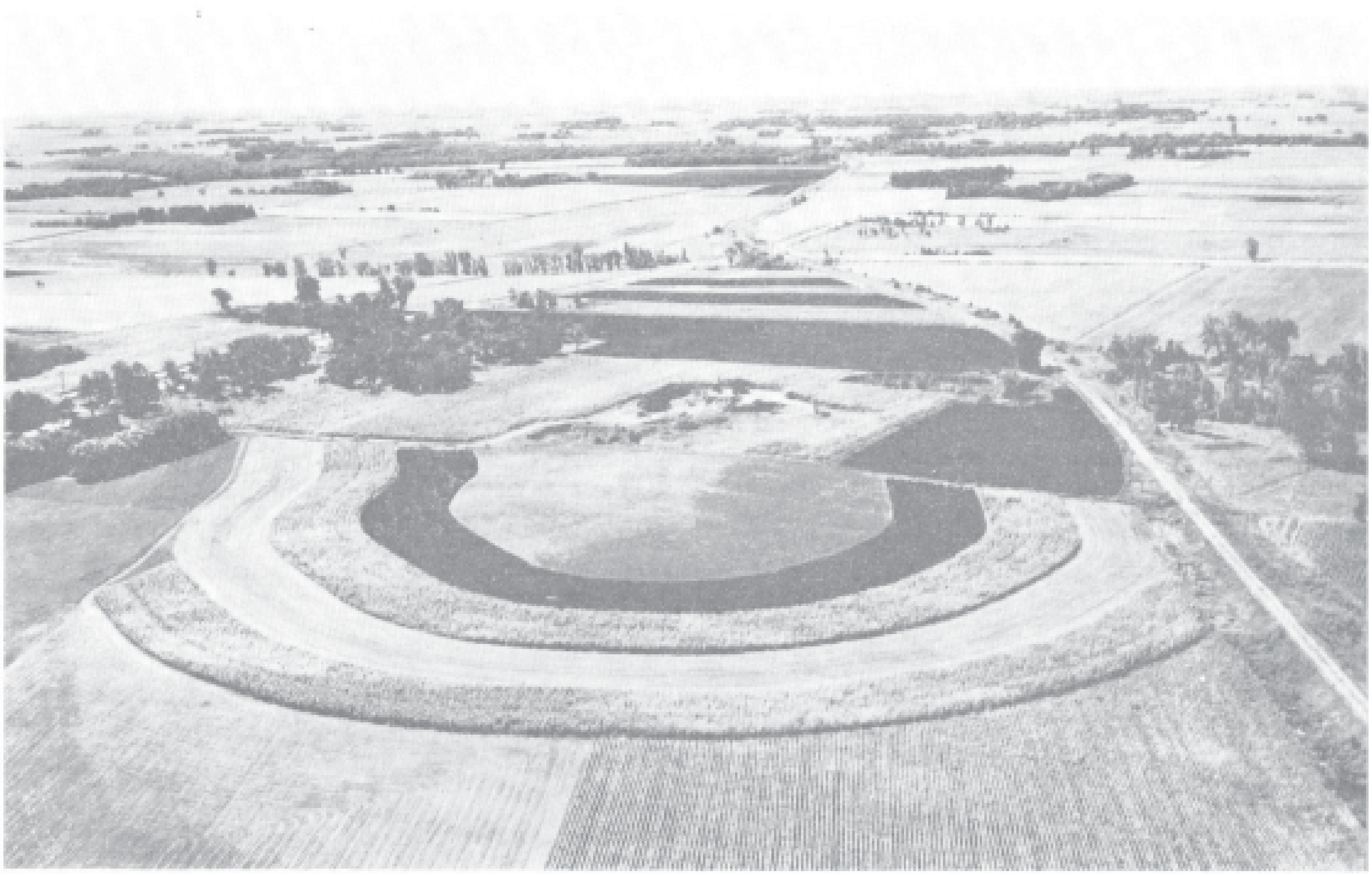
Series 1956, No. 19 Issued August 1961

SOIL SURVEY

Dodge County, Minnesota



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with the
MINNESOTA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS REPORT on Dodge County, Minnesota, will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, ponds, buildings, and other structures; give those interested in appraising land a basis for comparison between farms; and add to the soil scientists' fund of knowledge.

The aerial photographs bound in the back of this report would, if laid together, make a large map of Dodge County. An inch on this aerial map represents about 1,667 feet on the ground, and a square inch includes a little less than 64 acres. The index to map sheets is a smaller map of the county, on which numbered rectangles show what part of the county is covered by each sheet of the large map. By consulting this map, you can find out on which sheet of the larger map your own farm is located.

On these aerial maps, towns, roads, rivers, and other landmarks are shown. Each area of each soil is outlined by a boundary and identified by a symbol. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

If the soil symbol on the area that interests you is, for example, BbB2, you will find by looking at the map legend that this symbol represents Bixby loam, 2 to 6 percent slopes, eroded. The characteristics of this soil, and all the others mapped in the county, are described in the section, Descriptions of Soils. You will find that Bixby loam, 2 to 6 percent slopes, eroded, is in capability unit IIe-3. Each capability unit contains a group of soils that need and respond to about the same kind of management. The description of each capability unit, in the section, Use and Management of Soils, will tell you what crops are most suitable and what kind of management is needed. Yields that can be expected from each soil under common management and under the management suggested are given in the table under the heading, Estimated Yields.

The Guide to Mapping Units, at the back of the report, shows where to find each soil description and each capability unit.

A broad picture of the soils of various localities is presented in the section, General Soil Map.

Information on how the soils were formed and how they are classified is given in the section, Formation and Classification of the Soils of the County.

Words that are somewhat technical or that are used in a specialized sense in soil science are defined in the Glossary.

The section, Engineering Properties of Soils, gives information that will be useful when planning engineering structures.

Persons not familiar with the county can find a little information on its history, natural resources, climate, and agriculture in the section, General Information About the County.

Readers who want technical assistance on specific problems, such as erosion control, flood control, farm management, soil testing, forestry, windbreak establishment, wildlife development, financial assistance, drainage, etc., should contact one of the following agencies: Dodge County Soil Conservation District, United States Soil Conservation Service, Dodge County Agricultural Extension Service, Dodge County Agricultural Stabilization and Conservation Committee, Minnesota Department of Conservation, or United States Farmers' Home Administration. Large-scale aerial photographs that show additional information about the soils are available at the office of the soil conservation district at Dodge Center. Farmers planning specific management practices can get technical assistance at the same office.

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This survey is part of the technical assistance furnished to the Dodge County Soil Conservation District. Fieldwork was completed in 1956, and, unless otherwise indicated, all statements in the report refer to conditions in the county at that time.

Cover picture.—Contour stripcropping on Kasson and Racine soils northwest of Dodge Center.

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SOIL SURVEY OF DODGE COUNTY, MINNESOTA

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REPORT BY D. A. COWLES AND G. F. HARMS

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

DODGE COUNTY is in the southeastern part of Minnesota (fig. 1). It contains 12 townships and has a total land area of 435 square miles (278,400 acres). Mantorville is the county seat. Other important villages and settlements include Kasson, Dodge Center, Concord, West Concord, Hayfield, Berne, and Oslo.

Very few if any permanent settlers came to Dodge County before 1854. About 15 settlers established Mantorville in 1854. Before the end of that year, there were settlements in Milton, Claremont, Concord, Canisteo, Ripley, Ashland, and Wasioja Townships. The county was organized for local government in 1855.

Most of the first settlers came from New England. Some came from Wisconsin, from the more settled parts of Minnesota, or from the east-central states. Norwegian, German, Swiss, Danish, Scotch, English, Irish, and Canadian homeseekers migrated to the county in the first few years of its development.

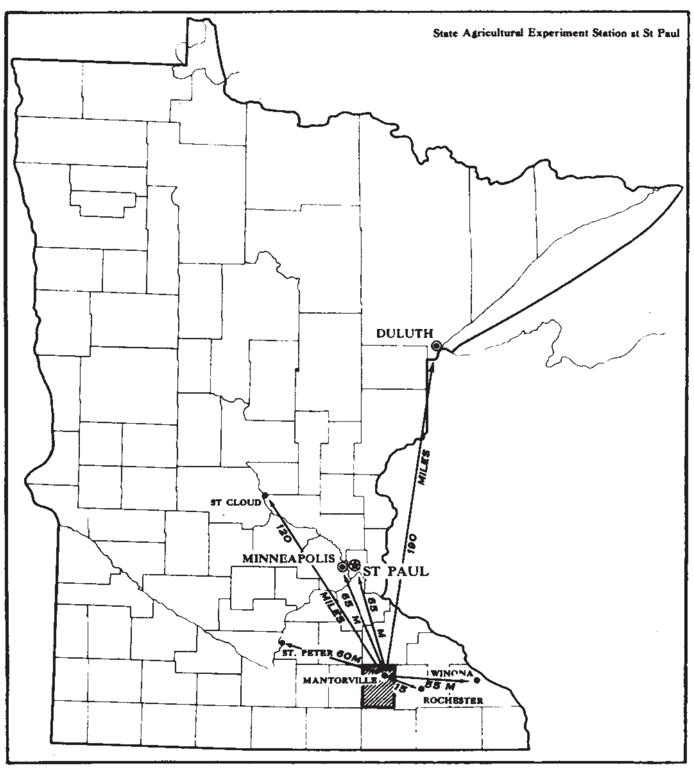

Figure 1.—**Location of Dodge County in Minnesota.**

By June 1857, the population of the county was 4,130. By June 1865, it was 6,222, and by 1881, according to the Federal census, it was 11,344. In 1950, the population of the county was 12,624.

General Soil Map

The colored general soil map at the back of the report shows 11 soil associations in Dodge County. Each of these associations consists of several different soils in a characteristic pattern. Within one soil association the pattern of soils is not strictly uniform, but each soil tends to be located in its own kind of place—on the ridgetops, on the slopes, on terraces, and so on. Each association differs somewhat from the others in topography, in soils, and in major problems in agricultural use.

The general soil map is useful for studying the general patterns of soils, but it is not detailed enough to be used for planning specific practices for a single farm. More detailed information about individual soils and their management is given under the headings, Descriptions of Soils and Capability Groups of Soils.

Descriptions of the soil associations and their chief problems follow.

Association 1

Dark-colored, nearly level soils of flood plains and terraces: Alluvial land, Waukegan, Bixby

This soil association occupies about 22 square miles, or 5 percent of the county. It consists of the flood plains along the Zumbro and Cedar Rivers and their tributaries, and it also includes fringes and bits of terraces and glacial outwash plains that are not large enough to map as a separate soil association.

Most of the soils on the flood plains are mapped as Alluvial land. The chief soils on the terraces and outwash plains are Waukegan silt loam; Waukegan silt loam, thick surface variant; Waukegan silt loam, deep; and Bixby loam. All of these soils are well drained.

The soils in this association vary widely in characteristics within short distances. Most of the flood-plain soils are moderately well drained to well drained. The flood-plain soils are dark colored, but some of the soils on terraces have a light-colored surface soil. Most of the soils are nearly level, but the Terrace escarpments land type is steeper.

Dairying is the principal type of farming in this soil association. Row crops are commonly grown on the better soils. The areas that are frequently flooded are used principally for permanent pasture, woodland, and wildlife shelter.

Flooding is a serious problem on the flood plains. Along the major streams in the eastern part of the county, streambank cutting is a problem. Some of the flood-plain soils have drainage problems, but artificial drainage would be too expensive to be practical. The terrace soils range from very good soils that have no particular problems to soils that are moderately droughty.

The major conservation practices that can be used on the various soils of this association are crop rotations, fertilization, liming, waterways, streambank stabilization, dikes, and irrigation. Special practices for managing pasture, woodland, or wildlife shelter may also be needed.

Association 2

Light-colored, well-drained soils formed in windblown silt on uplands: Fayette, Seaton

This soil association covers about 16 square miles, or 4 percent of the county. Most of it is in Milton and Mantorville Townships. Smaller areas occur in Concord and Canisteo Townships.

The chief soils are Fayette silt loam and Seaton silt loam. Smaller areas of Chaseburg silt loam, Downs silt loam, Renova silt loam, and Whalan silt loam occur. The slopes range from gentle to very steep. The valley slopes have many outcrops of bedrock. This association is similar to association 10, but the soils are lighter in color, the average slope is steeper, and rock outcrops are more common. It is similar to association 7, except that the soils formed in deep silt and the soils in association 7 formed in shallow silt over glacial till. The droughty Wykoff soils, which are common in association 7, seldom occur in this association.

Dairying is the principal type of farming. Corn, oats, hay, and pasture are the chief crops on the more gently sloping soils. Permanent pasture and woodland are the major uses of the steeper soils.

About 95 percent of this association has a moderate to severe problem of sheet erosion or gully erosion. The erosion hazards are most severe on the Seaton soils. Flooding and gullying are problems in and near waterways. Rock outcrops hamper renovation of pasture on steep slopes.

The principal conservation practices needed on the different soils are crop rotations, fertilization, liming, stripcropping, terracing, contouring, waterways, and gully stabilization. Special practices for managing pasture, woodland, and wildlife shelter may be needed.

Association 3

Dark-colored, somewhat poorly drained to very poorly drained soils formed in glacial till on uplands: Floyd, Clyde

This association occupies about 87 square miles, or 20 percent of the county. A large area is on the nearly level, somewhat poorly drained to very poorly drained till plains in the southwestern part of the county (fig. 2). Smaller areas occur southeast of Dodge Center and on the lake-modified till plains in the southern part of Ellington Township.

Figure 2.—**Typical landscape in association 3 (Floyd, Clyde).**

The two major soils in this association are the somewhat poorly drained to poorly drained Floyd silty clay loam and the very poorly drained Clyde silty clay loam. Minor soils are Peat and Muck, Skyberg silt loam, and Kasson silt loam.

This association is somewhat similar to association 4, but the soils are underlain by firm glacial till rather than by gravelly and sandy glacial outwash.

Cash-crop farming is the principal type of agriculture on this association. Where drainage is adequate, the major crops are corn, soybeans, oats, and hay. After the Clyde soils and Peat and Muck are drained, vegetable crops are grown occasionally. Undrained areas of Clyde and of Peat and Muck are used principally for permanent pasture and wildlife shelter. Row crops are often planted on the undrained Floyd soil, but yields vary widely according to the wetness of the growing season.

Removal of excess surface and subsurface water is the major problem on about 80 percent of this association. The rest has moderate hazards of erosion or droughtiness, or it has inherent limitations on fertility, such as too much lime, too little organic matter, or a low level of mineral nutrients.

The major conservation practices needed on various soils in this association are crop rotations, fertilization, open ditches and other surface drainageways and waterways, and tile drainage with proper outlet structures. Special practices for management of pasture and wildlife shelter may also be needed.

Association 4

Dark-colored, somewhat poorly drained to very poorly drained soils formed on outwash terraces underlain by sandy and gravelly material: Kato, Marshan

This association covers about 15 square miles, or 3 percent of the county. It occupies the large, flat glacial outwash plains between Claremont and Blooming Prairie, across the Steele County line. A small area occurs near Rice Lake.

The principal soils in this association are the somewhat poorly drained to poorly drained Kato silty clay loam; the very poorly drained Marshan silty clay loam; and the poorly drained to very poorly drained Canisteo silty clay loam, coarse substratum. Smaller areas of Peat and Muck, Udolpho silt loam, and Hayfield silt loam also occur.

This association is similar to association 3, except that the soils are underlain by gravelly and sandy glacial outwash instead of by firm glacial till.

Cash-crop farming is the principal type of agriculture in this association. Adequately drained areas are used mainly for corn, soybeans, oats, and hay. Vegetables are occasionally grown on Peat and Muck, Marshan silty clay loam, and Canisteo silty clay loam, coarse substratum, after these soils have been drained. If undrained, the Marshan soil and Peat and Muck are used principally for permanent pasture and wildlife shelter. Row crops are frequently planted on undrained areas of the Kato soil. Yields vary widely according to the wetness of the growing season.

Removal of excess water from the surface and subsoil is a major problem on 80 percent of this association. The presence of a few quicksand pockets complicates the drainage problem. Some of the soils have moderate hazards of erosion or droughtiness. Some have inherent limitations on fertility, such as an excess of lime, too little organic matter, or a low level of mineral nutrients.

The main conservation practices that may be needed on the various soils are crop rotations, fertilization, open ditches, surface drainageways, waterways, tile drainage, and tile outlet structures. Special management practices for pasture and wildlife shelter may also be needed.

Association 5

Dark-colored, well drained to somewhat poorly drained soils formed in glacial till on uplands: Ostrander, Kenyon, Floyd

This association covers about 47 square miles, or 11 percent of the county. It occupies gently sloping uplands in the north-central and eastern parts of the county. The largest areas are north of Wasioja, south of Kasson, near West Concord, and near Oslo.

