manganese concretions; friable.

Variations.—The color and depth of the A_{1p} horizon and the degree of mottling in the B horizon vary.

SPERRY SILT LOAM (slope of less than 1 percent)

A_{1p} 0 to 8 inches, black to very dark brown (10YR 2/1.5, moist) silt loam; slightly browner (10YR 2/2, moist) when crushed; weak fine crumb structure; friable.

A_{12} 8 to 12 inches, very dark brown (10YR 2/2, moist) silt loam; weak fine granular structure; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); friable.

A_2 12 to 18 inches, dark-gray (10YR 4/1, moist) silt loam; moderate fine subangular blocky structure that tends toward weak thin platy; a few, fine, faint mottles of yellowish brown (10YR 5/6, moist); sprinkling of gray (10YR 6/1, dry) on surfaces of peds; friable.

B_{21} 18 to 25 inches, very dark gray (10YR 3/1, moist) light to medium silty clay; strong fine subangular blocky structure; many, fine, prominent mottles of yellowish brown (10YR 5/4, moist); firm to very firm.

B_{22} 25 to 30 inches, dark-gray (10YR 4/1, moist) medium silty clay; strong fine and medium angular blocky structure; many, medium, prominent mottles of yellowish brown (10YR 5/4 and 5/6, moist); some pinholes; firm to very firm.

B_{23} 30 to 35 inches, gray (2.5Y 5/1, moist) light silty clay; moderate fine and medium angular blocky structure; many, medium, prominent mottles of yellowish brown (10YR 5/6, moist); many pinholes; firm.

B_3 35 to 42 inches, gray (2.5Y 5/1, moist) medium to heavy silty clay loam; weak fine subangular blocky structure; a very few dark seams of silty clay; a few pinholes; firm.

C_1 42 to 52 inches, gray (2.5Y 6/1, moist) and strong-brown (7.5Y 5/6, moist) light silty clay loam; massive (structureless); a few, soft, dark iron-manganese concretions; friable to slightly firm.

Variations.—The thickness of the A_2 horizon and the B horizon is variable.

Azonal soils

The azonal order consists of soils that do not have well-developed profile characteristics. Their youth, relief, or differences in parent material have prevented a normal profile from forming (*15*). In Jefferson County the Alluvial and Lithosol great soil groups belong to the azonal order.

The alluvial soils have a weakly developed A_1 layer underlain by recently deposited alluvium. The Lithosols have thin A and B horizons or the B horizon is lacking, and they are underlain by shale or limestone bedrock.

Alluvial soils.—The Alluvial great soil group consists of azonal soils that have developed from transported and relatively recently deposited material (alluvium). The profile characteristics of these soils are determined largely by the kinds of sediments deposited.

In Jefferson County, Alluvial land, wet, and the Nodaway soils are in the Alluvial great soil group. A profile description of a Nodaway soil follows.

NODAWAY SILT LOAM (slope of about 1 percent)

A_1 0 to 12 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2, moist) silt loam; weak medium crumb to moderate very fine granular structure; friable.

A_{12} 12 to 20 inches, dark grayish-brown (10YR 4/2, moist) silt loam; weak very fine granular structure; a few, fine, faint mottles of yellowish brown; friable.

C_1 20 to 40 inches, dark grayish-brown or grayish-brown (10YR 4/2 or 5/2, moist) silt loam or very fine sandy loam; structureless; common, medium, prominent mottles and occasional splotches of light gray (10YR 7/2, moist) to pale brown (10YR 6/3, moist); friable.

Variations.—In places the degree of stratification is greater than in the typical profile. In some places dark buried soils occur below a depth of 20 inches.

Lithosols.—The Lithosols are azonal soils that have no clearly expressed soil morphology. They consist of a freshly or imperfectly weathered mass of soil fragments and are confined largely to hilly and steep areas. Included in this great soil group are soils that are very shallow over bedrock and have very weakly developed profiles. Geologic erosion almost keeps pace with the weathering of the rocks.

In Jefferson County the soils of the Gosport and Sogn series are classified as Lithosols. Rough broken and rock land has also been placed in the Lithosol great soil group. Following are profile descriptions of members of the Gosport and Sogn series:

GOSPORT SILT LOAM (slope of about 11 percent)

A_1 0 to 6 inches, very dark gray to dark gray (10YR 3.5/1, moist) silt loam (contains a considerable amount of fine sand); weak very fine granular structure; friable.

B_{11} 6 to 11 inches, dark grayish-brown (10YR 4/2, moist) light silty clay; moderate medium subangular blocky structure; a few, fine, distinct, yellowish-brown mottles (10YR 5/4, moist) on peds; firm.

B_{12} 11 to 15 inches, yellowish-brown (10YR 5/6, moist) clay; moderate medium subangular blocky structure; firm.

C 15 to 30 inches, brown (10YR 5/3, moist) clay; weak medium subangular blocky structure; many, medium, prominent mottles of yellowish brown, strong brown, and dark reddish brown (10YR 5/8, 7.5YR 5/8, and 5YR 3/4, moist); very firm.

D 30 inches +, seam of coal.

Variations.—The thickness of the silt loam surface soil ranges from 2 to about 20 inches. The color and texture of the B horizons vary in places where the soil contains a few lenses of limestone and sandstone or a thin seam of coal.

SOGN SILT LOAM (slope of about 20 percent)

A_1 0 to 6 inches, very dark gray (10YR 3/1, moist) silt loam; friable.

C_1 6 to 12 inches, dark yellowish-brown (10YR 4/4, moist) silt loam; fragments of limestone; friable.

D 12 inches +, limestone.

Variations.—The thickness of the soil material and the amount of limestone fragments within the soil and on the surface vary. In many places the dark A_1 horizon is immediately above the D horizon. In some areas the bedrock is limy shale instead of limestone.

Additional Facts About Jefferson County

The following section discusses the early history of Jefferson County, the physiography and drainage, climate, water supply, agriculture, transportation, and community facilities.

Early Settlement

The settlement of the area that is now Jefferson County began in 1835. In that year the first homestead was established in what is now Round Prairie Township. The settlers soon began to plant corn, potatoes, and turnips, and a little later they began to grow wheat. The first corn crop yielded only 12 bushels per acre.

Jefferson County, formed from part of Henry County, was organized in 1839 by an act of the Legislature of the Iowa Territory. The county seat was located where the town of Fairfield now stands.

Physiography and Drainage

The topography of Jefferson County is that of a broad plain (*14*) dissected by streams that extend into nearly all parts of the county. The land surface can be classified according to topography as (1) level to rolling upland remnants, (2) rolling to steep uplands, (3) terraces, and (4) bottom lands.

The level to rolling upland remnants occupy strips that range in width from one-half mile in the southeastern part of the county to 8 miles in the northwestern part.