The major soils are the well drained Ostrander silt loam, the moderately well drained Kenyon silt loam, the somewhat poorly drained to poorly drained Floyd silty clay loam, and the very poorly drained Clyde silty clay loam. Small areas of Thurston and Dickinson loams also occur.

This association is somewhat similar to association 6, except that most of the well drained and moderately well drained soils are dark-colored prairie soils instead of the somewhat lighter colored soils of the transition between forest and prairie.

Dairying is the chief type of farming in this association. The major crops are corn, soybeans, oats, peas, hay, and pasture. The undrained Clyde soils are used mostly for permanent pasture.

About half of this association has a moderate or moderately severe hazard of erosion. Removal of excess water from the surface and subsoil is a problem on 40 percent of the area. Some soils have a hazard of droughtiness, and some have a hazard of flooding. Removal of scattered stones and a few boulders is also a problem.

The major conservation practices needed on different soils in this association are crop rotations, liming, fertilization, contouring, stripcropping, terracing, open ditches, waterways, tile drainage, and tile outlet structures. Practices for management of pasture and wildlife areas may also be needed.

Association 6

Dark colored to moderately dark colored, well drained to somewhat poorly drained soils formed in glacial till on uplands: Racine, Kasson, Floyd

This is the largest soil association in the county; it covers about 136 square miles, or 31 percent of the total. Areas of this soil association occur in nearly all parts of the county. The largest are northwest of West Concord, northeast of Mantorville, and northeast and southeast of Hayfield.

The major soils are the well drained Racine silt loam, the moderately well drained Kasson silt loam and Kenyon silt loam, the somewhat poorly drained to poorly drained Floyd silty clay loam, and the very poorly drained Clyde silty clay loam. There are also small areas of Thurston and Dickinson loams, Thurston and Dickinson soils, Skyberg silt loam, and Peat and Muck. In Milton, Mantorville, Canisteo, and Vernon Townships, this association contains small areas of Rockton silt loam, moderately deep, and Rockton silt loam.

Where this association is next to association 9, the dominant slope range is from 1 to 4 percent. Where it is next to associations 2 and 7, the dominant slope range is from 2 to 6 percent. The soils in this association have somewhat thinner surface soils than the soils in association 5 and are lower in fertility and organic matter.

Dairying and cash-grain farming are the principal types of agriculture. The major crops are corn, soybeans, oats, peas, hay, and pasture. If undrained, the Clyde soils and Peat and Muck are used mostly for permanent pasture. Scattered areas of woodland occur.

Removal of surplus water from the surface and subsoil is a problem on half of the acreage. The hazard of erosion is moderate to moderately severe on 40 percent. A few areas have problems of drought or flooding. Removal of scattered stones and a few glacial boulders is also a problem.

The major conservation practices needed on different soils of this association are crop rotations, liming, fertilization, contouring, stripcropping, terracing, open ditches, waterways, tile drainage, and tile outlet structures. Special management for pasture, woodland, and wildlife shelter may also be needed.

Association 7

Light-colored, well-drained soils formed in shallow silt over glacial till on sloping uplands: Renova, Wykoff

This association covers about 24 square miles, or 6 percent of the county. It occurs principally on the gently sloping to steep uplands along the major streams in the eastern part of the county. The largest areas are in Milton Township and along the South Middle Branch of the Zumbro River between Dodge Center and Mantorville.

The principal soils are Renova silt loam; Wykoff loam; Wykoff soils; Wykoff sandy loam; Whalan silt loam, moderately deep; and Whalan silt loam. All of these are well drained. A few areas of Chaseburg silt loam, Floyd silty clay loam, Fayette silt loam, and Racine silt loam occur.

Most of the soils in this association are light colored. They formed from shallow silt over glacial till. Outcrops of glacial till and bedrock are common. The dominant slopes are 6 to 12 percent.

This association is similar to association 2, but it includes large areas of the droughty Wykoff soils, which are seldom associated with Fayette and Seaton soils. The silty parent material is shallow over glacial till instead of deep, and the topography is somewhat more uneven than in association 2. This association has steeper slopes than association 8.

Dairying is the principal type of farming. The gently sloping to rolling soils are used chiefly for corn, oats, hay, and pasture, and the steep or shallow soils are used for permanent pasture and woodland. There are many rock quarries and gravel pits in this association.

Sheet erosion and gully erosion are moderate to severe problems on 85 percent of this association; 15 percent also has a moderate to severe problem of droughtiness. Poor drainage and flooding are problems on 10 percent of the association. Outcrops of bedrock or of gravel and sand hamper pasture renovation on steep slopes.

Conservation practices that are needed on various soils of this association are crop rotations, liming, fertilization, stripcropping, contouring, terracing, gully stabilization, waterways, open ditches, flood detention structures, tile drainage, and tile outlet structures. Practices for managing pasture, woodland, and wildlife shelter may also be needed.

Association 8

Light-colored, well drained to somewhat poorly drained soils formed in silt over glacial till on nearly level to gently sloping uplands: Renova, Vlasaty, Sargeant

This association covers about 14 square miles, or 3 percent of the county. It occurs on nearly level to gently sloping uplands that are now or were formerly covered with hardwood forest. The largest area is on the South Middle Branch of the Zumbro River, between Claremont and Dodge Center. Smaller areas are located north of Claremont, near Rice Lake, southwest of Dodge Center, southwest of Hayfield, southeast of Kasson, and near Danesville.

The principal soils in this association are the well drained Renova silt loam, the moderately well drained Vlasaty silt loam, the somewhat poorly drained Sargeant silt loam and Skyberg silt loam, the somewhat poorly drained to poorly drained Floyd silty clay loam, and the very poorly drained Clyde silty clay loam.

These soils developed in a thin silt cap over firm glacial till. Nearly all of them are light colored. This association differs from association 7 in having slopes dominantly of 1 to 3 percent instead of 6 to 12 percent.

Dairying is the principal type of farming. Corn, soybeans, oats, hay, and pasture are the major crops. Much of this association is still in woods. The undrained Clyde soils and the better drained soils that are only partly cleared are used chiefly for permanent pasture.

Removal of surplus water from the surface and the subsoil is a problem on 40 percent of this association. Moderate sheet erosion is a problem on another 40 percent. All of the light-colored soils are low in organic matter.

The soils in this association need various conservation practices, such as crop rotations, liming, fertilizing, contouring, stripcropping, waterways, surface drainageways, open ditches, tile drainage, and tile outlet structures. They also need practices for management of pasture, woodland, and wildlife shelter.

Association 9

Moderately dark colored, moderately well drained to somewhat poorly drained soils formed in silt over glacial till on uplands: Skyberg, Kasson

This association occupies about 57 square miles, or 13 percent of the county. It lies on level to gently sloping uplands (fig. 3). The largest area occurs on both sides of the Cedar River, between Hayfield and Blooming Prairie. Other large areas are between Dodge Center and Hayfield, along U.S. Highway 14 between Claremont and Dodge Center, and southwest of West Concord.

The principal soils are the moderately well drained Kasson silt loam, the somewhat poorly drained Skyberg silt loam, the somewhat poorly drained to poorly drained Floyd silty clay loam, and the very poorly drained Clyde silty clay loam. There are also some small areas of Racine silt loam and Thurston and Dickinson loams.

These soils developed in a thin silt cap over firm glacial till. The dominant slopes are from 1 to 2 percent. This association is more nearly level than association 6 and more rolling than association 3. It has a higher percentage of soils with drainage problems than associations 6 or 8.

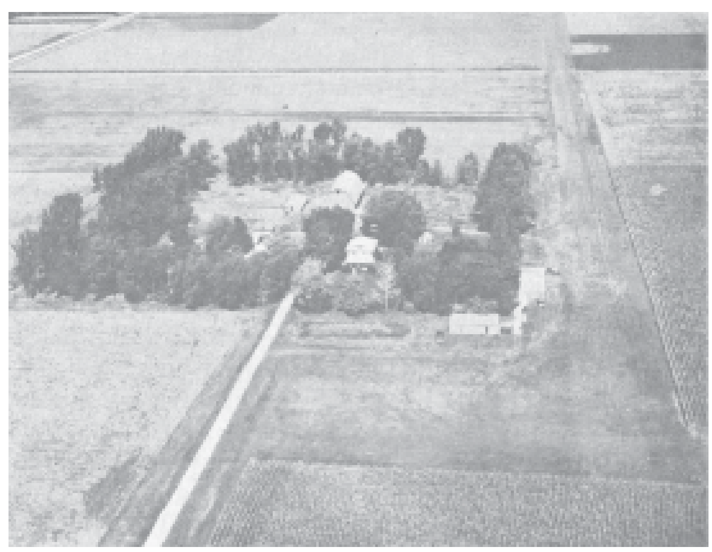

Figure 3.—**Typical farmstead in association 9 (Skyberg, Kasson).**

Cash-grain farming is the principal type of agriculture. Corn, soybeans, oats, peas, hay, and pasture are the major crops. A few scattered areas are still in woodland. The undrained areas of Clyde soils are in permanent pasture.

Removal of surplus water from the surface and subsoil is a problem on two-thirds of the association. A few areas have problems of slight erosion or moderate droughtiness.

Conservation practices that are needed on various soils in this association are crop rotations, liming, fertilization, waterways, surface drainageways, open ditches, tile drainage, and tile outlet structures. Practices for management of pasture and wildlife shelter are also needed.

Association 10

Dark colored to moderately dark colored, well-drained soils formed in windblown silt on uplands: Tama, Downs

This association covers about 7 square miles, or 2 percent of the county. Most of it is on nearly level to gently sloping uplands in the northeastern part of the county. Two areas, mostly of Downs silt loam, occur in the southern part of Milton Township, northwest and northeast of Mantorville. The largest area, just north of U.S. Highway 14 along the Olmstead County line, contains both Tama silt loam and Downs silt loam. Both Tama and Downs soils are well drained. The moderately well drained Judson silt loam occurs along the waterways.

These soils developed in deep silt. They differ from the soils in association 2 because they developed under prairie or under a mixture of prairie and forest vegetation and, consequently, have dark or moderately dark colored surface soils. The dominant slope range is 1 to 6 percent.

Dairy farming is the principal type of agriculture. Corn, soybeans, oats, hay, and pasture are the principal crops.

Sheet erosion is a moderate to moderately severe problem on about 85 percent of the association. Gully erosion is a major problem, and flooding is a problem along the waterways.

Conservation practices needed on the different soils in this association are crop rotations, fertilization, liming, stripcropping, contouring, terracing, waterways, gully stabilization, and tile outlet structures. Practices for pasture and wildlife management are also needed.

Association 11

Dark-colored to light-colored, well drained to moderately well drained soils formed on outwash terraces: Waukegan, Hayfield

This association covers about 7 square miles, or 2 percent of the county. It occupies the flat, well drained to moderately well drained glacial outwash plains between Claremont and Blooming Prairie and along the Rice Lake Branch of the South Middle Branch of the Zumbro River. Small spots of this association are mapped in association 1.

The chief soils are the well drained, somewhat droughty Waukegan silt loam; the moderately well drained, somewhat droughty Hayfield silt loam; and the somewhat poorly drained Udolpho silt loam. Other soils in the association are Kato silty clay loam; Marshan silty clay loam; Bixby loam; and Bixby loam, shallow. Most of the soils of this association have better drainage than the soils in association 4.

Cash-crop farming is the principal type of agriculture. The major crops are corn, soybeans, peas, oats, and hay. Some of the undrained areas of Marshan soil are in permanent pasture.

Moderate droughtiness is a major problem on 70 percent of the soils in this area. Yields are low in years of less than average rainfall. Removal of surplus water from the surface and subsoil is a problem on 30 percent of the association. Erosion is a problem on the escarpments.

Conservation practices needed on the various soils of this association are crop rotations, fertilization, liming, open ditches, surface drainageways, waterways, tile drainage, and tile outlet structures. Special management practices for pasture, woodland, and wildlife shelter are also needed.

Descriptions of Soils

This section describes each of the soil units that appear on the soil map and gives those soil characteristics that affect use and management.

The soils are arranged alphabetically by series name. Under each series name is a detailed description of that series and a complete profile of the most important mapping unit. This is followed by a brief description of each of the other mapping units in the series.

Each soil can be studied by referring to its description, to the more detailed description of the profile of a soil in that series, and to the series description itself. Specific suggestions on how to manage each soil are given under the respective capability units in the section, Use and Management of Soils.

The approximate acreage and proportionate extent of each soil or other mapping unit in Dodge County are given in table 1.

Alluvial soils

All types of bottom-land soils have been included in these mapping units of Alluvial land. They cover a considerable range in texture and drainage. The color depends on the source of the alluvial parent material.

The alluvial soils are on nearly level first bottoms and second bottoms. Floods cover these areas at intervals ranging from a few months to 5 years.

The moisture-holding capacity varies, but in most places it is medium to very high. The fertility also varies but is generally high to very high. The reaction of the surface soil ranges from slightly acid to calcareous.

These areas are free of stones, except in a few places where gravel bars are included. They are generally easy to work. The chief hazards to crops are wetness and floods. The areas that are occasionally flooded are generally used for crops. The areas that are frequently flooded are generally used for permanent pasture or left idle to shelter wildlife.

TABLE 1.—*Approximate acreage and proportionate extent of the soils mapped in Dodge County, Minnesota*

Map symbol	Soil	Area	Extent
		Acres	*Percent*
Ad	Alluvial land	774	0. 3
BbA	Bixby loam, 0 to 2 percent slopes	699	. 3
BbB2	Bixby loam, 2 to 6 percent slopes, eroded	44	([1])
BxA	Bixby loam, shallow, 0 to 2 percent slopes	38	([1])
BxB2	Bixby loam, shallow, 2 to 6 percent slopes, eroded	82	([1])
Ca	Canisteo silty clay loam	3, 717	1. 3
Cb	Canisteo silty clay loam, coarse substratum	3, 951	1. 4
ChA	Chaseburg silt loam, 0 to 2 percent slopes	126	([1])
ChB	Chaseburg silt loam, 2 to 6 percent slopes	499	. 2
CsA	Clyde silty clay loam, 0 to 2 percent slopes	15, 537	5. 6
CsB	Clyde silty clay loam, 2 to 6 percent slopes	258	. 1
DaA	Dakota sandy loam, 0 to 2 percent slopes	64	([1])
DaB2	Dakota sandy loam, 2 to 6 percent slopes, moderately eroded	64	([1])
DaC2	Dakota sandy loam, 6 to 12 percent slopes, moderately eroded	67	([1])
DoA	Downs silt loam, 0 to 2 percent slopes	341	. 1
DoB	Downs silt loam, 2 to 6 percent slopes	1, 112	. 4
DoB2	Downs silt loam, 2 to 6 percent slopes, moderately eroded	1, 548	. 6
DoC2	Downs silt loam, 6 to 12 percent slopes, moderately eroded	436	. 2
DoC3	Downs silt loam, 6 to 12 percent slopes, severely eroded	181	. 1
DoD2	Downs silt loam, 12 to 25 percent slopes, moderately eroded	49	([1])
FaA	Fayette silt loam, 0 to 2 percent slopes	158	. 1
FaB	Fayette silt loam, 2 to 6 percent slopes	1, 399	. 5
FaB2	Fayette silt loam, 2 to 6 percent slopes, moderately eroded	1, 320	. 5
FaC	Fayette silt loam, 6 to 12 percent slopes	657	. 2
FaC2	Fayette silt loam, 6 to 12 percent slopes, moderately eroded	1, 387	. 5
FaC3	Fayette silt loam, 6 to 12 percent slopes, severely eroded	1, 072	. 4
FaD	Fayette silt loam, 12 to 18 percent slopes	185	. 1
FaD2	Fayette silt loam, 12 to 18 percent slopes, moderately eroded	265	. 1
FaD3	Fayette silt loam, 12 to 18 percent slopes, severely eroded	407	. 1
FsE2	Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded	135	([1])
FsE3	Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded	148	. 1
FsF2	Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded	60	([1])
FtB	Floyd silty clay loam, 2 to 6 percent slopes	8, 002	2. 9
Fy	Floyd and Clyde silty clay loams	75, 058	27. 0
HaA	Hayfield silt loam, 0 to 2 percent slopes	1, 960	. 7
HaB	Hayfield silt loam, 2 to 6 percent slopes	83	([1])
JuA	Judson silt loam, 0 to 2 percent slopes	270	0. 1
JuB	Judson silt loam, 2 to 6 percent slopes	495	. 2
KaA	Kasson silt loam, 0 to 2 percent slopes	18, 843	6. 8
KaB	Kasson silt loam, 2 to 6 percent slopes	6, 530	2. 3
KaB2	Kasson silt loam, 2 to 6 percent slopes, moderately eroded	751	. 3
Kc	Kato silty clay loam	5, 782	2. 1
KnA	Kenyon silt loam, 0 to 2 percent slopes	15, 544	5. 6
KnB	Kenyon silt loam, 2 to 6 percent slopes	6, 019	2. 2
KnB2	Kenyon silt loam, 2 to 6 percent slopes, moderately eroded	197	. 1
Lo	Lawson and Orion silt loams	411	. 1
Ma	Marshan silty clay loam	2, 174	. 8
Mp	Mixed alluvial land, poorly drained	2, 169	. 8
Mx	Mixed alluvial land, moderately well drained	4, 208	1. 5
OsA	Ostrander silt loam, 0 to 2 percent slopes	660	. 2
OsB	Ostrander silt loam, 2 to 6 percent slopes	7, 903	2. 8
OsB2	Ostrander silt loam, 2 to 6 percent slopes, moderately eroded	2, 696	1. 0
OsC2	Ostrander silt loam, 6 to 12 percent slopes, moderately eroded	150	. 1
PmA	Peat and Muck, coarse substrata, 0 to 2 percent slopes	906	. 3
PtA	Peat and Muck, medium textured substrata, 0 to 2 percent slopes	1, 198	. 4
PtB	Peat and Muck, medium textured substrata, 2 to 6 percent slopes	117	([1])
RaA	Racine silt loam, 0 to 2 percent slopes	1, 989	. 7
RaB	Racine silt loam, 2 to 6 percent slopes	10, 136	3. 6
RaB2	Racine silt loam, 2 to 6 percent slopes, moderately eroded	9, 598	3. 4
RaC	Racine silt loam, 6 to 12 percent slopes	117	([1])
RaC2	Racine silt loam, 6 to 12 percent slopes, moderately eroded	935	. 3
RcB3	Racine soils, 2 to 6 percent slopes, severely eroded	207	. 1
RcC3	Racine soils, 6 to 12 percent slopes, severely eroded	208	. 1
ReA	Renova silt loam, 0 to 2 percent slopes	1, 083	. 4
ReB	Renova silt loam, 2 to 6 percent slopes	2, 697	1. 0
ReB2	Renova silt loam, 2 to 6 percent slopes, moderately eroded	3, 074	1. 1
ReC	Renova silt loam, 6 to 12 percent slopes	721	. 3
ReC2	Renova silt loam, 6 to 12 percent slopes, moderately eroded	1, 525	. 5
ReD	Renova silt loam, 12 to 18 percent slopes	400	. 1
ReD2	Renova silt loam, 12 to 18 percent slopes, moderately eroded	187	. 1
ReE	Renova silt loam, 18 to 25 percent slopes	158	. 1
ReE2	Renova silt loam, 18 to 25 percent slopes, moderately eroded	57	([1])
ReF2	Renova silt loam, 25 to 35 percent slopes, eroded	87	([1])
RfB3	Renova soils, 2 to 6 percent slopes, severely eroded	101	([1])
RfC3	Renova soils, 6 to 12 percent slopes, severely eroded	1, 275	. 5
RfD3	Renova soils, 12 to 18 percent slopes, severely eroded	568	. 2
RfE3	Renova soils, 18 to 25 percent slopes, severely eroded	104	([1])

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils mapped in Dodge County, Minnesota*—Continued

Map symbol	Soil	Area	Extent
		Acres	*Percent*
RoB2	Rockton silt loam, 2 to 6 percent slopes, moderately eroded	69	(1)
RoD	Rockton silt loam, 12 to 18 percent slopes	61	(1)
RoD2	Rockton silt loam, 12 to 18 percent slopes, moderately eroded	38	(1)
RpA	Rockton silt loam, moderately deep, 0 to 2 percent slopes	33	(1)
RpB	Rockton silt loam, moderately deep, 2 to 6 percent slopes	111	(1)
RpC	Rockton silt loam, moderately deep, 6 to 12 percent slopes	68	(1)
RsC3	Rockton soils, 6 to 12 percent slopes, severely eroded	96	(1)
RsD3	Rockton soils, 12 to 18 percent slopes, severely eroded	37	(1)
Ru	Rough broken and stony land	1, 248	0. 4
SaA	Sargeant silt loam, 0 to 2 percent slopes	2, 155	. 8
SeB	Seaton silt loam, 2 to 6 percent slopes	295	. 1
SeB2	Seaton silt loam, 2 to 6 percent slopes, moderately eroded	696	. 2
SeC	Seaton silt loam, 6 to 12 percent slopes	60	(1)
SeC2	Seaton silt loam, 6 to 12 percent slopes, moderately eroded	206	. 1
SeC3	Seaton silt loam, 6 to 12 percent slopes, severely eroded	447	. 2
SeD	Seaton silt loam, 12 to 18 percent slopes	63	(1)
SeD2	Seaton silt loam, 12 to 18 percent slopes, moderately eroded	55	(1)
SeD3	Seaton silt loam, 12 to 18 percent slopes, severely eroded	198	. 1
SkA	Skyberg silt loam, 0 to 2 percent slopes	19, 599	7. 0
SkB	Skyberg silt loam, 2 to 6 percent slopes	188	. 1
TaA	Tama silt loam, 0 to 2 percent slopes	465	. 2
TaB	Tama silt loam, 2 to 6 percent slopes	316	. 1
TaB2	Tama silt loam, 2 to 6 percent slopes, moderately eroded	128	(1)
Te	Terrace escarpments	319	. 1
ThB2	Thurston loam, 2 to 6 percent slopes, moderately eroded	1, 378	. 5
ThB3	Thurston loam, 2 to 6 percent slopes, severely eroded	172	. 1
ThC	Thurston loam, 6 to 12 percent slopes	60	(1)
ThC2	Thurston loam, 6 to 12 percent slopes, moderately eroded	355	. 1
ThC3	Thurston loam, 6 to 12 percent slopes, severely eroded	452	. 2
ThD3	Thurston loam, 12 to 18 percent slopes, severely eroded	50	(1)
TsB3	Thurston soils, 2 to 6 percent slopes, severely eroded	44	(1)
TsC2	Thurston soils, 6 to 12 percent slopes, moderately eroded	102	(1)
TsC3	Thurston soils, 6 to 12 percent slopes, severely eroded	245	. 1
TtA	Thurston and Dickinson loams, 0 to 2 percent slopes	485	. 2
TtB	Thurston and Dickinson loams, 2 to 6 percent slopes	315	. 1
TuA	Thurston and Dickinson soils, 0 to 2 percent slopes	79	(1)
TuB	Thurston and Dickinson soils, 2 to 6 percent slopes	85	(1)
TuB2	Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded	146	. 1
Ud	Udolpho silt loam	1, 923	. 7
VaA	Vlasaty silt loam, 0 to 2 percent slopes	745	0. 3
VaB	Vlasaty silt loam, 2 to 6 percent slopes	725	. 3
VaB2	Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded	58	(1)
WaA	Waukegan silt loam, 0 to 2 percent slopes	4, 461	1. 6
WaB	Waukegan silt loam, 2 to 6 percent slopes	213	. 1
WaB2	Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	156	. 1
WdA	Waukegan silt loam, deep, 0 to 2 percent slopes	492	. 2
WkA	Waukegan silt loam, thick surface variant, 0 to 2 percent slopes	475	. 2
WmC2	Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded	95	(1)
WnB	Whalan silt loam, 2 to 6 percent slopes	52	(1)
WnB2	Whalan silt loam, 2 to 6 percent slopes, moderately eroded	142	. 1
WnC	Whalan silt loam, 6 to 12 percent slopes	83	(1)
WnC2	Whalan silt loam, 6 to 12 percent slopes, moderately eroded	82	(1)
WnD	Whalan silt loam, 12 to 18 percent slopes	152	. 1
WnD2	Whalan silt loam, 12 to 18 percent slopes, moderately eroded	115	(1)
WoB	Whalan silt loam, moderately deep, 2 to 6 percent slopes	153	. 1
WoB2	Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded	268	. 1
WoC	Whalan silt loam, moderately deep, 6 to 12 percent slopes	78	(1)
WoC2	Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded	110	(1)
WoD	Whalan silt loam, moderately deep, 12 to 18 percent slopes	172	. 1
WoD2	Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded	142	. 1
WoE	Whalan silt loam, moderately deep, 18 to 25 percent slopes	101	(1)
WoE2	Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded	181	. 1
WpC3	Whalan soils, 6 to 12 percent slopes, severely eroded	49	(1)
WpD3	Whalan soils, 12 to 18 percent slopes, severely eroded	91	(1)
WsB3	Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded	52	(1)
WsC3	Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded	71	(1)
WsD3	Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded	65	(1)
WuA	Wykoff loam, 0 to 2 percent slopes	170	. 1
WuB	Wykoff loam, 2 to 6 percent slopes	267	. 1
WuB2	Wykoff loam, 2 to 6 percent slopes, moderately eroded	424	. 2
WuC	Wykoff loam, 6 to 12 percent slopes	47	(1)
WuC2	Wykoff loam, 6 to 12 percent slopes, moderately eroded	141	. 1
WuC3	Wykoff loam, 6 to 12 percent slopes, severely eroded	247	. 1
WuD2	Wykoff loam, 12 to 18 percent slopes, eroded	42	(1)
WuD3	Wykoff loam, 12 to 18 percent slopes, severely eroded	86	(1)
WyB	Wykoff soils 2 to 6 percent slopes	41	(1)

See footnote at end of table.

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TABLE 1.—*Approximate acreage and proportionate extent of the soils mapped in Dodge County, Minnesota*—Continued

Map symbol	Soil	Area	Extent	Map symbol	Soil	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
WyB2	Wykoff soils, 2 to 6 percent slopes, moderately eroded	92	(1)	WzD2	Wykoff and Thurston soils, 12 to 18 percent slopes, eroded	55	(1)
WyC2	Wykoff soils, 6 to 12 percent slopes, eroded	52	(1)	WzD3	Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded	103	(1)
WyC3	Wykoff soils, 6 to 12 percent slopes, severely eroded	79	(1)		Total	278, 400	99. 6

[1] Less than 0.1 percent.

Alluvial land (Ad) (Capability unit IIw-4).—The soils in this unit lie on level second bottoms that are about 5 feet higher than the first bottoms and 3 to 5 feet lower than the low terraces.

Most of these soils developed from dark-colored silty materials deposited by floodwaters. Some of the material is mildly calcareous or slightly acid, but most of it is neutral in reaction.

The soils that developed from light-colored materials have a very dark gray to gray surface layer. In both the light-colored and dark-colored materials, the texture of the surface and subsurface layers ranges from loam to light silty clay loam. Thin strata of fine sandy material may be present anywhere in the profile. The lower part of the subsurface layer is faintly mottled in some places. The reaction of the surface soil ranges from slightly acid to calcareous.

Alluvial land is easy to work and free of stones. Drainage is good to moderately good. The available moisture holding capacity is very high to high. The inherent fertility is very high.

These areas are flooded on an average of once every 5 years. Almost every flood leaves a thin deposit of fresh alluvium. Crops are seldom drowned out, but usually they are damaged.

Mixed alluvial land, poorly drained (Mp) (Capability unit VIw-1).—This unit consists of soils on level, narrow bottom lands and in depressions in the wider areas of bottom land.

In most places the profile is composed of dark-colored, neutral to mildly calcareous alluvial material of silt loam and silty clay loam texture. Thin layers of muck are present on the surface of some very poorly drained spots. The areas that are on narrow flood plains below the Clyde soils are generally underlain by fine-textured glacial till or outwash material within 4 feet of the surface.

These soils are generally free of stones. The available moisture holding capacity and the inherent fertility are very high.

These areas are frequently flooded. They are somewhat poorly drained to very poorly drained. Because of wetness and the flood hazard, these soils are used primarily for permanent pasture and for wildlife areas.

Mixed alluvial land, moderately well drained (Mx) (Capability unit VIw-1).—This is the most extensive unit of alluvial land in Dodge County. The soils in this unit lie on first bottoms along streams. The nearly level relief is broken in many places by old channels and trenches cut by meandering of the streams.

The texture ranges from silt loam to sand and gravel. It is most commonly sandy loam. Gravel wash and gravel bars are present in a few places. The soils developed from both dark-colored and light-colored materials. These materials are generally neutral to mildly calcareous.

Several small areas of sandy loam that are not flooded frequently are included in this unit. Several small areas of gullied land and some soils that lie in waterways and are frequently flooded are also included.

The available water holding capacity and the inherent fertility vary widely within short distances. Generally, the available water holding capacity is medium and the fertility high. All of these soils, except for a few gravelly spots, are generally free of stones.

Flood damage is frequent enough and severe enough to limit the usefulness of these areas primarily to permanent pasture. Some areas are left idle or used for wildlife shelter.

Bixby soils

The Bixby soils are light colored, well drained, and medium textured. They developed under a cover of hardwood forest on stream terraces and glacial outwash plains.

The principal areas are level to nearly level. Small areas have slopes of 2 to 6 percent. Steeper soils are included in Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded. Bixby soil that has slopes of more than 12 percent is in the Terrace escarpments mapping unit.

These soils developed in medium textured material over coarse textured to very coarse textured glacial outwash. In most places the depth to the glacial outwash is 24 to 42 inches. In some places it is only 15 to 24 inches, and in these spots a shallow phase is mapped.

The Bixby soils are similar to the Waukegan soils, which developed in similar parent materials but under grass vegetation. Their surface soil is thinner and lighter colored than that of the Waukegan soils, and they have a light-colored subsurface horizon. The Bixby subsoil is more strongly developed in structure, and gray films coat the soil blocks. The Bixby soils are mostly loams, and the Waukegan soils are mostly silt loams.

The shallow Bixby soils are somewhat like the Dakota soils, which are shallow soils that developed in similar parent materials but under grass. The deeper Bixby soils have a thinner, lighter colored surface layer, a light colored subsurface horizon, and gray films coating the blocks in the subsoil.

The surface soil and subsoil are medium acid. Both the available moisture holding capacity and the natural fertility are moderate in the moderately deep phases, but they are moderately low in the shallow phases.

In most places the Bixby soils are free of stones and easy to work. The hazard of drought is moderate on the moderately deep phases and moderately severe on the shallow phases.

Bixby loam, 0 to 2 percent slopes (BbA) (Capability unit IIs-1).—This soil occurs on level stream terraces and outwash plains. Little or no erosion has occurred.

Profile in a cultivated area—

Surface soil—
0 to 7 inches, dark grayish-brown loam; weak, fine, granular structure to weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
7 to 11 inches, brown to pale-brown loam; moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
11 to 17 inches, dark-brown loam to clay loam; weak to moderate, medium, subangular blocky structure; blocks are heavily coated with light brownish-gray films; friable when moist; medium acid.
17 to 25 inches, dark yellowish-brown to yellowish-brown clay loam to loam; moderate, medium, subangular blocky structure; many blocks are coated with light brownish-gray films; friable when moist; medium acid.
25 to 28 inches, dark-brown to dark reddish-brown gravelly clay loam; moderate, fine to medium, subangular blocky structure; firm when moist, weakly cemented when dry; medium acid.

Substratum—
28 to 60 inches, dark yellowish-brown to yellowish sandy loam to loamy sand; weakly cemented to loose when dry; contains fine gravel; contains many bands, 2 to 4 inches thick, of dark-brown to dark reddish-brown gravelly sandy clay loam that is single grain (structureless); medium acid to slightly acid.
60 inches +, light yellowish-brown coarse sand; single-grain structure; loose when dry; contains fine gravel; mildly calcareous.

The color of the moist surface soil ranges from dark gray to grayish brown. The surface and subsurface layers have a gritty silt loam texture in places. Along the lower part of the North Middle Branch of the Zumbro River, where the parent material included a capping of silt, the surface layers are more silty.

The texture of the subsoil ranges through loam, sandy clay loam, and clay loam. In some places the subsoil contains a few pebbles and cobblestones.

The depth to the coarse-textured substratum is generally between 27 and 30 inches, but it ranges from 24 to 42 inches. The depth to the calcareous layer in the substratum ranges from 4 to 8 feet. The bands of finer textured material commonly lie above the calcareous part of the substratum. They vary widely in thickness, texture, and number. In many places these bands contain a considerable number of dark-colored shale fragments.

There is little or no hazard of erosion.

Bixby loam, 2 to 6 percent slopes, eroded (BbB2) (Capability unit IIe-3).—This soil occupies short, gentle slopes on stream terraces and outwash plains. Except for the effects of erosion, the profile is similar to that of Bixby loam, 0 to 2 percent slopes. About one-half of the acreage has lost from 25 to 50 percent of its surface soil through erosion. In these moderately eroded areas, the plow layer is a mixture of surface soil, subsurface soil, and subsoil. The rest of the acreage has lost less than 25 percent of the surface soil.