The rolling to steep uplands have a much rougher topography than the level to rolling uplands because they have been cut extensively by geologic erosion. These areas extend from the irregular margins of the broad plains down to the bottom lands. They occupy much of the county. The longer slopes, which occur along the larger streams, have their greatest descent along Walnut Creek in Walnut Township and along the tributaries of the Des Moines River in Des Moines Township. These and other hilly and steep areas strikingly contrast with the more gently rolling areas of the upland plain.

Terraces occur in various places along the main streams—the Skunk River and Cedar Creek—and along a few of their tributaries. They occupy long, narrow strips. None of the areas are large.

The bottom lands, flat lowlands subject to overflow, occupy narrow bands along the streams. Their width is determined largely by the kind of soil material that the streams have cut through. Where a stream flows through less dense material, such as loess or glacial drift, the bottom lands are wide. Such an area lies along Cedar Creek in Locust Grove, Center, and Liberty Townships. But in Cedar and Round Prairie Townships, where Cedar Creek cuts through rock and other less easily eroded materials, the bottom lands are narrow and the bluffs extend almost to the stream.

The highest elevation, 835 feet above sea level, is at Pekin. The lowest, which is 570 feet above sea level, is in the extreme northeastern corner of the county.

The Skunk River and its tributaries drain most of the county. The rest of the county is drained by the tributaries of the Des Moines River. The chief tributaries of the Skunk River are Burr Oak Creek, Walnut Creek, and Rocky Branch, which drain the northern part of the county, and Brush Creek, which drains the east-central part. The southern, south-central, and west-central parts of the county are drained by Cedar Creek and its tributaries, principally Coon, Competine, and Rock Creeks. The extreme southwestern part is drained by Stump and Lick Creeks, which are small streams that flow into the Des Moines River to the south of Jefferson County.

In general the drainage system of the county is fairly well developed. The principal streams or their tributaries extend into all parts of the uplands. The prevailing drainage is to the southeast. Some parts of the uplands, particularly areas of Taintor and Haig silty clay loams, and some areas of the Grundy silty clay loams, are inadequately drained. In some of these places, artificial drainage is needed.

Climate

Jefferson County has a humid, continental climate with warm summers and moderately cold winters. The climate is fairly uniform throughout the county. The normal monthly, seasonal, and annual temperatures, and precipitation as recorded by the United States Weather Bureau Station at Fairfield are given in table 10.

TABLE 10.—*Temperature and precipitation at Fairfield Station, Jefferson County, Iowa*

[Elevation, 780 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1910)	Wettest year (1858)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	27. 2	69	−18	1. 40	0. 55	4. 70	6. 4
January	23. 1	67	−21	1. 20	2. 02	2. 35	6. 7
February	26. 0	69	−24	1. 40	. 66	2. 55	5. 9
Winter	25. 4	69	−24	4. 00	3. 23	9. 60	19. 0
March	38. 3	84	−12	2. 26	. 53	3. 05	6. 4
April	50. 4	89	11	3. 10	3. 18	6. 84	. 6
May	61. 4	102	26	4. 20	3. 75	8. 47	(3)
Spring	50. 0	102	−12	9. 56	7. 46	18. 36	7. 0
June	70. 8	104	37	4. 89	. 75	6. 94	0
July	75. 7	114	44	3. 77	3. 08	9. 44	(3)
August	73. 7	113	40	3. 70	3. 47	1. 83	0
Summer	73. 4	114	37	12. 36	7. 30	18. 21	(3)
September	66. 0	100	23	4. 00	1. 73	4. 83	. 1
October	53. 4	93	18	2. 50	. 63	6. 20	(3)
November	39. 9	81	−4	1. 90	. 48	8. 70	2. 0
Fall	53. 1	100	−4	8. 40	2. 84	19. 73	2. 1
Year	50. 5	114	−24	34. 32	20. 83	65. 90	28. 1

[1] Average temperature based on a 60-year record, through 1955; highest and lowest temperatures based on a 21-year record, through 1952.

[2] Average precipitation based on a 76-year record, through 1955; wettest and driest years based on a 75-year record, in the period 1856-1955; snowfall, based on a 21-year record, through 1952.

[3] Trace.

Summers are long, hot, and humid; the high humidity causes the nights to be warm. Winters consist of alternating periods of subzero weather and mild temperatures.

The average frost-free season is 159 days, extending from April 28 to October 4. Killing frosts, however, have occurred as late as May 31 and as early as September 11. The growing season is generally long enough for crops to mature. Crops rarely are damaged severely by fall frosts except when the summer has been extremely cool and wet. The grazing season is approximately 215 days, but some grazing is done throughout the winter if snowfall is light and if the pastures are in good condition.

The average annual precipitation is 34.32 inches. Most of the rain falls during the growing season. Severe droughts rarely occur, but occasionally yields of crops are reduced as a result of short periods of hot, dry weather. Most of the rain falls slowly and steadily. Heavy rains accompanied by strong winds and thunderstorms are uncommon but occur often enough to cause extensive erosion on unprotected slopes.

Winds are usually gentle but are strongest in the spring. In winter the prevailing winds are from the northwest, and in summer they are from the southwest. During spring and summer, tornadoes and hailstorms occur rarely, and they are not widespread.

Water Supply

Wells and ponds supply much of the water needed for livestock and other farm uses. To insure a constant supply of good water, it is necessary to drill the wells down through the coal measures (except where this material consists largely of sandrock) and into the underlying limestone.

Fairfield receives fairly soft water from the large ponds northeast of the city. During years when these ponds receive abundant runoff from the surrounding areas, they will supply all the water needed. During dry years the supply of water is supplemented by rather hard water obtained from deep wells. These wells furnish enough water for the city in the winter but do not supply enough in the summer.

Agriculture

The agriculture of Jefferson County is based mainly on the growing of corn and the raising and feeding of livestock. In the following pages, the more outstanding features of the agriculture of the county are pointed out. The statistics used are from reports published by the United States Bureau of the Census.

General farming practices

When this county was first farmed, little attention was given to checking losses of soil and water. The broad-level to gently rolling areas were cropped intensively. The cropping system consisted of a large proportion of row crops and few meadow crops. Fields were tilled up and down the slope instead of on the contour. This type of farming caused the loss of much of the original surface soil. In cultivated fields on rolling to hilly areas, erosion and loss of water presented an even greater problem.

Most of the soils on the steeper areas were originally in forest. These soils have a thinner surface layer than the soils formed under prairie and are lower in natural fertility and productivity. Many of these steeper soils are now used for permanent pasture.

To control erosion and conserve water on cultivated fields, many farmers are now using contouring and strip-cropping and are constructing terraces, grassed waterways, drop inlets, ponds, and tile drainage systems. Permanent pastures are being renovated.

The loss of much of the surface soil through erosion has caused changes in the structure and tilth of the soil. After a long period of intensive cultivation, the crumbly granular structure of the surface soil has been replaced, in many areas, by a less favorable hard, cloddy structure. Meadow crops help to restore good tilth and a crumbly, granular structure to the surface soil.

As crops are harvested, plant nutrients are removed from the soil. Many farmers apply lime and fertilizer and use a suitable rotation to help maintain the supply of plant nutrients and to keep the structure of the soil from deteriorating.