The hazard of further erosion is moderate. Where erosion has removed more than 25 percent of the surface soil, the fertility, the rate of infiltration, and the available moisture holding capacity have been moderately reduced, and the tilth has been somewhat impaired.

Bixby loam, shallow, 0 to 2 percent slopes (BxA) (Capability unit IIIs-1).—This soil occupies nearly level stream terraces and outwash plains. Little or no erosion has occurred.

Profile in a cultivated area—

Surface soil—
0 to 7 inches, dark grayish-brown loam to sandy loam; weak, fine, granular structure to weak, thin, platy structure; soft when dry, very friable when moist, slightly sticky when wet; medium acid.

Subsurface soil—
7 to 9 inches, grayish-brown loam; moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
9 to 15 inches, dark-brown loam; weak to moderate, fine to medium, subangular blocky structure; blocks are heavily coated with light brownish-gray films; very friable when moist; medium acid.
15 to 19 inches, dark yellowish-brown to yellowish-brown loam to sandy loam; weak to moderate, medium, subangular blocky structure; many blocks are coated with gray films; very friable when moist; contains scattered pieces of gravel; medium acid.
19 to 22 inches, dark yellowish-brown to yellowish-brown sandy loam to gravelly loam; structureless; loose when moist, weakly cemented when dry; contains fine gravel; medium acid.

Substratum—
22 to 60 inches, yellowish-brown loamy sand to medium sand; single-grain structure; loose when moist, weakly cemented to loose when dry; contains fine gravel; medium acid.
60 inches +, light yellowish-brown medium to coarse sand; single grain (structureless); loose when dry; contains fine gravel; mildly calcareous.

The surface soil varies in texture from sandy loam to gritty silt loam. The colors range from dark gray to grayish brown when the soil is moist.

The subsoil ranges in texture from sandy loam to loam. In some places it contains a few pebbles and cobblestones. The depth to the coarse textured to very coarse textured material is generally between 18 and 21 inches, but it ranges from 15 to 24 inches.

Thin, dark-colored layers that range in texture from sandy clay loam to loam occur in the substratum in many places. These layers contain a considerable amount of dark-colored shale. The depth to the calcareous layer in the substratum ranges from 4 to 8 feet.

This soil has little or no hazard of erosion.

Bixby loam, shallow, 2 to 6 percent slopes, eroded (BxB2) (Capability unit IIIs-3).—This soil occupies short, gentle slopes on stream terraces and outwash plains. Except for the effects of erosion, the profile is similar to that of Bixby loam, shallow, 0 to 2 percent slopes. Nearly half of the acreage has lost from 25 to 50 percent of its original surface layer. In these eroded areas, the present plow layer is a mixture of original surface soil, subsurface soil, and subsoil. Up to 25 percent of the surface soil is gone from the other areas.

Mapped with this soil is a small acreage in Westfield Township where the soil is similar to this one but has a loamy sand texture. Also included are two small areas that have slopes of 6 to 12 percent, and a few small areas that are severely eroded.

This soil has a moderate hazard of further erosion. Where more than 25 percent of the surface layer is gone, the fertility, the rate of infiltration, and the available moisture holding capacity have been moderately reduced, and the tilth has been somewhat impaired.

Canisteo soils

The Canisteo soils are moderately deep to deep, dark colored, and poorly drained. They occur on the rims of depressions and on slightly elevated, nearly level areas near depressions.

These soils have developed from medium textured to moderately fine textured glacial drift, which was covered in many places by a layer of silt loam or silty clay loam. Pockets and thin layers of sand and gravel are common in the lower subsoil. Calcareous clay loam glacial till lies beneath the outwash in some areas. In the Canisteo, coarse substratum, the subsoil is underlain by sand and gravel outwash many feet thick.

Canisteo soils are more calcareous at the surface than the Clyde soils. They are more poorly drained and less acid than the Floyd soils.

The coarse substratum phase is somewhat better drained and less acid than the Marshan soils. It is less acid than the Kato soils and lies at slightly lower elevations.

The Canisteo soils have a high to very high available moisture supplying capacity. They are high in clay and consequently are often sticky and somewhat difficult to work. They need artificial drainage to make them suitable for row crops and grains. The calcareous reaction of the surface layer tends to decrease the availability of potassium.

Canisteo silty clay loam (Ca) (Capability unit IIIw–4).—This soil occurs principally on nearly level areas slightly above areas of Clyde silty clay loam, which is in depressions, and below areas of Floyd silty clay loam, which is on the adjoining uplands.

Profile—

Surface soil—
- 0 to 13 inches, black silty clay loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; moderately calcareous.

Subsurface soil—
- 13 to 18 inches, mixed dark-gray and light brownish-gray silty clay loam; few, distinct mottles; very thin, platy structure to massive (structureless); friable when moist; weakly calcareous.

Subsoil—
- 18 to 26 inches, light brownish-gray silt loam to silty clay loam; few, distinct mottles; weak, medium, platy structure to massive (structureless); friable when moist; weakly calcareous.
- 26 to 30 inches, light brownish-gray sandy clay loam; common, prominent mottles; weak, medium to coarse, subangular blocky structure to massive (structureless); very friable when moist; neutral.
- 30 to 36 inches, yellowish-brown medium to fine sand; loose; contains medium to fine gravel; neutral.

Substratum—
- 36 inches +, yellowish-brown and grayish-brown clay loam; many, prominent mottles; massive (structureless); firm when moist, very sticky and plastic when wet; neutral at top of layer but mildly calcareous at lower depths.

The texture of the surface soil ranges from silt loam to silty clay loam. In many places old snail shells or fragments of snail shells lie on the surface. The reaction ranges from mildly alkaline to moderately alkaline within short distances.

The medium textured to moderately fine textured material ranges from 24 to 40 inches in thickness. The layer of sand or gravel that underlies the above layer in many places ranges from 1 to 12 inches in thickness. The texture of the substratum ranges from clay loam to loam.

Canisteo silty clay loam, coarse substratum (Cb) (Capability unit IIIw–5).—This soil occurs on the rim of depressions and at slight elevations above depressions on the outwash plains. It is associated with Marshan silty clay loam, Kato silty clay loam, and Peat and Muck, coarse substrata.

Profile—

Surface soil—
- 0 to 10 inches, black silty clay loam to silt loam; weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; mildly calcareous.
- 10 to 14 inches, black silty clay loam; weak, fine, granular structure; slightly sticky when wet; neutral.

Subsurface soil—
- 14 to 18 inches, very dark gray to olive-gray silty clay loam; few, faint mottles; massive (structureless); sticky when wet; neutral.

Subsoil—
- 18 to 26 inches, light olive-gray, gritty silty clay loam; few, distinct mottles; massive (structureless); sticky when wet; neutral.
- 26 to 30 inches, light olive-gray clay loam to loam; common, distinct mottles; massive (structureless); sticky when wet; neutral.

Substratum—
- 30 to 38 inches, light brownish-gray medium sand, in which the sand grains are black, yellow, and red; loose; neutral.
- 38 to 50 inches, light brownish-gray coarse sand in which the sand grains are black, yellow, and red; loose; contains fine gravel; neutral.
- 50 inches +, light brownish-gray coarse sand, in which the sand grains are black, yellow, and red; loose; contains fine gravel; moderately calcareous.

In most places the surface soil is silty clay loam, but in others it is mucky silt loam, silt loam, or clay loam. Within short distances the reaction ranges from mildly alkaline to moderately calcareous. Many areas have snail shells or fragments of snail shells on the surface.

The subsoil ranges in texture from light clay loam to silty clay. In most places the upper part of the subsoil is silty clay loam. The lower part of the subsoil, near the coarse-textured substratum, grades into clay loam or loam.

The depth to the sand or gravelly sand substratum is commonly between 30 and 36 inches, but it ranges from 21 to 42 inches. This substratum is 3 or more feet thick. It is underlain in most places by very firm glacial till. Thin layers that range in texture from sandy clay loam to sandy loam are common in the substratum. The substratum is generally neutral to slightly acid to a depth of about 48 to 54 inches, but it is moderately calcareous below that.

The surface layer of this soil is free of stones, but it is somewhat difficult to work because of the high clay content. The calcareous reaction in the surface layer tends to decrease the availability of the potassium in the soil.

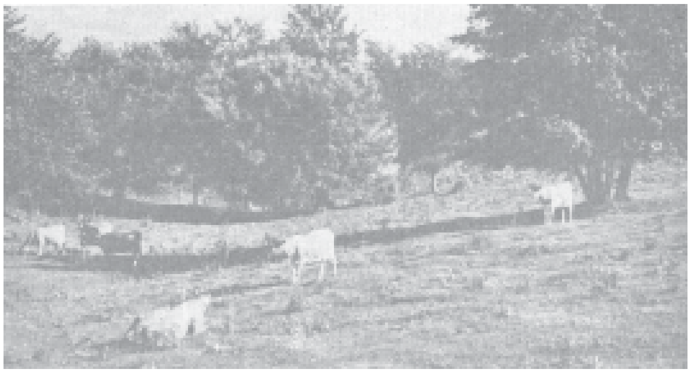

Figure 4.—**Partly cleared permanent pasture on Chaseburg silt loam at left and center; Renova silt loam at the right.**

Artificial drainage is needed to make this soil suitable for crops. The soil has only a moderate available moisture holding capacity and may be slightly droughty after drainage because of its sandy and gravelly substratum. This substratum makes it difficult to install tile drainage and to maintain ditch slopes.

Chaseburg soils

The Chaseburg soils are deep, well drained to moderately well drained, and moderately dark colored to light colored. They lie on nearly level and gentle slopes in narrow valleys, drainageways, and waterways where no stream channel has developed, and also on alluvial fans (fig. 4). They developed in light-colored, silty, alluvial and colluvial materials that washed from nearby upland soils.

These soils are associated principally with Fayette and Seaton soils and to a small extent with the Renova soils. The Chaseburg soils are similar to the Judson soils in topographic position, but the parent material of the Judson soils washed from dark-colored soils, and their surface horizon is, therefore, darker colored than that of the Chaseburg soils.

The Chaseburg soils are free of stones and easy to work. They are slightly acid in most places. The available moisture holding capacity is high to very high. The fertility is moderately high.

Chaseburg silt loam, 0 to 2 percent slopes (ChA) (Capability unit IIw–4).—This soil occurs in nearly level parts of narrow valleys and waterways.

Profile—

Surface soil—
- 0 to 18 inches, dark-gray to dark grayish-brown silt loam; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 18 to 30 inches, dark grayish-brown and grayish-brown silt loam; weak, very fine, subangular blocky structure; very friable when moist; slightly acid.
- 30 to 36 inches, grayish-brown silt loam to silty clay loam; weak to moderate, fine, subangular blocky structure; very friable when moist; slightly acid.
- 36 inches +, grayish-brown silt loam to silty clay loam; common, distinct mottles; massive (structureless); very friable when moist; neutral.

The color of the surface and upper subsurface layers ranges from dark gray to light brownish gray. In some places the texture is loam or very fine sandy loam. The upper part of the subsurface layer may be faintly mottled. In some places, darker colored soils have been buried beneath the parent material of the Chaseburg soils.

Eroded material from soils on the uplands accumulates on these areas. Unless a channel for runoff is established and maintained, a few gullies are likely to develop. Crops are often damaged by the water that runs across these areas and by the silt that is deposited on them.

Chaseburg silt loam, 2 to 6 percent slopes (ChB) (Capability unit IIw–5).—This soil occurs in gently sloping, narrow valleys and waterways. Its profile is similar to that of Chaseburg silt loam, 0 to 2 percent slopes. Material washed from light-colored soils on the uplands accumulates in these areas.

The hazard of erosion is moderate. Except where channels for runoff are established and maintained, gullies are very likely to develop. Crops are frequently damaged by runoff water and by the deposits of silt.

Clyde soils

The Clyde soils are dark colored and very poorly drained. The most common texture is silty clay loam. These soils developed in a thin mantle of silt loam or silty clay loam over glacial till. The principal vegetation was swamp grass and sedges (fig. 5). The soils lie in nearly level drainageways on uplands and on gently sloping areas that are wet because of seepage.

The Clyde soils are associated with the poorly drained to somewhat poorly drained Floyd soils. Where some ponding has occurred, Canisteo soils lie between the Clyde and the Floyd soils. The Clyde soils differ from the Marshan soils because, beneath the capping of silt loam or silty clay loam, the Marshan soils have outwash materials many feet deep over the glacial till, but the Clyde soils have only a thin band of sand or gravel or none at all.

Figure 5.—**Native vegetation and natural drainage on Clyde silty clay loam. The cultivated areas in the background are principally Floyd silty clay loam.**

These soils have a high to very high available moisture holding capacity. They are somewhat difficult to work because of the large proportion of silt and clay in the surface soil.

Boulders are common on the surface, especially where these soils are associated with the gently sloping Floyd and Kenyon soils in the eastern part of the county. Many of the boulders are very large and very difficult to remove.

Surface and subsurface drainage are necessary before these soils can safely be used for row crops and small grains.

Clyde silty clay loam, 0 to 2 percent slopes (CsA) (Capability unit IIIw–4).—This soil lies in level to nearly level drainageways in the uplands. It is frequently flooded by runoff from surrounding uplands. Alluvium is usually deposited on the surface of this soil during floods.

Profile—

Surface soil—
- 0 to 15 inches, black silty clay loam; weak, very fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky when wet; slightly acid to neutral.

Subsurface soil—
- 15 to 18 inches, dark-gray to gray silty clay loam; few, faint mottles; weak, fine, subangular blocky structure; sticky when wet; slightly acid to neutral.

Subsoil—
- 18 to 33 inches, light olive-gray to olive-gray silty clay loam; few, distinct mottles; massive (structureless); very sticky when wet; slightly acid to neutral.
- 33 to 37 inches, grayish-brown and yellowish-brown sandy clay loam to sandy loam; common, distinct mottles; massive (structureless); slightly sticky when wet; neutral.

Substratum—
- 37 inches +, grayish-brown and yellowish-brown clay loam; common, prominent mottles; massive (structureless); very sticky when wet; contains many pebbles and stones; moderately calcareous.

In most places the surface texture is silt loam or silty clay loam. Muck is present on the surface in a few places, in some spots reaching a depth of 12 inches. The number of boulders in and on the soil varies considerably; most are on the surface. The surface soil generally is slightly acid to neutral, but in a few spots it is calcareous.

In most places a layer of sand or gravel lies between the silt loam and silty clay loam materials of the subsoil and the glacial till of the substratum. The thickness of the coarse-textured layer ranges from 3 to 18 inches; most commonly it is 4 to 6 inches. The texture ranges from sand to sandy clay loam.

The substratum is generally calcareous just beneath the layer of sand or gravel. The texture ranges from loam to clay loam. In many places the lower part of the substratum is blue.

Clyde silty clay loam, 2 to 6 percent slopes (CsB) (Capability unit VIw–2).—Most areas of this soil are less than 5 acres in size. The profile is similar to that of Clyde silty clay loam, 0 to 2 percent slopes.

This soil developed on uplands on gentle slopes that are next to steeper slopes. These areas are kept very wet by seepage during the entire growing season. This severe problem of seepage makes it very difficult to drain this soil artificially and to improve it. Water seldom stands on these areas, because of the slope.

Dakota soils

The Dakota soils are shallow, dark colored, and well drained. They developed under grass vegetation on stream terraces and outwash plains. The parent material was a thin layer of moderately coarse textured to medium textured material over coarse textured to very coarse textured glacial outwash. Slopes range from 0 to 12 percent. Dakota soils that have slopes of more than 12 percent are mapped with Terrace escarpments.

The Dakota soils are closely associated with the Waukegan soils. They are similar, except that the Dakota soils are 15 to 24 inches thick over coarse textured to very coarse textured materials, and the Waukegan soils are 24 to 42 inches thick over the same kind of materials. The Dakota soils have a deeper and darker colored surface soil than the Bixby soils, and their subsurface horizon is darker colored. The Bixby soils have light brownish-gray films coating the structural blocks in the subsoil, and the Dakota soils have none.

In most places these soils are free of stones and easy to work. The fertility is moderate. The surface soil and subsoil are generally medium acid. The available moisture holding capacity is moderately low, and the hazard of drought is moderately severe.

Dakota sandy loam, 0 to 2 percent slopes (DaA) (Capability unit IIIs–1).—This soil developed on level stream terraces and outwash plains. It is uneroded, and there is little or no hazard of erosion.

Profile—

Surface soil—
- 0 to 9 inches, black to very dark brown sandy loam to loam; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 9 to 12 inches, very dark brown to very dark grayish-brown sandy loam to loam; weak, very fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 12 to 16 inches, dark-brown loam; weak, fine, subangular blocky structure; very friable when moist; medium acid.
- 16 to 20 inches, dark-brown to dark yellowish-brown sandy loam to loam; weak, fine, subangular blocky structure; very friable when moist; contains scattered pieces of gravel; medium acid.
- 20 to 23 inches, dark yellowish-brown to yellowish-brown sandy loam; massive (structureless); loose when moist, slightly cemented when dry; contains fine gravel; medium acid.

Substratum—
- 23 to 54 inches, yellowish-brown loamy sand to medium sand; single grain (structureless); loose when moist, loose when dry; contains fine gravel; medium acid.
- 54 inches +, light yellowish-brown medium to coarse sand; single grain (structureless); loose when moist, loose when dry; contains fine gravel; mildly calcareous.

The texture of the surface soil ranges from sandy loam to gritty silt loam. The areas where the surface soil is loamy are in the lower part of the watershed of the North Middle Branch of the Zumbro River.

The subsoil ranges in texture from loam to sandy loam. In some places it contains a few pieces of gravel and a few cobblestones. The depth to coarse textured to very coarse textured material is 15 to 24 inches. Most commonly it is between 18 and 21 inches.

Thin bands of dark-colored sandy clay loam to loam are present in many places in the substratum. These bands contain a considerable amount of dark-colored shale. Below depths of 3½ to 6 feet, but most commonly below a depth of 4½ feet, the substratum generally is calcareous.

Some areas of soil that developed under a mixture of grass and hardwood forest are included in this unit. Such soils have lighter colored surface and subsurface horizons than the profile described, and gray films coat a few of the blocks in the subsoil.

Dakota sandy loam, 2 to 6 percent slopes, moderately eroded (DaB2) (Capability unit IIIs–2).—This soil is on short, gentle slopes on stream terraces and outwash plains. Its profile is similar to that of Dakota sandy loam, 0 to 2 percent slopes, except that it has lost from 25 to 50 percent of its original surface soil through erosion. The plow layer is a mixture of the remaining surface soil and the subsurface layer.

A small area of this soil is less eroded than is normal for the unit.

The fertility level, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have been moderately reduced by erosion. The hazard of further erosion is moderate.

Dakota sandy loam, 6 to 12 percent slopes, moderately eroded (DaC2) (Capability unit IVs–1).—This soil is on moderate slopes on stream terraces and outwash plains. The profile is similar to that of Dakota sandy loam, 0 to 2 percent slopes, except that in many areas from 25 to 50 percent of the original surface soil has been removed by erosion. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil.

Some areas of this soil are more eroded than is typical for the unit, and a few areas are less eroded.

Erosion has moderately to severely reduced the fertility level, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity. The hazard of further erosion is moderately severe.

Dickinson soils

These are well-drained soils that are dark colored to moderately dark colored and moderately deep to shallow. They lie principally on slopes of less than 6 percent. They developed under prairie grass or a mixture of prairie grass and hardwood forest. The parent material was medium textured glacial material overlying coarse textured to very coarse textured glacial till.

These soils occupy small acreages and have not been mapped separately in this county. They are associated with the Thurston soils and are included in undifferentiated mapping units with those soils. The profiles are similar, except that the Thurston soils contain gravel and the Dickinson soils do not.

The surface soil and subsoil are generally medium acid to strongly acid. The hazard of drought is moderate to moderately severe. The available moisture holding capacity is moderate to moderately low. Fertility is high to moderately high.

Downs soils

The Downs soils are deep, well drained, medium textured, and moderately dark colored. They developed under mixed prairie grass and hardwood forest. The principal areas are on upland ridgetops and valley slopes in the northeastern part of the county. Slopes of 2 to 6 percent predominate, but the slope range is 0 to 25 percent.

The parent material of these soils is silty loess that is 6 to 8 feet in thickness. Beneath the loess is loam and clay loam glacial till, and below that, limestone bedrock.

Judson soils, which are dark colored and occur in waterways, are the principal associated soils.

The Downs soils and the Fayette soils developed in similar parent material, but the Fayette soils were covered with forest vegetation. The Downs soils differ from the Fayette soils in that they have a darker colored and thicker surface soil, a thinner and less prominent platy subsurface horizon, and a weaker structure in the subsoil.

The Tama soils developed in parent material similar to that of the Downs soils but under grass. The Downs soils differ from the Tama soils in that they have a lighter colored and thinner surface soil, a weak platy subsurface horizon, and a stronger structure in the subsoil.

The Downs soils are well drained, free of stones, and easy to work. The surface soil and subsoil are generally medium acid. The available moisture holding capacity is moderately high to high. The fertility is moderately high.

Downs silt loam, 0 to 2 percent slopes (DoA) (Capability unit I–1).—This soil lies on nearly level ridgetops. Only a few hundred acres are mapped in Dodge County.

The profile of this soil is similar to that of Downs silt loam, 2 to 6 percent slopes, but the surface soil is several inches thicker because there has been little or no erosion. This soil is not likely to erode.

Downs silt loam, 2 to 6 percent slopes (DoB) (Capability unit IIe–1).—This soil lies on gentle slopes on the uplands. Little or no erosion has occurred, but there is a moderate hazard of future erosion.

Profile—

Surface soil—
- 0 to 9 inches, very dark gray silt loam; moderate, fine, granular structure; very friable when moist; medium acid.

Subsurface soil—
- 9 to 11 inches, grayish-brown silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 11 to 18 inches, dark grayish-brown to brown silt loam; weak to moderate, fine, subangular blocky structure; friable when moist; medium acid.
- 18 to 32 inches, dark yellowish-brown silt loam to silty clay loam; weak to moderate, fine to medium, subangular blocky structure; many blocks are coated with grayish-brown films; friable when moist; medium acid.
- 32 to 38 inches, yellowish-brown silt loam; weak, medium to coarse, subangular blocky structure; a few blocks are coated with grayish-brown films; friable when moist; medium acid.

Substratum—
- 38 to 72 inches, yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; medium acid.
- 72 inches +, light yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; moderately calcareous.

In some places the subsurface horizon lacks the platy structure. Where the subsurface horizon is slightly darker than in the profile described, the films coating the blocks in the subsoil are also darker colored than in the profile given.

The texture of the subsoil ranges from silt loam to silty clay loam. The calcareous layer in the substratum is within 4 feet of the surface in a few places, but generally it is at a depth of 5 to 6 feet. The clay loam glacial till or the bedrock is commonly at a depth of 6 to 8 feet, but in some places one or the other is within 3½ feet of the surface.

Downs silt loam, 2 to 6 percent slopes, moderately eroded (DoB2) (Capability unit IIe–1).—This soil lies on gentle slopes on the uplands. The profile is like that of Downs silt loam, 2 to 6 percent slopes, except that the surface soil is only 6 to 7 inches thick.

From 25 to 50 percent of the original surface soil has been removed by erosion. The fertility level, the quality of tilth, and the rate of infiltration of water have been moderately reduced. There is a moderate hazard of further erosion.

Downs silt loam, 6 to 12 percent slopes, moderately eroded (DoC2) (Capability unit IIIe–1).—This soil occurs on moderate slopes on uplands and in valleys. It has a profile similar to that of Downs silt loam, 2 to 6 percent slopes, but the surface soil is only 6 to 7 inches thick.

Most areas of this soil have lost from 25 to 50 percent of the original surface soil through erosion. Several areas have a few shallow gullies. A few small areas are less eroded than the rest of this soil. The level of fertility, the quality of tilth, and the rate of infiltration of water have all been moderately reduced by erosion. The hazard of further erosion is moderately severe.

Downs silt loam, 6 to 12 percent slopes, severely eroded (DoC3) (Capability unit IIIe–1).—This soil lies on moderate slopes on the upland. From 50 to 75 percent of the original surface layer has been lost through erosion. A few areas have a few shallow gullies. The plow layer consists of the rest of the original surface soil, the subsurface soil, and part of the upper subsoil; otherwise, the profile is like that of Downs silt loam, 2 to 6 percent slopes.

Erosion has severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderately severe.

Downs silt loam, 12 to 25 percent slopes, moderately eroded (DoD2) (Capability unit IVe–1).—Most of this soil is on moderately steep slopes on the upland and in valleys. From 25 to 75 percent of the original surface soil has been lost from most of the area through erosion. In a few areas there are a few shallow gullies. The profile is like that of Downs silt loam, 2 to 6 percent slopes, except that the present plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately to severely reduced by erosion. The hazard of further erosion is severe.

Fayette soils

The Fayette soils are deep, well drained, and light colored. The most common texture is silt loam.

These soils are in the northeastern and eastern third of the county. They lie on nearly level to steep slopes on the upland, in valleys, and on upland ridgetops. Slopes of 0 to 12 percent predominate, but the slope range is 0 to 18 percent. Fayette soils on slopes of 18 percent or more are mapped in undifferentiated units with the Seaton soils.

The Fayette soils developed under hardwood forest in silty loess about 8 to 10 feet thick. Beneath the loess is a thin blanket of loam to clay loam glacial till, and beneath that, limestone bedrock.

The principal associated soils are the light colored to moderately dark colored Chaseburg soils, which developed in waterways. Fayette soils differ from the Downs soils, which developed in the same kind of parent material, because the vegetation on the Downs soils was a transition between hardwood forest and prairie grass. The Fayette soils have a thinner, lighter colored surface soil than the Downs soils, a thicker subsurface soil that has a more prominent platy structure, and a stronger structure in the subsoil.

Where the Fayette soils are associated with the Seaton soils, the profiles of the two series are very similar. The Fayette soils are slightly finer textured than the Seaton soils throughout the profile. The Fayette soils in these places have a somewhat weaker structure in the subsoil than the typical Fayette soil, but a stronger structure than the Seaton soil. The Fayette soils are deeper above the calcareous substratum than the Seaton soils are, but the Fayette soils associated with the Seaton soils are shallower above calcareous materials or above glacial till or bedrock than is typical for the Fayette soils.

The surface soil and subsoil of these soils are generally medium acid. The soils are well drained, free of stones, and easy to work. The available moisture holding capacity is high to moderately high, and the fertility level is moderate.

Fayette silt loam, 0 to 2 percent slopes (FaA) (Capability unit I–2).—This soil is on the nearly level ridgetops on the uplands. The profile is like that of Fayette silt loam, 2 to 6 percent slopes.

All of this soil is well drained except a few small areas in Milton Township, where the natural drainage is moderately good to somewhat poor.

Little or no erosion has occurred on this soil, or is likely to occur.

Fayette silt loam, 2 to 6 percent slopes (FaB) (Capability unit IIe–2).—This soil lies on gentle slopes on uplands and in valleys. The erosion hazard is moderate, but less than 25 percent of the original surface soil has been removed by erosion.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark grayish-brown to grayish-brown silt loam; weak, fine, granular to weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 12 inches, grayish-brown to light brownish-gray silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 12 to 18 inches, yellowish-brown silt loam; weak to moderate, medium, subangular blocky structure; blocks are heavily coated with gray films; friable when moist; medium acid.
- 18 to 28 inches, yellowish-brown silt loam to silty clay loam; moderate, medium, subangular blocky structure;

blocks are heavily coated with gray films; friable to firm when moist; medium acid.

28 to 36 inches, yellowish-brown silt loam; weak to moderate, medium, subangular blocky structure; many blocks are coated with gray films; friable when moist; medium acid.

Substratum—

36 to 54 inches, yellowish-brown silt loam; weak, coarse, blocky structure; very friable when moist; medium acid.

54 to 72 inches, light yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; neutral.

72 inches +, light yellowish-brown to very pale brown very fine sandy loam to silt loam; massive (structureless); loose; mildly calcareous.

The original surface layer of this soil is 6 inches or less in thickness in all but a few places. Where the soil is cultivated, the plow layer commonly includes part of the subsurface horizon. The platy subsurface horizon is grayish brown to light gray and ranges from 3 to 8 inches in thickness.

The texture of the subsoil ranges from silt loam to silty clay loam. The structural blocks in the subsoil and a few in the upper substratum are heavily coated with gray films. The silt in the substratum becomes coarser with depth; in the lower part of the substratum, it is nearly a very fine sandy loam.

The depth to the calcareous material in the substratum ranges from 48 to 80 inches; most commonly, it is 66 to 72 inches. In most places the loess is 8 to 10 feet thick over the glacial till. In about one-fourth of the area, the loess is only 42 to 48 inches thick. None of this relatively shallow loess is calcareous. In some places the layer of glacial till is missing, and the loess lies directly above the limestone bedrock and the soil material that weathered from it.

Fayette silt loam, 2 to 6 percent slopes, moderately eroded (FaB2) (Capability unit IIe–2).—This soil is on gentle slopes on the uplands. The profile is like that of Fayette silt loam, 2 to 6 percent slopes, except that from 25 to 50 percent of the original surface soil has been lost through erosion, and the platy subsurface soil has been mixed with the remaining surface soil in the plow layer. A few areas have lost from 50 to 75 percent of the original surface soil.

The fertility level and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate.

Fayette silt loam, 6 to 12 percent slopes (FaC) (Capability unit IIIe–1).—This soil is on moderate slopes on uplands and in valleys. Much of the area is still wooded. The profile of this soil is similar to that of Fayette silt loam, 2 to 6 percent slopes.

Less than 25 percent of the original surface soil has been lost through erosion. The hazard of further erosion is moderately severe.

Fayette silt loam, 6 to 12 percent slopes, moderately eroded (FaC2) (Capability unit IIIe–1).—This soil lies on moderate slopes on uplands and in valleys. The profile is like that of Fayette silt loam, 2 to 6 percent slopes, except that it has lost from 25 to 50 percent of the original surface soil through erosion. The platy subsurface horizon has been mixed with the rest of the surface soil in the plow layer. Some areas have a few gullies.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderately severe.

Fayette silt loam, 6 to 12 percent slopes, severely eroded (FaC3) (Capability unit IIIe–1).—This soil lies on moderate slopes on uplands. The profile is similar to that of Fayette silt loam, 2 to 6 percent slopes, except that from 50 to 75 percent of the original surface soil is gone because of erosion. A few areas have lost all of the surface soil, and some have a few or many shallow or deep gullies. The plow layer consists of any remaining surface soil, mixed with the subsurface layer and part of the subsoil.

Erosion has severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. There is a moderately severe hazard of further erosion.

Fayette silt loam, 12 to 18 percent slopes (FaD) (Capability unit IVe–1).—This soil lies on moderately steep slopes on the uplands and in valleys. The profile is somewhat like that of Fayette silt loam, 2 to 6 percent slopes, except that the subsoil has a less strongly developed structure, and the average depth of the loess is 5 to 7 feet. Also, this soil has more areas where the glacial till layer is absent and the limestone bedrock lies just beneath the loess.

Many areas of this soil have not been cleared of woods. Less than 25 percent of the original surface soil has been lost through erosion. The hazard of future erosion is severe.

Fayette silt loam, 12 to 18 percent slopes, moderately eroded (FaD2) (Capability unit IVe–1).—This soil is on moderately steep slopes on the uplands and in valleys. The profile is somewhat similar to that of Fayette silt loam, 2 to 6 percent slopes. From 25 to 50 percent of the original surface soil has been lost through erosion, and about one-third of the area has a few deep and shallow gullies. The platy subsurface horizon has been mixed with the remainder of the surface soil in the plow layer. The subsoil is not so strongly developed as that in the profile described. The average depth of the loess in which this soil developed is 5 to 7 feet. Limestone bedrock rather than glacial till commonly lies just beneath the loess.

Erosion has moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water in this soil. The hazard of further erosion is severe.

Fayette silt loam, 12 to 18 percent slopes, severely eroded (FaD3) (Capability unit IVe–1).—This soil is on moderately steep slopes on the upland and in valleys. Most areas have lost from 50 to 75 percent of the original surface soil through erosion; some areas have lost all of it; and a few areas have a few deep or shallow gullies. The plow layer consists of a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. The subsoil structure is not strongly developed. The average depth of the loess is only 4 to 6 feet. In many places, limestone bedrock rather than glacial till lies just below the loess. In other respects, the profile of this soil is similar to that of Fayette silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion, and the hazard of further erosion is severe.

Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded (FsE2) (Capability unit VIe–1).—This mapping unit consists of a mixed pattern of Fayette silt loam and Seaton silt loam. The profile of the Seaton silt loam is like that of Seaton silt loam, 2 to 6 percent slopes. The Fayette soil has a profile similar to that of Fayette silt loam, 2 to 6 percent slopes, but some of its characteristics are like those of the Seaton soil.

These soils are intermixed on steep slopes on the upland and in valleys. Many areas are still in woods and have lost less than 25 percent of their original surface soil. Other areas have lost from 25 to 50 percent. About half the areas mapped have a few or many shallow gullies.

On the most severely eroded parts of this unit, the level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is very severe. These soils can be quickly and severely damaged by gullies. Most of the acreage is now in permanent pasture.

Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded (FsE3) (Capability unit VIe–1).—In this mapping unit, areas of Fayette silt loam and areas of Seaton silt loam are mingled on steep slopes on the upland. The profiles of the soils are similar to those of Fayette silt loam, 2 to 6 percent slopes, and Seaton silt loam, 2 to 6 percent slopes. Most of the areas have lost from 50 to 75 percent of the original surface soil, and a few are even more severely eroded. Many areas have a few or many shallow to deep gullies.

Erosion has severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is very severe. Most of the areas are now in permanent pasture.

Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded (FsF2) (Capability unit VIIe–1).—The soils in this unit are Fayette silt loam and Seaton silt loam, intermingled on narrow, very steep slopes on the upland. The profiles are somewhat like those of Fayette silt loam, 2 to 6 percent slopes, and Seaton silt loam, 2 to 6 percent slopes.

All classes of erosion are represented in the soils of this unit, but most areas have lost from 25 to 75 percent of the original surface soil. Many areas have a few or many shallow gullies. Erosion has moderately to severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water in much of this unit. The hazard of further erosion is extremely severe. Most areas are now in permanent pasture or woodland.

Floyd soils

The Floyd soils are dark colored and poorly drained to somewhat poorly drained. They developed in silty clay loam materials 24 to 36 inches thick over clay loam and loam glacial till on uplands. The vegetation is water-tolerant grass.

In many places Floyd soils are next to, but lower than, Kenyon, Ostrander, Racine, Kasson, Skyberg, Renova, Vlasaty, and Sargeant soils. In the more nearly level areas of Floyd soils, there are many small, slightly depressed areas of Clyde soils. The two series were mapped in the same unit. The more sloping areas of Floyd soils do not contain spots of Clyde soils.

The Kato soils differ from the Floyd soils in that they are underlain by thick beds of coarse-textured sand or gravelly sand below a depth of 30 inches. The Floyd soils have only a thin layer of coarse-textured material between the silty clay loam material of the subsoil and the loam or clay loam glacial till of the substratum.

The reaction of the Floyd soils is generally slightly acid, but in some places it is neutral. The water-holding capacity and the fertility level are both high.

The silty clay loam texture makes these soils more difficult to farm than the silt loam soils nearby. There are a few stones on the surface. Both surface and subsurface drainage are needed.

Floyd silty clay loam, 2 to 6 percent slopes (FtB) (Capability unit IIw–2).—This soil is on gentle slopes on uplands. Some of the longer slopes show the effects of slight erosion. Seepage is a problem in many places.

Profile—

Surface soil—
- 0 to 15 inches, black silty clay loam; weak, fine, granular structure; cloddy; very friable when moist, slightly hard when dry, sticky when wet; slightly acid.

Subsurface soil—
- 15 to 18 inches, very dark gray to dark grayish-brown silty clay loam; few, faint mottles; weak, medium, subangular blocky structure; sticky when wet; slightly acid.

Subsoil—
- 18 to 27 inches, dark grayish-brown to olive-brown silty clay loam; common, faint mottles; massive (structureless) to weak, medium, subangular blocky structure; sticky when wet; slightly acid.
- 27 to 30 inches, yellowish-brown to light yellowish-brown and olive-gray clay loam to loam; common, distinct mottles; weak, medium, subangular blocky structure; slightly sticky when wet; contains many pieces of gravel; slightly acid.
- 30 to 33 inches, yellowish-brown to light yellowish-brown and grayish-brown sandy clay loam; few, faint mottles; massive (structureless); slightly sticky when wet; contains many pieces of gravel; slightly acid.

Substratum—
- 33 to 52 inches, light yellowish-brown to brownish-yellow and olive-gray clay loam to sandy clay loam; common, distinct mottles; massive (structureless); sticky when wet; slightly acid.
- 52 inches +, light yellowish-brown to brownish-yellow and olive-gray clay loam; common, distinct mottles; massive (structureless); sticky when wet; mildly calcareous.

The thickness of the surface soil ranges from 10 to 18 inches. The surface soil is thinner in areas next to Skyberg, Kasson, Renova, Vlasaty, or Sargeant soils. Where materials eroded from nearby soils have accumulated, the surface soil is thick and has a silt loam texture. In some places there are stones on the surface, especially in the eastern part of the county. Where the surface soil is thinnest, the subsurface soil has a weak, thin, platy structure and is grayish brown to dark grayish brown.

The texture of the upper part of the subsoil ranges from silt loam to silty clay loam. At depths of 24 to 36 inches, there is a layer where the texture ranges from light clay loam to loamy sand but is most commonly sandy clay loam. This coarser textured horizon is called a "pebble band" because it generally contains a considerable amount of gravel, small stones, and sand. It is at depths of more than 36 inches, in areas where large amounts of colluvium have collected on the surface and where loess soils are nearby. The thickness ranges from 1 to 18 inches, but 2 to 4 inches is most common.

The substratum ranges in texture from loam to clay loam. In some places it consists of till from two different glaciations. The lower till is generally finer textured, firmer, and more plastic. The two kinds of till are generally separated by a thin, coarser textured horizon similar to the pebble band in the subsoil.

Calcareous material is present in the substratum at a depth of 30 inches near the Steele County line and in other places at a depth of 72 inches It is most commonly at depths of 48 to 54 inches.

Floyd and Clyde silty clay loams (Fy) (Capability unit IIw–1).—Most of the soils in this mapping unit lie on level to nearly level flats and in swales on the upland (see fig. 5). About 80 percent of the area is Floyd silty clay loam. Spots of Clyde silty clay loam lie in depressions that cover about 20 percent.

The profiles are similar to those described for Floyd silty clay loam, 2 to 6 percent slopes, and for Clyde silty clay loam, 0 to 2 percent slopes. Some areas of Floyd silty clay loam have a mildly calcareous surface soil, but they were included in the Canisteo silty clay loam mapping unit.

Hayfield soils

The Hayfield soils are moderately deep, moderately dark colored, and moderately well drained. They developed under a mixture of grass and hardwood forest on moderately thick, medium textured materials over coarse to very coarse textured glacial outwash. Most areas are on the level outwash plains in the southwestern part of the county; small areas are on gentle slopes.

The Hayfield soils are closely associated with the Udolpho, Waukegan, and Kato soils. They differ from the Udolpho soils in that they are moderately well drained and are mottled only in the lower part of the subsoil. They differ from Kasson soils in that the substratum is coarse textured to very coarse textured outwash rather than fine textured glacial till and, also, the structure in the subsoil is more weakly developed.

The Hayfield surface soil and subsoil are generally medium acid to strongly acid. Because of the coarse textured to very coarse textured substratum, these soils have a moderate capacity for holding available water. They are somewhat droughty, especially when dry periods in summer last for 2 to 3 weeks. The soils are free of stones and easy to work. The fertility is moderately high.

Hayfield silt loam, 0 to 2 percent slopes (HaA) (Capability unit IIs–1).—This soil lies on nearly level outwash plains. Little or no erosion has occurred or is likely to occur.

Profile in a cultivated field—

Surface soil—
- 0 to 8 inches, very dark gray silt loam; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 8 to 12 inches, dark grayish-brown silt loam; weak, thin, platy structure to weak, fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 12 to 17 inches, brown loam to clay loam; weak, medium, subangular blocky structure; friable when moist; strongly acid.
- 17 to 25 inches, brown to pale-brown loam to clay loam; few, faint mottles; weak, medium, subangular blocky structure; friable when moist; strongly acid.

Substratum—
- 25 to 32 inches, dark yellowish-brown sand; single grain (structureless); loose; medium acid.
- 32 to 48 inches, dark yellowish-brown sand; massive (structureless) to single grain (structureless); loose; contains fine gravel; contains many thin bands of darker sandy clay loam that include a considerable amount of shale fragments; slightly acid.
- 48 inches +, light yellowish-brown sand; massive (structureless) to single grain (structureless); loose; contains fine gravel; contains a few thin bands of dark yellowish-brown sandy loam that include a considerable amount of shale fragments; mildly calcareous.

The texture of the surface soil ranges from loam to silt loam, the thickness from 6 to 10 inches, and the color from very dark gray to dark gray. In some places the subsurface soil shows no platy structure.

The upper layer of the subsoil ranges from loam to clay loam or from silt loam to silty clay loam in texture. It is generally free of mottling. The lower layer nearly everywhere has a loam or clay loam texture. The mottles range from few and faint to common and distinct. Pieces of gravel are more common in the layer just above the substratum. The depth to the substratum is commonly 27 to 30 inches, but it may be as much as 36 inches or as little as 24 inches.

The substratum consists principally of medium to coarse sand that contains fine to medium gravel. The bands of darker colored material in the substratum range in texture from loamy sand to sandy clay loam. The amount of dark-colored shale fragments included in these bands varies from place to place. The depth to the calcareous material in the substratum ranges from 42 to 72 inches, but 48 to 54 inches is the most common.

The coarse textured to very coarse textured part of the substratum is commonly underlain by fine textured glacial till at depths of 8 to 10 feet. There are a few areas where the substratum is only 12 to 18 inches thick and glacial till is within 4 to 5 feet of the surface.

Spots of somewhat poorly drained Udolpho silt loam, too small to separate on the map, are included in this mapping unit.

Hayfield silt loam, 2 to 6 percent slopes (HaB) (Capability unit IIe–3).—This soil lies on short gentle slopes on outwash plains. The profile is like that of Hayfield silt loam, 0 to 2 percent slopes, except that up to 25 percent of the original surface soil has been lost through erosion. One small area has lost between 25 and 50 percent of its surface soil. There is a moderate hazard of further erosion.

Judson soils

The Judson soils are deep, moderately well drained, and dark colored. They developed under grass on nearly level and gentle slopes on alluvial fans and in narrow valleys, drainageways, and waterways that have no stream channel. The parent material was dark-colored, silty, alluvial and colluvial material that washed from dark-colored soils nearby on the upland.

These soils are associated principally with the Tama and Downs soils. The Judson and Chaseburg soils differ principally in color. Grass vegetation covered the dark-colored Judson soils and the soils from which their parent material was washed. The lighter colored Chaseburg soils and the soils from which their parent material was derived developed under deciduous forest.

The Judson soils are generally only slightly acid. They are free of stones and easy to work. The available water holding capacity is high to very high, and the fertility is very high.

Judson silt loam, 0 to 2 percent slopes (JuA) (Capability unit IIw–4).—This soil is in nearly level positions in narrow valleys and waterways. Material washed from dark-colored soils of the upland accumulates in these areas. Unless channels are established and maintained to divert runoff, a few gullies develop. Crops are often damaged by runoff and by the silt that is deposited.

Profile—

Surface soil—
- 0 to 12 inches, black silt loam; moderate, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 12 to 24 inches, black silt loam; weak, very fine to fine, subangular blocky structure; very friable when moist; slightly acid.
- 24 to 30 inches, black to very dark gray silt loam; weak to moderate, fine, subangular blocky structure; very friable when moist; slightly acid.
- 30 inches +, grayish-brown silty clay loam; common, distinct mottles; massive (structureless); very friable when moist; neutral.

The surface soil ranges from black to very dark gray. The silt loam materials of the surface soil and subsurface soil range from 18 inches to many feet in thickness over the silty clay loam materials. The silty clay loam in the profile described was originally the surface layer of a soil buried beneath the alluvium and colluvium in which the Judson soil developed. Those soils in which the silt loam is shallower over the silty clay loam are generally somewhat poorly drained rather than moderately well drained.

Judson silt loam, 2 to 6 percent slopes (JuB) (Capability unit IIw–5).—This soil lies on gentle slopes in narrow valleys and waterways. Its profile is like that of Judson silt loam, 0 to 2 percent slopes. Material washed from dark-colored soils accumulates in these areas and frequently damages crops. The erosion hazard is moderate; unless runoff is diverted by channels, crops are damaged and gullies often develop.

Kasson soils

The Kasson soils are deep, moderately well drained, and moderately dark colored. They developed under a mixture of grass and hardwood forest on nearly level to gentle slopes. The parent material was a thin cap of silt over firm loam to clay loam glacial till.

These soils are associated chiefly with the Skyberg soils and the Racine soils, which developed in the same kind of parent material under the same kind of vegetation. Both differ from the Kasson soils in that the somewhat poorly drained Skyberg soils are mottled in all horizons except the surface horizon, and the well drained Racine soils are not mottled in either the surface soil or subsoil. The glacial till beneath the Kasson soils is more dense than that beneath the Racine soils.

The Kasson soils differ from the Vlasaty and Kenyon soils, which developed from the same kind of parent material with the same drainage, because of differences in vegetation. The forested Vlasaty soils have a slightly lighter colored, thinner surface soil and a lighter subsurface horizon. The grass-covered Kenyon soils have a thicker, darker surface soil, a darker subsurface soil, weaker development of structure, and less dense glacial till in the substratum.

Except where limed, the surface soil and subsoil of the Kasson soils are medium acid to strongly acid. The surface soil is free of gravel and small stones, except where the silt cap is less than 7 inches thick. The available moisture holding capacity is high, and the fertility is moderately high.

Kasson silt loam, 0 to 2 percent slopes (KaA) (Capability unit IIs–1).—This soil lies in nearly level areas on the upland. Little or no erosion has occurred, and little or none is likely.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, very dark gray silt loam; fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 11 inches, dark grayish-brown silt loam; weak, thin, platy structure to weak, fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 11 to 16 inches, dark-brown to brown silt loam; moderate, fine to medium, subangular blocky structure; a few blocks are coated with grayish-brown films; friable when moist; strongly acid.
- 16 to 25 inches, dark yellowish-brown to yellowish-brown clay loam; few, faint mottles; weak, medium, prismatic structure to moderate, medium, angular blocky structure; many prisms and blocks are coated with gray films; firm when moist; cobblestones and pebbles are very common in the upper part of this horizon; strongly acid.
- 25 to 40 inches, dark yellowish-brown to yellowish-brown clay loam; common, faint mottles; moderate, medium to coarse, prismatic structure to moderate, medium, subangular blocky structure; surfaces in vertical cracks are heavily coated with brownish-gray sand; firm when moist; strongly acid.

Substratum—
- 40 to 60 inches, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless) to weak, coarse, angular blocky structure; a few surfaces in vertical cracks are coated with grayish-brown sand; firm when moist; slightly acid.
- 60 inches +, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless); firm when moist; mildly calcareous.

The silt cap from which the upper horizons of this soil have developed ranges from 6 to 30 inches in thickness but is commonly 14 to 16 inches thick. The surface soil is normally 6 to 8 inches in thickness but in some places is as much as 10 inches thick. In some places the subsurface soil does not have a platy structure.

The subsoil and substratum below the silt cap may have a loam, sandy clay loam, or clay loam texture. Gravel and cobblestones are common in these horizons, but they tend to be concentrated in a thin pebble band just below the silt cap. A few pockets and bands of coarse-textured materials are present in some places in the subsoil and substratum. The depth to the firm, calcareous glacial till ranges from 4 to 12 feet but is generally about 5 feet.

Some areas of Skyberg silt loam that were too small to separate were included in this unit.

Kasson silt loam, 2 to 6 percent slopes (KaB) (Capability unit IIe–2).—This soil is on the upland, on gentle slopes that rarely exceed 3 percent. The profile is like that of Kasson silt loam, 0 to 2 percent slopes, except that a small part, less than 25 percent, of the original surface soil has been removed by erosion. The hazard of further erosion is moderate.

A few small areas of Skyberg silt loam are included in this mapping unit.

Kasson silt loam, 2 to 6 percent slopes, moderately eroded (KaB2) (Capability unit IIe–2).—This soil lies on gentle upland slopes that average 4 or 5 percent. From 25 to 50 percent of the original surface soil has been lost through erosion, and the plow layer is a mixture of the remaining surface soil, the subsurface layer, and, in a few places, part of the upper subsoil. Except for this, the profile is like that of Kasson silt loam, 0 to 2 percent slopes.

There are only a few inclusions of Skyberg silt loam in this unit.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate.

Kato soils

The Kato soils are moderately deep and dark colored. Their drainage is poor to somewhat poor. They developed from a thin mantle of silty clay loam materials over clay loam and coarse textured to very coarse textured glacial outwash.

These soils are closely associated with Marshan and Udolpho soils and with the coarse substratum phase of Canisteo soils. The Kato soils lie in slightly higher positions than the very poorly drained Marshan soils, they have better drainage, and their subsoil is less gray and more brightly mottled. The surface soil of the Kato soils is thicker and darker colored than that of the Udolpho soils. They differ from the Floyd soils in that they are underlain by many feet of coarse textured to very coarse textured glacial outwash instead of by fine textured glacial till.

The surface layer of the Kato soils is free of stones, but it is somewhat difficult to work because of its silty clay loam texture. After these soils are drained, the available moisture holding capacity is only moderate. The coarse textured to very coarse textured materials in the substratum make laying tile and maintaining ditchbanks very difficult.