Types, sizes, and tenure of farms

In 1954, 12.7 percent of the farms in Jefferson County were miscellaneous and unclassified. The rest were classified by major source of income as follows:

	Percent
Cash grain	16. 6
Dairy	2. 2
Poultry	1. 3
Livestock (other than dairy or poultry)	55. 4
General	11. 8

The number of farms in the county decreased from 1,782 in 1940 to 1,601 in 1954. During this period, however, the average size of farms increased from 147.8 acres to 160.7 acres. The total land in farms was 257,298 acres in 1954, as compared to 263,453 acres in 1940. Since 1940 an increasing number of farms have been operated by owners. The proportion of farmland operated by tenants was only 25.4 percent in 1954, in contrast to 42.3 percent in 1940.

Crops

Jefferson County is in the hay and pasture belt of Iowa. Nevertheless, in 1954, about 24 percent of the farmland was in corn, 13 percent in oats, 8 percent in soybeans, and a small percentage in other crops. About 12 percent was in hay crops, and the rest was in pasture and woodland.

Corn.—Corn is grown mainly as feed for hogs and for beef and dairy cattle. Some of it is fed to sheep and poultry. The rest of the crop is sold or placed in storage.

Hay crops.—Hay or meadow crops are important not only as feed for cattle but also as soil-conserving crops when grown in a rotation with row crops. A grass-legume mixture of bromegrass and alfalfa is gradually replacing the meadow mixture of timothy and red clover in this county. Alfalfa, because of its long taproot, withstands droughts well and will produce three crops a year. The meadow crop is often stored as silage or as dry hay.

Small grains.—Except for oats, small grains are not grown extensively. Most of the oats are grown as nurse crops for grasses and legumes, but the grain is harvested and fed to cattle, hogs, and poultry.

Soybeans.—Soybeans are becoming more important in Jefferson County. The acreage in soybeans increased from 12,081 acres in 1949 to 19,564 acres in 1954. In level to undulating areas, soybeans fit well into the crop rotation. They are grown mainly as a cash crop.

Pasture and woodland

In 1954 about 35 percent of the farmland was in pasture and 12 percent in woodland. Although pasture and woodland are listed separately, little of the woodland is fenced to keep out livestock. As a result the woodland is of little value, either for pasture or for timber crops.

Livestock and livestock products

Livestock raising is an important industry in Jefferson County. The numbers of domestic animals on farms in 1954 are shown in the following list:

Chickens (4 months old and over)	161, 059
Hogs and pigs	77, 056
Cattle and calves	35, 263
Sheep and lambs	17, 534
Horses and mules	822

In 1954 a total of 5,338,667 pounds of whole milk, 668,967 pounds of butterfat, and 1,101,832 dozen eggs was sold in this county.

Farm buildings and equipment

In Jefferson County the types of farm dwellings and outbuildings and the number of farm improvements vary somewhat according to topography and the kinds of soils. On the level to undulating, dark-colored soils of the uplands and on the soils of the terraces, most of the farm homes are well built and modern. These farms usually have 1 or 2 barns, a corncrib, a machine shed, a hoghouse, a garage, a chickenhouse, and possibly other small sheds.

On the rolling to steep, dark-colored soils of the uplands, the condition of the farmsteads varies; many of these farms are located in valleys. Most of the farmsteads on light-colored soils of the uplands are located on the tabular divides.

Many farms have electricity, telephones, radio and television sets, running water, septic tanks, and furnaces. Fuel oil is used to heat some of the homes. Labor-saving machinery that is available to all farms includes improved types of tractors, combines, hay-harvesting machines, disks, cultivators, cultipackers, harrows, and planters. Workhorses are used but little in the county.

Transportation

Jefferson County is served by many highways and railroads. United States Highway 34 extends across the county from east to west, parallel to the Chicago, Burlington, and Quincy Railroad. Iowa State Highway No. 1 crosses the county from north to south. The highway system includes several other State highways, county highways, all-weather roads, and graded roads. Few farms are more than 1 mile from a road leading to one of the many markets and trading centers located within the county. Fairfield, the largest city, is the principal trading center. Others are Batavia, Libertyville, Lockridge, Pleasant Plain, East Pleasant Plain, Packwood, Linby, and Abingdon.

The Chicago, Burlington, and Quincy Railroad, which connects Chicago and Omaha, extends across the south-central part of the county, passing through Lockridge, Fairfield, and Batavia. A main line of the Chicago, Rock Island, and Pacific Railroad, extending between Chicago and Kansas City, crosses the county from northeast to southwest. It serves East Pleasant Plain, Fairfield, and Libertyville. A main line of the Chicago, Milwaukee, St. Paul and Pacific Railroad, which also connects Chicago and Kansas City, passes through Linby in the extreme northwestern corner of the county. The Minneapolis and St. Louis Railway serves Packwood and Linby.

Community Facilities

Many churches are located in Jefferson County. Most of them are in Fairfield and other towns, but some are in rural areas.

Rural schools furnish instruction through the eighth grade. The number of country schools is gradually decreasing, however. Rural students are transported by bus to the high schools in Fairfield and the other towns. Parsons College, an accredited institution located in Fairfield, offers courses leading to degrees in arts and sciences.

Electricity is available in all parts of the county. Rural mail routes serve the entire county.

Engineering Applications[9]

This soil survey report for Jefferson 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 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 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 soil units for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making soil maps and reports that can be used readily by engineers.

The mapping 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.

[9] This section was prepared in cooperation with the Division of Physical Research, Bureau of Public Roads. Test data in table 11 were obtained in the Soils Laboratory, Bureau of Public Roads.

Soil Science Terminology

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—may 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 mm. (millimeter) in diameter. Clay as a textural class includes soil material that contains 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 mm. to 0.05 mm. As a textural class sand includes soil material that contains 85 percent or more sand and not more than 10 percent clay.

Silt: A soil separate that ranges in diameter from 0.05 mm. to 0.002 mm. As a textural class silt includes soil material that contains 80 percent or more silt and less than 12 percent clay.

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.

Soil Test Data and Engineering Soil Classifications

To be able to make the best use of the soil maps and the soil survey reports, the engineer should know the physical properties of the soil materials and the in-place condition of the soil. After testing soil materials and observing the behavior of soils when used in engineering structures and foundations, the engineer can develop design recommendations for the soil units delineated on the maps.

Soil test data

Soil samples from 3 profiles of each of 3 extensive soil series were tested in accordance with standard procedures (*2*) to help evaluate the soils for engineering purposes. The test data are given in table 11.

The engineering soil classifications in table 11 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming textural classes for soil classification.

The liquid-limit and plastic-limit tests measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid or plastic state. As the moisture content is further increased, the material changes from the plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Table 11 also gives compaction (moisture-density) data for the tested soils. If a soil material is compacted at successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material will increase until the "optimum moisture content" is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in earthwork, for as a rule optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*2*). 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. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best materials to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol, in the next to last column in table 11. The principal characteristics according to which soils are classified in this system are shown in table 12.