Kato silty clay loam (Kc) (Capability unit IIw–3).—This soil lies on nearly level areas of glacial outwash. There has been little or no erosion, and little or none is likely.

Profile—

Surface soil—
- 0 to 14 inches, black silty clay loam; weak, fine, granular structure; slightly hard when dry, very friable when moist, sticky when wet; slightly acid.

Subsurface soil—
- 14 to 17 inches, very dark gray to olive-gray silty clay loam; few, faint mottles; weak, medium, subangular blocky structure; sticky when wet; slightly acid.

Subsoil—
- 17 to 24 inches, dark grayish-brown to olive-gray silty clay loam; many, faint mottles; massive (structureless) to weak, medium to coarse, subangular blocky structure; very sticky when wet; slightly acid.
- 24 to 28 inches, grayish-brown to light olive-brown clay loam; many, distinct mottles; massive (structureless) to weak, coarse, subangular blocky structure; sticky when wet; slightly acid.
- 28 to 30 inches, grayish-brown to yellowish-brown sandy clay loam; many, distinct mottles; sticky when wet; contains many pieces of fine gravel; slightly acid.

Substratum—
- 30 to 48 inches, yellowish-brown and grayish-brown sand; massive (structureless) to single grain (structureless); loose; contains fine gravel; contains many thin bands of dark-colored sandy clay loam that include a considerable amount of shale fragments; slightly acid.
- 48 inches +, light brownish-gray to light yellowish-brown coarse sand; single grain (structureless); loose; contains fine gravel; mildly calcareous.

The surface soil ranges in texture from clay loam to silty clay loam. Its reaction is slightly acid or neutral. Where the surface soil is clay loam, the texture of the entire subsoil is clay loam or sandy clay loam. Where the surface soil is silty clay loam, the upper part of the subsoil is silty clay loam and the lower part, just above the coarse textured to very coarse textured substratum, is clay loam or sandy clay loam. In the Zumbro valleys, the subsoil contains medium and large stones.

The depth to the coarse-textured material in the substratum ranges from 24 to 36 inches; most commonly, it is 27 to 30 inches. The dark-colored material in the thin bands ranges in texture from loamy sand to sandy clay loam. Fine gravel is common. The coarse substratum ranges from 2 to 6 feet in thickness, but is generally 3 to 4 feet thick. Dense glacial till lies beneath the coarse layer of the substratum.

Kenyon soils

The Kenyon soils are deep, moderately well drained, and dark colored. They developed under prairie grass on nearly level to gently sloping upland. The parent material was a thin deposit of loess over loam to clay loam glacial till.

The associated soils are the well drained, dark colored Ostrander, the well drained, moderately dark colored Racine, and the poorly drained to somewhat poorly drained Floyd soils. The Kenyon soils have a thicker, darker colored surface soil than the Kasson soils, their subsurface soil is darker, and the structure in the subsoil is less strongly developed.

The Kenyon soils have slightly thicker, darker colored surface and subsurface layers and a less dense glacial till substratum than the Ostrander soils. They are faintly to distinctly mottled in the lower subsoil as well as in the substratum.

In some places where the silt cap is less than 7 inches thick, scattered gravel and cobblestones are present in the surface soil, but most areas are free of stones and gravel. The surface soil and subsoil are generally medium acid to strongly acid. The available moisture holding capacity and the fertility are both high.

Kenyon silt loam, 0 to 2 percent slopes (KnA) (Capability unit I–1).—This soil is in nearly level positions on the upland. Little or no erosion has occurred, and there is little hazard of erosion.

Profile—

Surface soil—
0 to 10 inches, black to very dark gray silt loam; fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
10 to 16 inches, black to very dark brown silt loam; moderate, very fine to fine, subangular blocky structure; friable when moist; medium acid.

Subsoil—
16 to 20 inches, very dark grayish-brown to dark-brown silt loam to silty clay loam; weak, fine, subangular blocky structure; friable when moist; medium acid.
20 to 28 inches, brown to dark yellowish-brown clay loam; common, fine, faint mottles; weak to moderate, fine to medium, subangular blocky structure; friable when moist; medium acid.
28 to 35 inches, yellowish-brown and dark grayish-brown clay loam; common, fine, distinct mottles; moderate, medium, subangular blocky structure; firm when moist; medium acid.

Substratum—
35 to 54 inches, yellowish-brown to grayish-brown clay loam; common, medium, distinct mottles; massive (structureless) to weak, coarse, angular blocky structure; firm when moist; slightly acid.
54 inches +, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless); firm when moist; mildly calcareous.

The silt cap in which this soil developed ranges from 15 to 30 inches in thickness, but averages 18 inches. In these places the surface soil is silt loam. Where the silt cap is missing, the surface soil is loam. Areas next to the Floyd soils are silty clay loam; these areas are somewhat poorly drained. Areas next to the Racine soils have a slightly lighter colored and thinner surface soil.

The subsoil and substratum below the silt cap have a loam, sandy clay loam, or clay loam texture. Gravel and small stones are common in these horizons, but they tend to be concentrated in a thin pebble band just below the silt cap.

The glacial till in the substratum is firm and very firm. A few pockets of coarse-textured material are present. The depth to calcareous material ranges from 3½ to 6 feet, but averages 4½ feet.

Kenyon silt loam, 2 to 6 percent slopes (KnB) (Capability unit IIe–1).—This soil lies on gentle, generally long slopes that rarely exceed 3 percent. Some erosion has occurred, but less than 25 percent of the original surface soil has been lost. The profile is similar to that of Kenyon silt loam, 0 to 2 percent slopes. A silty clay loam surface texture is rare in this unit. The hazard of erosion is moderate.

Kenyon silt loam, 2 to 6 percent slopes, moderately eroded (KnB2) (Capability unit IIe–1).—This soil is on generally long, gentle slopes that rarely exceed 3 percent. The profile is like that of Kenyon silt loam, 0 to 2 percent slopes, except that from 25 to 50 percent of the original surface soil has been lost through erosion. The plow layer is a mixture of the remaining surface soil and part of the subsurface soil. The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate. A surface texture of silty clay loam is rare in this unit.

Lawson soils

The Lawson soils are dark colored and somewhat poorly drained. They developed from dark-colored silt and silty clay loam deposited by floods. They lie principally in slight depressions on second bottoms, near the better drained alluvial soils.

Where the Lawson soils are associated with better drained alluvial soils, they are flooded about once in 5 years. Where they are the only alluvial soils on the flood plain, they generally lie only 3 to 4 feet above the stream and are flooded about once every 2 or 3 years. Flood damage on the Lawson soils is a little more severe than on the better drained alluvial soils because the water does not drain off so rapidly after the floods subside. A thin deposit of fresh alluvium remains on the surface after each flood.

These soils are free of stones and easy to work. The available moisture holding capacity is high to very high. The fertility is very high. Most of the material deposited is neutral in reaction, but some is mildly calcareous or slightly acid.

Lawson and Orion silt loams (Lo) (Capability unit IIw–4).—These soils are on the somewhat poorly drained parts of bottom lands. The Lawson silt loam is dark colored, and the Orion silt loam is light colored. The distribution depends on whether light-colored or dark-colored material was deposited by floodwaters.

Profile of Lawson silt loam—

Surface soil—
0 to 5 inches, black silt loam; moderate, fine, granular structure; friable when moist; neutral to mildly alkaline.

Subsurface soil—
5 to 13 inches, very dark gray silt loam; few, small, distinct, dark reddish-brown mottles; massive (structureless); slightly acid to mildly alkaline.
13 to 20 inches, black silt loam; weak to moderate, very fine and fine, subangular blocky structure; friable when moist; slightly acid to mildly alkaline.

Substratum—
20 to 36 inches, very dark gray silt loam; massive (structureless); friable when moist, slightly plastic when wet; neutral to mildly alkaline.
36 to 48 inches, dark-gray silt loam; few, small, faint, olive-colored mottles; massive (structureless); friable when moist, slightly plastic when wet; neutral to mildly alkaline.

The surface soil is black to very dark brown when the granules are crushed. Streaks and bands less than one-eighth of an inch thick of lighter colored silt or very fine sand may be present anywhere in the profile. In some places the texture below a depth of 20 inches is light silty clay loam. Stratified sand and gravel are present in some profiles at a depth of about 5 feet. The underlying material is a clay loam glacial drift in some places.

The Orion soil has a lighter colored surface layer than the Lawson soil. A dark-colored surface soil is buried in the Orion profile, generally at a depth of 18 inches or more. In other characteristics, the Orion soil is very similar to the Lawson soil.

Profile of Orion silt loam—

Surface soil—
0 to 18 inches, dark-gray silt loam; many, medium, distinct, yellowish-brown mottles; moderate, fine to medium, subangular blocky structure; friable when moist; neutral.

Buried surface soil—
18 to 31 inches, black silt loam; few, faint, dark-brown mottles; weak, fine, subangular blocky structure; friable when moist; neutral.

Substratum—
31 to 42 inches, very dark grayish-brown silty clay loam; many, fine, distinct, yellowish-brown mottles; massive (structureless); firm when moist; neutral.

The thickness and arrangement of the horizons in the Orion profile vary considerably because the parent material was stratified. The depth to the buried surface soil and the darkness of its color also vary considerably. Other variations are in the degree of mottling and the amount of organic matter present throughout the profile.

Marshan soils

The Marshan soils are dark colored and very poorly drained. They developed in depressions and old drainageways on outwash plains. The vegetation consists of swamp grass and sedges. The parent materials consisted of 30 to 36 inches of silt loam and silty clay loam deposited over sand and gravelly sand glacial outwash materials. In some places several inches of muck have developed on the surface.

These soils are commonly surrounded by the coarse substratum Canisteo soils, which are on the rims of the depressions, and by Kato soils. The Canisteo soils are a little better drained and less acid than the Marshan soils. The Kato soils are better drained than the Marshan and are less gray in the subsoil.

The substratum of the Clyde soils is glacial till, and the substratum of the Marshan soils is outwash many feet thick. The two series have similar drainage and vegetation, and the parent material of the upper part of the profile is similar.

The surface soil is slightly acid to neutral. These soils need artificial drainage before crops can be grown successfully. After drainage, the available moisture holding capacity is only moderate.

These soils are free of stones, but they are somewhat difficult to work because of the high proportion of silt and clay in the surface soil. The sand to gravelly sand substratum makes laying tile and maintaining ditchbanks very difficult.

Marshan silty clay loam (Ma) (Capability unit IIIw-5).—This soil lies in depressions and old drainageways on outwash plains. There is no erosion or hazard of erosion.

Profile—

Surface soil—
0 to 15 inches, black silty clay loam; weak, fine, granular structure; slightly hard to soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
15 to 18 inches, very dark gray to olive-gray silty clay loam; few, faint mottles; massive (structureless) to weak, medium, subangular blocky structure; sticky when wet; slightly acid.

Subsoil—
18 to 28 inches, light olive-gray to olive-gray silty clay loam; few, distinct mottles; massive (structureless); sticky when wet; slightly acid.
28 to 32 inches, light olive-gray to olive-gray clay loam to sandy clay loam; common, distinct mottles; massive (structureless); sticky when wet; slightly acid.

Substratum—
32 to 40 inches, light brownish-gray medium sand; loose; contains a few pieces of gravel; slightly acid.
40 to 46 inches, light brownish-gray coarse sand; loose; contains fine gravel; neutral.
46 inches +, light brownish-gray coarse sand; loose; contains fine gravel; moderately calcareous.

The surface soil generally has a silty clay loam texture, but in some places it is silt loam or clay loam. Elsewhere, a layer of muck less than 12 inches thick is present on the surface. The subsoil texture ranges from sandy clay loam to silty clay loam. The sandy clay loam and clay loam are generally just above the very coarse textured substratum. The upper layers of this soil are slightly acid to neutral, but calcareous material is present in the substratum, generally beginning at a depth of 36 to 48 inches. The very coarse textured material is 3 or 4 feet thick in most places. Pockets of quicksand are common. Thin bands of sandy loam to sandy clay loam are present in many places. Firm glacial till lies beneath the very coarse textured substratum material.

Orion soils

These soils are light colored and somewhat poorly drained. They developed from light-colored silt and silty clay loam deposited by floods. A dark-colored, older soil is buried beneath the light-colored alluvium at a depth of 18 inches or more. Most of the Orion soils lie in slight depressions on second bottoms, near better drained alluvial soils.

The areas that lie next to better drained alluvial soils are flooded about once in 5 years. Those that lie only 3 or 4 feet above the stream are flooded about once in 2 or 3 years. These somewhat poorly drained soils are damaged more severely by floods than the better drained alluvial soils, because water stands on them longer. A thin deposit of fresh alluvium remains on the surface after each flood. Some of the material deposited is mildly calcareous or slightly acid, but most of it is neutral.

These soils are easy to work and free of stones. The available moisture holding capacity is high to very high, and the fertility is very high.

The Orion soils in Dodge County have been mapped only in an undifferentiated mapping unit with the Lawson soils. A profile of Orion silt loam is described under Lawson and Orion silt loams.

Ostrander soils

The Ostrander soils are deep, well drained, medium textured, and dark colored. They developed on gentle slopes under prairie grass. The parent material was a thin deposit of loess over loam to clay loam glacial till.

The moderately well drained Kenyon soils are associated with the Ostrander soils and developed from the same kind of material. Where the loess is deeper, the Ostrander soils grade into the Tama soils, which developed entirely in loess.

The Ostrander soils differ from the Racine soils, which developed under a transition between forest and prairie grass, in having a deeper and darker colored surface soil, a darker colored subsurface soil, and a weaker structure and thinner clay films in the subsoil.

The surface of these soils is generally stone free, but where the silt cap is less than 12 inches thick or where the surface texture is loam, some gravel and cobblestones are scattered on the surface. The surface soil is medium acid to strongly acid in most places. The available moisture holding capacity is moderately high, and the fertility is high.

Ostrander silt loam, 0 to 2 percent slopes (OsA) (Capability unit I–1).—This soil is nearly level but well drained. Little or no erosion has occurred, and the hazard is slight. The profile is like that of Ostrander silt loam, 2 to 6 percent slopes, except that it contains many bands of coarse-textured material in the subsoil and substratum. Some areas have a loam surface texture.

A few small areas of moderately well drained Kenyon silt loam are included in this unit.

Ostrander silt loam, 2 to 6 percent slopes (OsB) (Capability unit IIe–1).—This soil lies on gentle slopes on the upland. The hazard of erosion is moderate, but less than 25 percent of the original surface soil has been removed by erosion.

Profile—

Surface soil—
0 to 10 inches, black to very dark brown silt loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
10 to 15 inches, mixed very dark brown and brown silt loam; weak to moderate, very fine to fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
15 to 25 inches, yellowish-brown clay loam; moderate, fine to medium, subangular blocky structure; blocks are coated with brown films; friable when moist; medium acid.
25 to 35 inches, yellowish-brown clay loam; moderate to strong, medium, angular blocky structure; blocks are coated with brown films; very firm when moist; medium acid.

Substratum—
35 to 56 inches, yellowish-brown to brownish-yellow clay loam; few, fine, grayish-brown mottles and splotches; massive (structureless) to weak, coarse, angular blocky structure; firm when moist; slightly acid.
56 inches +, light yellowish-brown to brownish-yellow clay loam; common, faint, grayish-brown mottles and splotches; massive (structureless); firm when moist; mildly calcareous.

In most places the surface soil is silt loam, but in about 10 percent of the area it is loam. The silt cap ranges from 7 to 18 inches in thickness in the glaciated areas; generally it is about 15 inches thick. Next to the Tama silt loam, the thickness of the silt cap averages 24 to 30 inches.

Below the silt cap, the subsoil and substratum range from loam to clay loam. Gravel and cobblestones are common in these layers, and a few bands and pockets of sand and gravel are present. In many places the substratum is faintly to distinctly mottled. The depth to the calcareous material in the substratum ranges from 3½ to 6 feet but is most commonly about 4½ feet.

Ostrander silt loam, 2 to 6 percent slopes, moderately eroded (OsB2) (Capability unit IIe–1).—This soil lies on gentle slopes on the upland. About 25 to 50 percent of the original surface soil has been lost through erosion, and the plow layer is a mixture of the remaining surface soil and part of the subsurface soil. Otherwise, the profile is like that of Ostrander silt loam, 2 to 6 percent slopes. In some areas the surface soil has a loam texture.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate.

Ostrander silt loam, 6 to 12 percent slopes, moderately eroded (OsC2) (Capability unit IIIe–1).—This soil lies on moderate slopes on the upland. Most areas have lost from 25 to 50 percent of the original surface soil, and the plow layer is a mixture of the remaining surface soil and part of the subsurface soil. The other areas have lost up to 25 percent of the surface soil. Except for erosion, the profile is like that of Ostrander silt loam, 2 to 6 percent slopes. A few areas in this unit have a loam surface soil.