Some engineers prefer to use the Unified soil classification system (*16*). In this system, soil materials are identified as coarse-grained (8 classes), fine-grained (6 classes), or highly organic (1 class). An approximate classification can be made in the field. The principal characteristics of the 15 classes of soil are given in table 13. The classification of the tested soils according to the Unified system is given in the last column of table 11.

Soil Engineering Data and Recommendations

Some of the engineering information can be obtained from the soil map. It will often be necessary, however, to refer to other parts of the report, particularly to the sections entitled: Location and Extent, Soil Management, Descriptions of the Soils; Formation and Classification of Soils, and Additional Facts About Jefferson County.

The soil engineering data in table 14 are based on the soil test data in table 11, on information given in the rest of the report, and on experience with the same kinds of soils in other counties.

Soil features affecting highway work

Many of the soils of Jefferson County have formed in several feet of loess that overlies glacial till of the Kansan age. On the nearly level uplands and the tops of ridges, the thickness of the loess ranges from 8 to 10 feet; on the more dissected terrain, the loess is absent and the glacial till outcrops.

The soils derived from loess are generally fine textured, A–6 and A–7 (CL, CH) with A–7 and high group index numbers (poorer materials) predominant. The texture is somewhat different, however, where the terrain is nearly level to gently rolling. Here, some of the finer particles have washed down through the A horizon so that the A horizon is A–4 to A–6; the finer particles have accumulated in the B horizon to form an A–7 with very high group index numbers. The soil material in the B horizon is generally unstable for highway subgrade and should not be used within 5 feet of the gradeline.

The Kansan glacial till that underlies the loess is heterogeneous and is of poor quality. On the nearly level to gently rolling uplands, under the mantle of loess, lies what remains of the original Kansan till plain. Here, the upper layer of the Kansan till is a very plastic clay, or gumbotil, A–7–6 (18–20), that is unstable for highway subgrade and should not be used within 5 feet of finished grade. In places, where the glacial till is on or near the surface, this old layer of gumbotil is evident at the higher elevations. Under the gumbotil the soil is predominantly A–6, but because the material was deposited in different ways, the texture varies. In some areas, pockets of sand and gravel occur, and in others there are pockets or layers of heavy clay.

In the soils derived from loess the seasonally high water table usually lies above the glacial till-loess interface. In the nearly level soils, a thin, perched water table occurs in places, above the B horizon. In these areas the in-place density of the loess is relatively low and the soil has a high moisture content. This high moisture content may cause an unstable foundation condition for a road. If the wet material is used in an embankment, moisture-density control normally will be necessary in grading operations. Because of their high in-place density, the soils derived from glacial till generally do not have an excessively high moisture content. The shrinkage factors used in computing earthwork quantities in grading operations are usually about 30 percent for loess and 10 percent for glacial till. (Geological information of value to engineers is contained in the Iowa Geological Survey Report for Jefferson County, v. 12.)

Frost heaving may be a problem in cut sections where only a few feet of loess overlies a clayey glacial till. It may be a problem even in areas of glacial till in which pockets of coarser textured material occur.

Sodding, paving, or check dams may be needed in gutters and ditches to prevent excessive erosion.

The Nodaway soils and Alluvial land, wet, which are on the lower parts of the bottom lands, may be flooded each year. The Blockton, Cantril, Coppock, Gravity, and Wabash soils, on the higher parts of the bottom lands, are flooded less often. Roadways in these lowlands should be constructed on a continuous embankment that extends above the level reached by frequent floods. Many of the soils of bottom lands have a high moisture content. The layers of fine sand and silt that occur in places in the alluvial soils are susceptible to differential frost heave. Therefore, proper drainage is needed if roads are built on these soils, and foundation materials that are not susceptible to frost action should be used where pavements are to be constructed at an elevation of only a few feet above the water table.

Some of the Hagener and Chelsea soils are susceptible to wind erosion; the slopes of roadways on these soils need protection from both water and wind erosion.

Ratings are given in table 14 to show the suitability of the soils of Jefferson County as sources of topsoil to promote the growth of vegetation on embankments, on cut slopes, and in ditches. These topsoil materials are generally unsuitable for use on shoulders of the highways that are to support limited traffic during wet periods.

At many construction sites there are major variations in the soil within the depth of the proposed excavation,

TABLE 11.—*Engineering test data* [1] *for*

Soil name and location	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density [2]	
					Maximum dry density	Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Grundy silty clay loam:						
100 feet N. of SE. corner of NW¼ SW¼ sec. 10, T. 71 N., R. 11 W. (Modal profile).	Loess (Wisconsin)	S 32174	0 to 7	A_p	96	22
		S 32175	16 to 22	B_2	99	22
		S 32176	41 to 48	C_2	107	17
10 feet N. of SW. corner of sec. 23, T. 72 N., R. 9 W. (Intergrades to Mahaska soil).	Loess (Wisconsin)	S 32177	0 to 8	A_p	95	19
		S 32178	13 to 21	B_{21}	95	19
		S 32179	48 to 56	C_2	109	17
210 feet S. of SE. corner of NW¼ NW¼ sec. 23, T. 71 N., R. 10 W. (Intergrades to Seymour soil).	Loess (Wisconsin)	S 32180	0 to 4	A_p	102	19
		S 32181	13 to 21	B_{22}	94	24
		S 32182	39 to 59	C_2	108	17
Haig silty clay loam:						
240 feet N. of SE. corner of SW¼ NW¼ sec. 10, T. 71 N., R. 11 W. (Modal profile).	Losss (Wisconsin)	S 32183	0 to 7	A_p	99	21
		S 32184	18 to 27	B_{21}	95	21
		S 32185	48 to 65	C_2	109	17
100 feet N. of NW. corner of SW¼ NW¼ sec. 26, T. 72 N., R. 9 W. (Intergrades to Taintor soil).	Loess (Wisconsin)	S 32186	0 to 7	A_p	94	22
		S 32187	23 to 29	B_{21}	94	25
		S 32188	49 to 64	C_2	106	18
160 feet N. and 40 feet E. of SW. corner of NW¼SW¼ sec. 31, T. 71 N., R. 9 W. (Intergrades to Edina soil).	Loess (Wisconsin)	S 32189	0 to 9	A_p	99	21
		S 32190	14 to 23	B_{21}	95	25
		S 32191	52 to 64	C_2	107	19
Weller silt loam:						
470 feet E. of NW. corner of sec. 31, T. 71 N., R. 10 W. (Modal profile).	Loess (Wisconsin)	S 32192	0 to 3	A_1	90	26
		S 32193	15 to 28	B_{21}	97	26
		S 32194	56 to 66	C_2	107	18
880 feet N. and 150 feet E. of SW. corner of sec. 22, T. 71 N., R. 9 W. (More plastic variation of profile).	Loess (Wisconsin)	S 32195	0 to 5	A_1	92	22
		S 32196	24 to 35	B_{22}	98	22
		S 32197	59 to 66	C_2	107	18
600 feet S. of NE. corner of SW¼ SW¼ sec. 27, T. 72 N., R. 10 W. (Intergrades to Clinton soil).	Loess (Wisconsin)	S 32198	0 to 3	A_1	102	19
		S 32199	16 to 24	B_{21}	100	22
		S 32200	49 to 60	C_2	108	18

[1] Tests performed by Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (A. A. S. H. O.).

[2] Compaction test performed in accordance with procedures in A. A. S. H. O. Designation: T 99–49.

[3] Mechanical analyses are based on the soil samples as received by the Bureau of Public Roads Laboratory and tested according to the A. A. S. H. O. Designation: T 88–54. Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the A. A. S. H. O. procedure, the fine material is analyzed

soil samples taken from 9 soil profiles

Mechanical analysis [3]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve				Percentage smaller than—							
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			A. A. S. H. O.[4]	Unified [5]
100	99	98	97	96	74	40	34	44	17	A-7-6 (12)	ML-CL.
100	99	99	99	97	80	47	41	60	32	A-7-6 (20)	CH.
---	---	100	99	98	75	37	31	43	20	A-7-6 (13)	CL.
100	98	97	95	93	71	35	29	44	15	A-7-6 (11)	ML.
100	99	99	99	97	78	48	42	58	32	A-7-6 (20)	CH.
---	---	---	100	98	77	38	29	40	20	A-6 (12)	CL.
100	98	97	96	95	76	38	30	36	13	A-6 (9)	ML-CL.
100	99	99	98	97	81	52	45	68	40	A-7-6 (20)	CH.
---	---	100	99	98	75	35	28	40	18	A-6 (11)	CL.
100	99	98	97	96	73	36	28	38	12	A-6 (9)	ML-CL.
100	99	99	98	97	81	52	44	63	35	A-7-6 (20)	CH.
---	---	---	100	99	78	39	32	42	22	A-7-6 (13)	CL.
100	99	99	98	97	75	36	28	44	16	A-7-6 (11)	ML-CL.
100	99	99	98	97	78	52	46	66	38	A-7-6 (20)	CH.
---	---	---	100	98	78	40	33	47	26	A-7-6 (16)	CL.
---	---	---	100	98	75	37	29	39	14	A-6 (10)	ML-CL.
---	---	---	100	98	82	54	47	66	40	A-7-6 (20)	CH.
---	---	---	100	98	78	40	32	45	24	A-7-6 (15)	CL.
100	99	98	97	95	68	27	19	38	8	A-4 (8)	ML.
---	---	---	100	98	83	52	44	60	33	A-7-6 (20)	CH.
---	---	100	99	98	80	38	30	40	19	A-6 (12)	CL.
100	99	98	97	96	72	30	21	42	11	A-7-5 (9)	ML.
---	---	---	100	98	81	50	44	59	34	A-7-6 (20)	CH.
---	100	99	98	97	79	40	33	40	20	A-6 (12)	CL.
---	---	100	99	97	72	34	26	37	11	A-6 (8)	ML-CL.
---	---	---	100	98	79	48	41	56	31	A-7-6 (19)	CH.
---	100	99	98	97	76	40	30	36	16	A-6 (10)	CL.

by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material in the soil sample, including that coarser than 2 mm. in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 mm. in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes of soils.

[4] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Purposes, A. A. S. H. O. Designation: M 145-49.

[5] Based on the Unified Soil Classification System Tech. Memo. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers, March 1953.

and several soil units occur within short distances. The soil map and profile descriptions, as well as the engineering data and recommendations given in this section, should be used in planning detailed surveys of soils at construction sites. By using the information in the soil survey reports, the soils engineer can concentrate on the most important soil units. Then he can obtain a minimum number of soil samples for laboratory testing, and an adequate soil investigation can be made at minimum cost.

Soil features affecting soil conservation

Following is a discussion of the characteristics of the soils in relation to the conservation of soil and water.

Farm ponds.—Water can be impounded in farm ponds successfully in nearly all of the upland soils of Jefferson County. The Chelsea and Hagener soils and the soils of the Chelsea-Lamont complexes, however, are too sandy and permeable to hold water well. Neither are they suitable as sources of fill material for the earthen dams that are used to impound the water.

Soils that have limestone bedrock near the surface are not suitable as sites for farm ponds. The Kato and Waukegan soils, which have developed on terraces, are unsuitable for farm ponds because they have sandy or gravelly layers near the surface. The Sogn soils and some areas of Rough broken and rock land have bedrock near the surface. This bedrock contains crevices that cause the water to drain away rapidly.

Drainage and irrigation.—The Beckwith, Berwick, Belinda, Curran, Edina, Rubio, and Sperry soils have fine-textured, nearly impermeable layers that generally extend from a depth of approximately 20 inches to a depth of 36 inches. These soils normally occur in small areas. Tiles are not effective in draining them, so surface drainage must be used to a great extent. Likewise, the Wabash and Blockton soils, which are fine-textured and have formed from alluvium, can generally be drained more effectively through surface drains than through tile.

The Clarinda and Adair soils are nearly impermeable, but their principal drainage problem is caused by seepage through the overlying loess. By placing tile lines so as to intercept the seepage effectively, these soils can be drained satisfactorily.

Detailed information concerning drainage and irrigation suggestions for the soils of the county can be obtained from drainage and irrigation guides prepared cooperatively by the 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 of these were published in 1955.

Terraces.—All terraces in Jefferson County should be constructed on a gradient that will permit adequate drainage of the channel. Level terraces are not suitable. The soils are not permeable enough to allow the water that is collected to drain down through the soil within a reasonable length of time.

TABLE 12.—*Classification of soils by American Association of State Highway Officials* [1]

General classification	Granular materials (35 percent or less passing No. 200 sieve)							Silt-clay materials (More than 35 percent passing No. 200 sieve)				
Group classification	A–1		A–3	A–2				A–4	A–5	A–6	A–7	
	A–1–a	A–1–b		A–2–4	A–2–5	A–2–6	A–2–7				A–7–5	A–7–6
Sieve analysis: Percent passing—												
No. 10	50 maximum.											
No. 40	30 maximum.	50 maximum.	51 minimum.									
No. 200	15 maximum.	25 maximum.	10 maximum.	35 maximum.	35 maximum.	35 maximum.	35 maximum.	36 minimum.	36 minimum.	36 minimum.	36 minimum.	36 minimum.
Characteristics of fraction passing No. 40 sieve:												
Liquid limit			NP [2]	40 maximum.	41 minimum.	40 maximum.	41 minimum.	40 maximum.	41 minimum.	40 maximum.	41 minimum.	41 minimum.
Plasticity index	6 maximum.	6 maximum.	NP [2]	10 maximum.	10 maximum.	11 minimum.	11 minimum.	10 maximum.	10 maximum.	11 minimum.	11 minimum.[3]	11 minimum.[3]
Group index	0	0	0	0	0	4 maximum.	4 maximum.	8 maximum.	12 maximum.	16 maximum.	20 maximum.	20 maximum.
Usual types of significant constituent materials.	Stone fragments, gravel, and sand.	Stone fragments, gravel, and sand.	Fine sand.	Silty gravel and sand.	Silty gravel and sand.	Clayey gravel and sand.	Clayey gravel and sand.	Nonplastic to moderately plastic silty soils.	Highly elastic silts.	Medium plastic clays.	Highly plastic clays.	Highly plastic clays.
General rating as subgrade.	Excellent to good					Fair to poor						

[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, A.A.S.H.O. Designation: M 145–49.

[2] NP=Nonplastic.

[3] Plasticity index of A–7–5 subgroup is equal to or less than LL minus 30. Plasticity index of A–7–6 subgroup is greater than LL minus 30.

TABLE 13.—*Characteristics of soil groups*

Major divisions	Group symbol	Soil description	Value as foundation material [2]	Value as base course directly under bituminous pavement.
Coarse-grained soils (*50 percent or less passing No. 200 sieve*): Gravels and gravelly soils (*more than half of coarse fraction retained on No. 4 sieve*).	GW	Well-graded gravels and gravel-sand mixtures; little or no fines.	Excellent	Good
	GP	Poorly graded gravels and gravel-sand mixtures; little or no fines.	Good to excellent	Poor to fair
	GM	Silty gravels and gravel-sand-silt mixtures.	Good	Poor to good
	GC	Clayey gravels and gravel-sand-clay mixtures.	Good	Poor
Sands and sandy soils (*more than half of coarse fraction passing No. 4 sieve*).	SW	Well-graded sands and gravelly sands; little or no fines.	Good	Poor
	SP	Poorly graded sands and gravelly sands; little or no fines.	Fair to good	Poor to not suitable
	SM	Silty sands and sand-silt mixtures	Fair to good	Same
	SC	Clayey sands and sand-clay mixtures	Fair to good	Not suitable
Fine-grained soils (*more than 50 percent passing No. 200 sieve*): Silts and clays (*liquid limit of 50 or less*).	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, and clayey silts of slight plasticity.	Fair to poor	Not suitable
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, and lean clays.	Fair to poor	Not suitable
	OL	Organic silts and organic clays having low plasticity.	Poor	Not suitable
Silts and clays (*liquid limit greater than 50*).	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, and elastic silts.	Poor	Not suitable
	CH	Inorganic clays having high plasticity and fat clays.	Poor to very poor	Not suitable
	OH	Organic clays having medium to high plasticity and organic silts.	Same	Not suitable
Highly organic soils	Pt	Peat and other highly organic soils	Not suitable	Not suitable

[1] Based on information in the Unified Soil Classification System, Tech. Memo. No. 3–357, vols. 1, 2, and 3, Waterways Experiment Station, Corps of Engineers, 1953 (*16*). Ratings and ranges in test values are for guidance only. Design should be based on field survey and test of samples from construction site.

[2] Ratings are for subgrade and subbases for flexible pavement.

in Unified soil classification system [1]

Value for embankments	Compaction: Characteristics and recommended equipment	Approximate range in A. A. S. H. O. maximum dry density [3]	Field (in-place) CBR	Subgrade modulus k	Drainage characteristics	Comparable groups in A. A. S. H. O. classification
		Lb./cu. ft.		*Lb./sq. in./in.*		
Very stable; use in pervious shells of dikes and dams.	Good; use crawler-type tractor, pneumatic-tire roller, or steel-wheel roller.	125–135	60–80	300+	Excellent	A–1.
Reasonably stable; use in pervious shells of dikes and dams.	Same	115–125	25–60	300+	Excellent	A–1.
Reasonably stable; not particularly suited to shells, but may be used for impervious cores or blankets.	Good, but needs close control of moisture; use pneumatic-tire or sheepsfoot roller.	120–135	20–80	200–300+	Fair to practically impervious.	A–1 or A–2.
Fairly stable; may be used for impervious cores.	Fair, use pneumatic-tire or sheepsfoot roller.	115–130	20–40	200–300	Poor to practically impervious.	A–2.
Very stable; may be used in pervious sections; slope protection required.	Good; use crawler-type tractor or pneumatic-tire roller.	110–130	20–40	200–300	Excellent	A–1.
Reasonably stable; may be used to dike section having flat slopes.	Same	100–120	10–25	200–300	Excellent	A–1 or A–3.
Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.	Good, but needs close control of moisture; use pneumatic-tire or sheepsfoot roller.	110–125	10–40	200–300	Fair to practically impervious.	A–1, A–2, or A–4.
Fairly stable; use as impervious core for flood-control structures.	Fair; use pneumatic-tire roller or sheepsfoot roller.	105–125	10–20	200–300	Poor to practically impervious.	A–2, A–4, or A–6.
Poor stability; may be used for embankments if properly controlled.	Good to poor; close control of moisture is essential; use pneumatic-tire or sheepsfoot roller.	95–120	5–15	100–200	Fair to poor	A–4, A–5, or A–6.
Stable; use in impervious cores and blankets.	Fair to good; use pneumatic-tire or sheepsfoot roller.	95–120	5–15	100–200	Practically impervious.	A–4, A–6, or A–7.
Not suitable for embankments.	Fair to poor; use sheepsfoot roller.[4]	80–100	4–8	100–200	Poor	A–4, A–5, A–6, or A–7.
Poor stability; use in core of hydraulic fill dam; not desirable in rolled fill construction.	Poor to very poor; use sheepsfoot roller.[4]	70–95	4–8	100–200	Fair to poor	A–5 or A–7.
Fair stability on flat slopes; use in thin cores, blankets, and dike sections of dams.	Fair to poor; use sheepsfoot roller.[4]	75–105	3–5	50–100	Practically impervious.	A–7.
Not suitable for embankments.	Poor to very poor; use sheepsfoot roller.[4]	65–100	3–5	50–100	Same	A–5 or A–7.
Not used in embankments, dams, or subgrades for pavements					Fair to poor	None.

[3] Determined in accordance with test designation: T 99–49, A. A. S. H. O.

[4] Pneumatic-tire rollers may be advisable, particularly when moisture content is higher than optimum.

TABLE 14.—*Engineering*

Soil series or miscellaneous land type	Parent material	Brief description of soil profile and ground condition
Adair	Glacial till (in places some loess in surface layer).	Moderately well-drained to imperfectly drained soils that have a subsoil of very firm, gritty silty clay or gumbolike material containing some small stones.
Alluvial land, wet	Alluvium	Wet soils on flood plains; most areas are silty throughout; but some have a surface layer of silty clay loam and a subsoil of silty clay.
Beckwith and Berwick	Loess	Poorly drained soils that have a subsoil of very firm, medium silty clay.
Belinda	Loess	Poorly drained soils that have a subsoil of very firm, medium silty clay.
Bertrand	Outwash or alluvium	Well-drained soils that have a subsoil of slightly firm to friable light clay loam.
Blockton	Alluvium	Poorly drained soils on low terraces; they have a subsoil of firm silty clay; high content of organic matter extends to depths of 1½ to 2 feet.
Cantril	Alluvium	Imperfectly drained soils on alluvial fans or at the bases of slopes; subsoil is slightly firm or firm silty clay loam.
Chelsea	Wind-deposited sandy material	Excessively drained, deep sandy soils
Chelsea-Lamont complex	Loess and wind-deposited sandy material.	Excessively drained sandy soils that have a subsoil of friable sandy clay loam.
Clarinda	Thin loess over gumbotil	Imperfectly drained to poorly drained soils that have a subsoil of very firm clay.
Clinton	Loess	Well-drained soils that have a subsoil of moderately firm silty clay loam.
Coppock	Alluvium	Imperfectly drained to poorly drained silt loams on high stream bottoms; they have a subsoil of slightly firm, medium silty clay loam.
Curran	Alluvium	Poorly drained silt loams that have a subsoil of firm to very firm, light silty clay.
Edina	Loess	Poorly drained silt loams that have a subsoil of very firm, medium silty clay.
Gara	Glacial till	Well-drained to moderately well-drained soils that have a subsoil of firm, gritty silty clay loam with a few pockets of sand; in places the subsoil consists of gumbotil.
Givin	Loess	Imperfectly drained silt loams that have a subsoil of firm silty clay loam to silty clay.
Gosport	Thin layer of loess or glacial till over shale.	Well-drained to moderately well-drained soils that have a subsoil of very firm clay that overlies shale, which occurs at shallow depths.
Gravity	Alluvium	Imperfectly drained to poorly drained soils on alluvial fans; they have a subsoil of firm silty clay loam; high content of organic matter that extends to depths of 2 to 4 feet.
Grundy	Loess	Moderately well-drained to well-drained soils that have a subsoil of firm to very firm silty clay.
Hagener	Eolian sand	Excessively drained, deep sandy soils
Haig	Loess	Poorly drained soils that have a subsoil of firm to very firm silty clay; high content of organic matter extends to depths of 1 to 2 feet.
Jackson	Loess or alluvium	Imperfectly drained soils that have a subsoil of firm to slightly firm silty clay loam.
Kato	Alluvium	Imperfectly drained soils that have a subsoil of friable to slightly firm silty clay loam; high content of organic matter that extends to depths of 1 to 2 feet; in places sand or gravel occurs at depths below 3 feet.
Keomah	Loess	Imperfectly drained soils that have a subsoil of moderately firm to firm silty clay or silty clay loam.
Ladoga	Loess	Well-drained soils that have a subsoil of slightly firm to firm silty clay loam.
Lindley	Glacial till	Well drained to moderately well drained soils in which the subsoil is a firm clay loam that, in places, contains some gravel fragments or sand pockets or both.
Mahaska	Loess	Imperfectly drained soils that have a subsoil of moderately firm silty clay loam or silty clay; high content of organic matter that extends to depths of 1 to 1½ feet.
Nodaway	Alluvium	Well drained to moderately well drained soils on flood plains; they have a subsoil of friable silt loam.
Otley	Loess	Well drained to moderately well drained soils that have a subsoil of moderately firm silty clay loam.

See footnotes at end of table.

characteristics of soils

Slope	Engineering soil classification: A. A. S. H. O.	Engineering soil classification: Unified	Depth to seasonally high water table	Suitability as source of— Topsoil [1]	Suitability as source of— Borrow for highway construction
			Feet		
5 to 12 percent	A–7	CH	[2] 0–3	Unsuitable	Unsuitable.
Nearly level	A–4, A–6, or A–7	ML, OL, or CL	0–4	Fair to poor	Poor.
Nearly level	A–4, A–6, or A–7	ML, CL, or CH	[2] 1–2	Poor	Poor.
Nearly level	A–4, A–6, or A–7	ML, CL, or CH	[2] 1–2	Good to depth of 6 inches	Poor.
1 to 10 percent	A–4 or A–6	ML or CL	(3)	Fair	Fair.
Nearly level	A–6 or A–7	OH or CH	1–4	Fair to depth of 1½ feet	Unsuitable.
2 to 5 percent	A–4, A–6, or A–7	ML, CL, or CH	1–4	Fair to depth of 6 inches	Poor.
5 to 50 percent	A–2, A–3, or A–4	SP, SM, SC, or ML	(3)	Unsuitable	Fair.
5 to 50 percent	A–2, A–3, A–4, or A–6	SP, SM, SC, ML, or CL	(3)	Unsuitable	Fair.
5 to 8 percent	A–7	CH	[2] 1–3	Unsuitable	Unsuitable.
2 to 25 percent	A–6 or A–7	CL or CH	(3)	Fair to poor	Poor.
Nearly level	A–4, A–6, or A–7	ML, CL, or CH	[2] 1–3	Good to depth of 6 inches	Poor.
0 to 4 percent	A–4, A–6, or A–7	ML, CL, or CH	[2] 1–2	Poor	Poor.
Nearly level	A–4, A–6, or A–7	ML, CL, or CH	[2] 1–2	Good to depth of 6 inches	Poor.
9 to 24 percent	A–6 or A–7	CL or CH	(3)	Fair to poor	Fair.
0 to 4 percent	A–4, A–6, or A–7	ML, CL, or CH	(3)	Good to fair	Poor.
9 to 24 percent	A–4, A–6, or A–7	ML, CL, or CH	(3)	Unsuitable	Unsuitable.
2 to 4 percent	A–6 or A–7	OL, CL, OH, or CH	1–4	Fair to depth of 1½ feet	Unsuitable.
0 to 9 percent	A–4, A–6, or A–7	ML, CL, or CH	(3)	If uneroded, good to depth of 6 inches.	Unsuitable.
2 to 15 percent	A–2 or A–3	SP, SW, or SM	(3)	Unsuitable	Fair.
Nearly level	A–6 or A–7	CL or CH	[2] 1–3	Good to depth of 1 foot	Unsuitable.
0 to 5 percent	A–4, A–6, or A–7	ML, CL, or CH	(3)	Fair to depth of 8 inches	Poor.
Nearly level	A–6 or A–7	CL or CH	2–4	Good to depth of 1½ feet	Poor.
0 to 5 percent	A–4, A–6, or A–7	ML, CL, or CH	(3)	Fair to depth of 6 inches	Poor.
2 to 8 percent	A–6 or A–7	CL or CH	(3)	Good to fair	Poor.
9 to 35 percent	A–6 or A–7	CL or CH	(3)	Poor	Fair.
0 to 4 percent	A–6 or A–7	OL, CL, or CH	(3)	Good to depth of 1½ feet	Unsuitable.
Nearly level	A–4 or A–6	SM, ML, or CL	1–4	Good to fair	Fair.
2 to 8 percent	A–6 or A–7	CL or CH	(3)	Good to fair	Poor.

TABLE 14.—*Engineering*

Soil series or miscellaneous land type	Parent material	Brief description of soil profile and ground condition
Pershing	Loess	Moderately well drained soils that have a subsoil of firm silty clay.
Rough broken and rock land	Limestone, shale, or glacial till	Very steep land or land on which limestone bedrock or shale outcrops; variable in characteristics.
Rubio	Loess	Poorly drained soils that have a subsoil of firm to very firm, medium silty clay.
Shelby	Glacial till	Well drained to moderately well drained soils that have a subsoil of firm clay loam; contains a few pebbles, stones, and sand pockets; in places the subsoil is gumbotil.
Sogn	Thin layer of loess over limestone.	10 to 15 inches of well-drained silty material over limestone
Sperry	Loess	Poorly drained soils that have a subsoil of firm to very firm, medium silty clay; these soils occur in small, shallow depressions.
Taintor	Loess	Poorly drained soils that have a subsoil of moderately firm to very firm silty clay; high content of organic matter that extends to depths of 1½ to 2 feet.
Wabash	Alluvium	Poorly drained soils that have a surface soil and subsoil of firm, medium silty clay; high content of organic matter that extends to depths of 2 to 3 feet.
Waukegan	Alluvium	Well-drained soils on second bottoms; they have a subsoil of friable loam or silt loam; in some areas sandy materials occur at depths of 2½ to 3½ feet.
Weller	Loess	Well drained to moderately well drained soils that have a subsoil of firm to very firm silty clay.

[1] If depth of topsoil is not indicated, rating is for A horizon only.
[2] Soil has a perched water table during wet periods only.

characteristics of soils—Continued

Slope	Engineering soil classification		Depth to seasonally high water table	Suitability as source of—	
	A. A. S. H. O.	Unified		Topsoil [1]	Borrow for highway construction
			Feet		
2 to 10 percent	A-6 or A-7	CL or CH	(3)	Good to depth of 6 inches	Poor.
25 to 40 percent	A-1, A-2, or A-6	GP, GM, GC, SP, SM, or SC.	(3)	Unsuitable	Variable.
Nearly level	A-4, A-6, or A-7	ML, CL, or CH	[2] 1-3	Good to depth of 6 inches	Poor.
9 to 20 percent	A-6 or A-7	SC, CL, or CH	(3)	Fair to poor	Fair.
8 to 35 percent	A-2, A-4, or A-6	SM, SC, ML, or CL	(3)	Variable	Unsuitable.
Nearly level and in depressions.	A-4, A-6, or A-7	ML, CL, or CH	[2] 1-2	Fair to depth of 6 inches	Poor.
Nearly level	A-6 or A-7	CL, OH, or CH	[2] 1-4	Good to depth of 1½ feet	Unsuitable.
Nearly level	A-7	OH or CH	1-4	Poor	Unsuitable.
Nearly level	A-2, A-4, or A-6	SM, SC, ML, or CL	(3)	Good to depth of 1 foot	Fair.
2 to 12 percent	A-6 or A-7	CL or CH	(3)	Fair to poor	Poor.

[3] Water table is deep.

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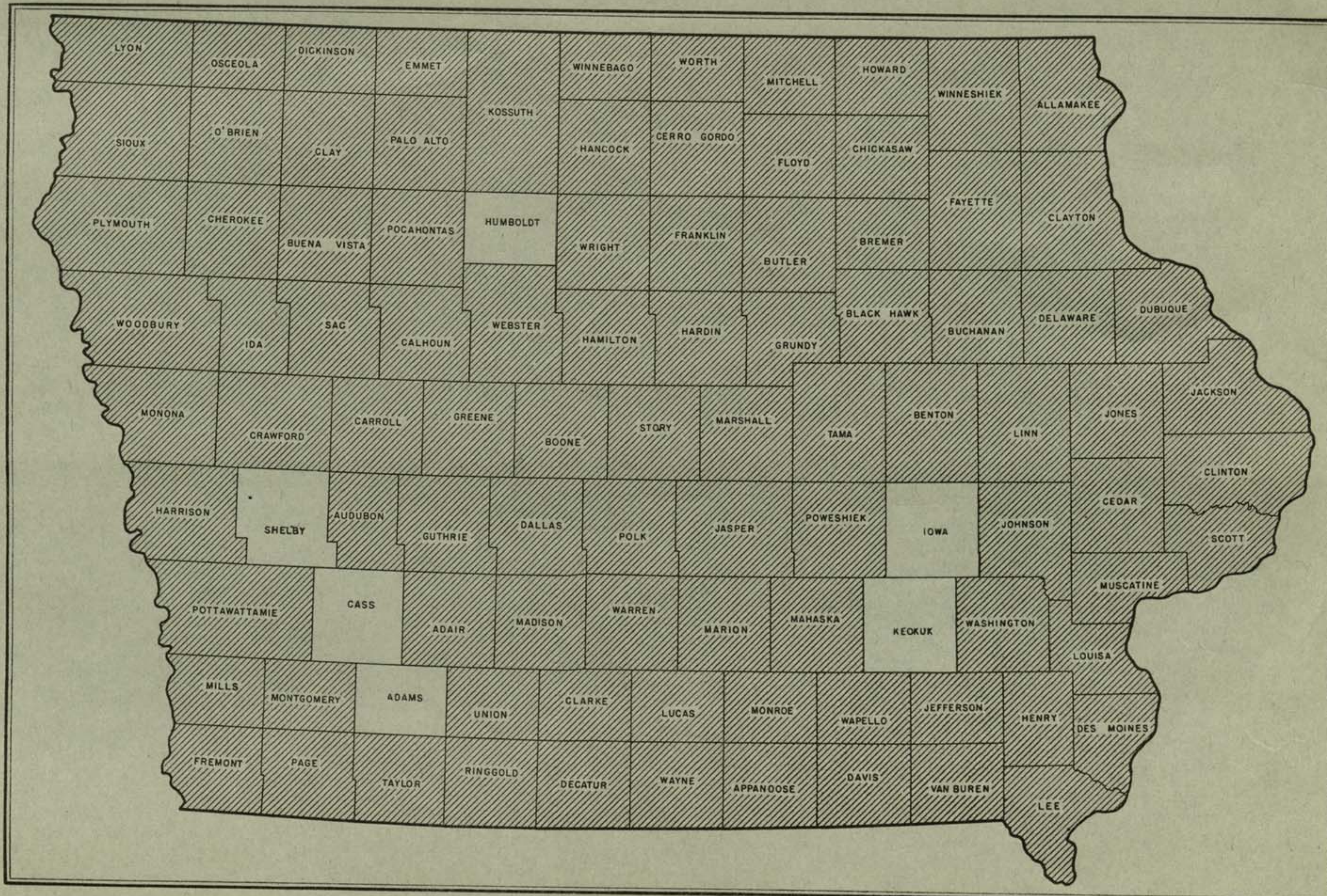

Areas surveyed in Iowa shown by shading.