Erosion has moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderately severe.

Peat and Muck soils

The Peat and Muck soils are very poorly drained. They have developed on nearly level to sloping seepage areas, principally in the eastern third of the county, and in old lakebeds and depressions in the western fourth of the county. A few areas lie in depressions on bottom land. Peat and Muck are not separated on the map because the acreage of both is small.

These soils consist of muck and peat more than 12 inches thick over mineral soil material. The muck and peat have developed principally from partly decayed sedges and grasses. The more thoroughly decayed material that contains a high percentage of silt and clay is called muck. The nearly raw, undecomposed material that contains less than 50 percent silt and clay is called peat. In some areas the muck and peat are underlain by coarse-textured glacial outwash, in others by fine-textured glacial till, and in others by fine-textured, lake-laid silts and clays.

Peat and Muck are high in organic matter, but they are normally very low in available phosphorus and potassium. Generally they are only slightly acid. The available water holding capacity is very high.

Peat and Muck, coarse substrata, 0 to 2 percent slopes (PmA) (Capability unit IIIw–7).—This soil lies in depressions in glacial outwash plains in the western part of the county. It is closely associated with Marshan silty clay loam and Canisteo silty clay loam, coarse substratum.

Profile in a cultivated field—

Surface soil—
0 to 7 inches, black mucky peat; well decomposed; slightly acid.

Subsurface soil—
7 to 32 inches, brown sedge peat; raw; slightly acid.
32 to 40 inches, black, mucky silty clay loam; massive (structureless); very sticky when wet; neutral.

Substratum—
40 inches +, light brownish-gray coarse sand; contains fine gravel; mildly calcareous.

Some areas of this soil have been farmed long enough and are well enough decomposed to be muck soils. The depth to the fine-textured mucky subsurface horizon ranges from 12 to 36 inches but is most commonly 24 to 30 inches. The lower subsurface soil ranges from fine silty muck to silty clay in texture, from 3 to 12 inches in thickness, and from neutral to mildly calcareous in reaction. In many places a band of sandy clay loam from 2 to 8 inches thick is present between the fine-textured subsurface soil and the coarse-textured substratum.

The depth to the coarse-textured substratum ranges from 24 to 42 inches but is most commonly 36 to 42 inches. The substratum ranges from 2 to 6 feet in thickness. In many places it contains thin bands of dark-colored sandy loam and sandy clay loam. Pockets of quicksand are common. Dense glacial till generally lies beneath the coarse-textured substratum.

This soil needs artificial drainage. Installation of tile and maintenance of ditchbanks are difficult because of the coarse material in the substratum. The supply of available phosphorus and potassium is very low.

Peat and Muck, medium textured substrata, 0 to 2 percent slopes (PtA) (Capability unit IIIw–6).—This soil has developed in depressions in glacial till on the upland, on glacial outwash plains, and on bottom land. On the upland it is associated with Clyde soils, on the outwash plains with Marshan soils, and on bottom land with Alluvial land.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, very dark brown to black muck; well decomposed; slightly acid.

Subsurface soil—
- 7 to 12 inches, very dark brown peaty muck; somewhat decomposed; slightly acid.
- 12 to 27 inches, brown sedge peat; raw; slightly acid.
- 27 to 34 inches, black, mucky silty clay loam; massive (structureless); very sticky when wet; neutral.
- 34 to 38 inches, light olive-gray silty clay loam; many, faint mottles; massive (structureless); very sticky when wet; neutral.

Substratum—
- 38 inches +, grayish-brown and yellowish-brown clay loam; many, distinct mottles; massive (structureless); very sticky when wet; mildly calcareous.

About half of the areas of this soil have peat at the surface instead of muck. In a few areas, the peat is 4 to 6 feet deep. In most of the areas, peat or muck from 18 to 24 inches deep overlies mineral soil. The substratum has a loam to clay loam texture, but thin bands or pockets of coarse-textured material are present in some places.

Peat and Muck, medium textured substrata, 2 to 6 percent slopes (PtB) (Capability unit VIw–2).—This soil has developed on seepage slopes or spring-like areas. The areas are generally less than 4 acres in size. Clyde or Floyd silty clay loams are commonly associated with this soil but are at slightly lower elevations.

Profile in an uncultivated area—

Surface soil—
- 0 to 18 inches, black mucky peat; raw; slightly acid.

Subsurface soil—
- 18 to 24 inches, black silty clay; massive (structureless); very sticky when wet; neutral.

Substratum—
- 24 to 30 inches, grayish-brown, reddish-brown, and yellowish-red sandy clay loam; many, distinct mottles; massive (structureless); slightly sticky when wet; slightly acid.
- 30 inches +, blue clay loam to clay; massive (structureless); very sticky and very plastic when wet; mildly calcareous.

The peat and muck range from 12 to 42 inches in depth, but in most places they are from 15 to 21 inches deep. About half of the acreage has a muck surface.

The coarse-textured horizon ranges from 2 inches to several feet in thickness and from sand to sandy clay loam in texture. In many places it has a reddish color because of the very high content of iron in the seepage water that moves through it.

The substratum is dense clay loam to clay. In color it is generally bluish or gray with bluish and reddish colors intermixed. In the areas where the bedrock is shale, the substratum is bluish-green clay that contains a considerable number of shale fragments.

These areas are very difficult to drain because of the water that continuously seeps through the soil. The soil is very low in available phosphorus and potassium.

Racine soils

The Racine soils are deep, well drained, and moderately dark colored. They developed on the upland under a mixture of forest and prairie grass. The parent material was a deposit of loess less than 42 inches thick over loam to clay loam glacial till.

These soils are closely associated with the Downs soils, which developed under the same vegetation but where the loess was deeper. They are also associated with the moderately well drained Kasson and Kenyon soils, the moderately droughty Thurston soils, and the Rockton soils.

The Racine, Renova, and Ostrander soils are all well-drained soils that developed in the same kind of parent material. The forested Renova soils have a lighter colored, slightly thinner surface soil; a thicker, lighter, more prominent subsurface horizon; and more strongly developed structure in the subsoil. The grass-covered Ostrander soils have a darker colored surface soil; a subsurface horizon that is blocky instead of platy; and weaker development of structure and thinner clay films on the blocks in the subsoil.

In most places the Racine soils are free of gravel and cobblestones on the surface. Where the silt cap is less than 7 inches thick and where the surface soil has a loam texture, some gravel and cobblestones are scattered on the surface and throughout the profile.

The surface soil and subsoil are generally medium acid to strongly acid. The available moisture holding capacity is moderately high. The fertility is moderately high.

Racine silt loam, 0 to 2 percent slopes (RaA) (Capability unit I–1).—This soil is in nearly level but well-drained areas on the upland. The profile is like that of Racine silt loam, 2 to 6 percent slopes. Little or no erosion has occurred, and the hazard is slight. In many places there are thin bands of coarse-textured material beneath this soil. In a few places, limestone bedrock lies within 4 to 6 feet of the surface.

Some areas of Racine loam are included in this unit.

Racine silt loam, 2 to 6 percent slopes (RaB) (Capability unit IIe–1).—This soil lies on gentle slopes on the upland. The hazard of erosion is moderate, but less than 25 percent of the original surface soil has been lost.

Profile in a cultivated field—

Surface soil—
- 0 to 8 inches, very dark gray to very dark grayish-brown silt loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 8 to 11 inches, dark grayish-brown to grayish-brown silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 11 to 17 inches, dark-brown to brown silt loam; weak to moderate, fine, subangular blocky structure; blocks are coated with scattered, grayish-brown films; friable when moist; medium acid.
- 17 to 26 inches, brown to yellowish-brown clay loam; moderate, medium, angular blocky structure; many blocks are coated with grayish-brown films; friable when moist; medium acid.
- 26 to 36 inches, yellowish-brown clay loam; moderate to strong, medium to coarse, angular blocky structure; a few blocks are coated with grayish-brown films; firm when moist; medium acid.

Substratum—
- 36 to 50 inches, yellowish-brown to brownish-yellow clay loam; few, faint, grayish-brown splotches and mottles; massive (structureless) to weak, coarse, angular blocky structure; firm when moist; slightly acid.
- 50 inches +, light yellowish-brown to brownish-yellow clay loam; common, faint, grayish-brown mottles and splotches; massive (structureless); firm when moist; mildly calcareous.

The silt cap in which the upper layers developed is most commonly about 15 inches thick. Generally, it ranges from 6 to 18 inches in thickness, but near areas of Downs silt loam it is from 24 to 30 inches thick.

In a few places the surface soil is loam, but generally it is silt loam. The color ranges from very dark gray to dark grayish brown. Where the surface soil and subsoil are darker colored, the films coating the blocks in the subsoil are very dark grayish brown rather than grayish brown.

The part of the subsoil below the silt cap has a loam, sandy clay loam, or clay loam texture. Gravel and cobblestones are common.

In many places the substratum is faintly to distinctly mottled. The texture ranges from loam to clay. There are many pockets of sand and gravel in the substratum and a few in the subsoil. The material in these pockets ranges from gravelly sand to gravelly sandy clay loam. The depth to the calcareous material in the substratum is commonly 4½ to 5 feet; it may range from 3½ to 6 feet.

Where moderately deep Rockton silt loam soils are nearby, limestone bedrock commonly lies at a depth of only 4 to 6 feet.

Racine silt loam, 2 to 6 percent slopes, moderately eroded (RaB2) (Capability unit IIe–1).—This soil is on gentle slopes on the upland. From 25 to 50 percent of the original surface soil has been lost through erosion. A few small areas have a few shallow gullies. The plow layer is a mixture of the remaining surface soil and the subsurface soil. The surface soil is loam instead of silt loam in part of this unit. Otherwise, the profile is like that of Racine silt loam, 2 to 6 percent slopes.

The erosion that has occurred has moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderate.

Racine silt loam, 6 to 12 percent slopes (RaC) (Capability unit IIIe–1).—This soil is on moderate slopes on the upland. The profile is similar to that of Racine silt loam, 2 to 6 percent slopes. Although the hazard of erosion is moderately severe, less than 25 percent of the original surface soil has been lost. A few small areas have a few shallow gullies. Pockets of gravel and sand are more common in the substratum and subsoil than in that of the profile described. In places the surface soil is loam.

Racine silt loam, 6 to 12 percent slopes, moderately eroded (RaC2) (Capability unit IIIe–1).—This soil lies on moderate slopes on the upland. About 25 to 50 percent of the original surface soil has been lost through erosion, and some areas have a few shallow gullies. The subsurface layer is mixed with the remainder of the surface soil in the plow layer. In some places the surface soil is loam. Pockets of gravel and sand are common in the substratum and subsoil. With these exceptions, the profile is like that of Racine silt loam, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion.

Racine soils, 2 to 6 percent slopes, severely eroded (RcB3) (Capability unit IIe–2).—The surface texture of these soils was loam and silt loam, but from 50 to 75 percent of the original surface soil has been removed by erosion. The plow layer is a mixture of the remainder of the surface soil, the subsurface soil, and part of the subsoil. A few small areas have a few shallow gullies. Pockets of gravel and sand are common in the substratum and subsoil of these soils. The profile is like that of Racine silt loam, 2 to 6 percent slopes.

Erosion has severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderate (fig. 6).

Figure 6.—**Stripcropping to control erosion on Racine soils, 2 to 6 percent slopes, severely eroded.**

Racine soils, 6 to 12 percent slopes, severely eroded (RcC3) (Capability unit IIIe-1).—These are silt loam and loam soils on moderate slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil through erosion. Some areas are even more severely eroded and have a few shallow gullies. The subsurface soil and part of the subsoil are mixed with the remainder of the surface soil in the plow layer. Pockets of gravel and sand are common in the substratum. Otherwise the profile is similar to that of Racine silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion. There is a moderately severe hazard of further erosion.

Renova soils

The Renova soils are deep, well drained, and light colored. They developed under hardwood forest on the upland. They lie principally on gentle and moderate slopes along the major streams. Lesser acreages are on moraines away from the major streams. Slopes of 2 to 12 percent predominate. The parent material was a layer of silt less than 42 inches thick over loam to clay loam glacial till.

These soils are associated with the Fayette and Seaton soils, which developed where the loess was somewhat deeper. They are also associated with the moderately well drained Vlasaty soils, which developed on the same kind of parent material, but whose poorer drainage causes mottling in their subsoil. The associated Wykoff soils are more droughty than the Renova soils. The Whalan soils lie near the Renova soils, but they are shallow over limestone bedrock.

The Racine soils developed from the same kind of parent material as the Renova, but their vegetation was a mixture of forest and grass. As a result, the Renova soils have a lighter colored and thinner surface soil, a thicker and more prominent platy subsurface soil, and a more strongly developed subsoil structure.

The surface layer of the Renova soils is normally free of gravel and cobblestones, except where the silt cap is less than 12 inches thick or where the surface texture is loam instead of silt loam.

The surface soil and subsoil are generally medium acid to strongly acid. The available moisture holding capacity is moderately high and the fertility is moderate.

Renova silt loam, 0 to 2 percent slopes (ReA) (Capability unit I-2).—This soil is on nearly level areas on the upland, but it is well drained, nevertheless. Little or no erosion has occurred, and the erosion hazard is only slight.

In many places thin bands of coarse-textured material lie beneath this soil. In a few places limestone bedrock is within 4 to 6 feet of the surface. The surface soil is loam in a few areas. Otherwise, the profile is like that of Renova silt loam, 2 to 6 percent slopes.

Renova silt loam, 2 to 6 percent slopes (ReB) (Capability unit IIe-2).—This soil lies on gentle slopes on the upland. Although it has a moderate hazard of erosion, less than 25 percent of the original surface soil has been lost.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark grayish-brown to grayish-brown silt loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; medium acid.

Subsurface soil—
- 7 to 11 inches, grayish-brown to light brownish-gray silt loam; weak, thin, platy structure; very friable when moist; strongly acid.

Subsoil—
- 11 to 15 inches, dark grayish-brown to brown silt loam; weak to moderate, fine, subangular blocky structure; many blocks are coated with grayish-brown films; friable when moist; strongly acid.
- 15 to 24 inches, brown to yellowish-brown clay loam; moderate, fine to medium, angular blocky structure; blocks are heavily coated with grayish-brown films; friable when moist; gravel and cobblestones are common in the upper part of this horizon; strongly acid.
- 24 to 36 inches, brown to yellowish-brown clay loam; strong, medium to coarse, angular blocky structure; blocks are heavily coated with grayish-brown films; very firm when moist; strongly acid.
- 36 to 45 inches, dark yellowish-brown to yellowish-brown clay loam; strong, coarse, angular blocky structure; blocks are coated with very dark grayish-brown films; very firm when moist; medium acid.

Substratum—
- 45 to 54 inches, yellowish-brown to brownish-yellow clay loam; few, faint, grayish-brown splotches and mottles; moderate, medium to coarse, angular blocky structure; blocks are coated with brown films; firm when moist; neutral.
- 54 inches +, light yellowish-brown to brownish-yellow clay loam; common, faint, grayish-brown mottles and splotches; massive (structureless); firm when moist; mildly calcareous.

The silt cap ranges from 7 to 18 inches in thickness over most of the area. Near areas of Fayette and Seaton silt loams, the silt cap ranges from 24 to 30 inches in thickness. The silt cap is missing from about 25 percent of the area, and in these places the surface soil and subsurface soil are loam and the upper part of the subsoil is loam to clay loam.

The original surface soil was rarely more than 6 inches thick. In areas near Racine silt loam, it was very dark gray to dark grayish brown. The lower part of the subsoil ranges in texture from loam to clay loam, and its structural development ranges from moderate to strong. The dark films coating the structural blocks are present in the lower subsoil, except where the strongly acid reaction of the subsoil extends into the substratum. There are many pockets of gravelly sand to gravelly sandy clay loam in the substratum, and a few in the subsoil. The depth to the calcareous part of the substratum is commonly about 60 inches, but it ranges from 42 to 72 inches. Where this soil is associated with the moderately deep Whalan soils, it is commonly underlain by limestone bedrock at depths of 4 to 6 feet.

Renova silt loam, 2 to 6 percent slopes, moderately eroded (ReB2) (Capability unit IIe-2).—This soil lies on gentle slopes on the upland. About 25 to 50 percent of the original surface soil has been lost through erosion, and a few areas have a few shallow gullies. The platy subsurface soil has been mixed into the remainder of the surface soil in plowing. Some areas have a loam surface soil. With these exceptions, the profile is like that of Renova silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have all been moderately reduced by erosion, and the hazard of further erosion is moderate.

Renova silt loam, 6 to 12 percent slopes (ReC) (Capability unit IIIe–1).—This soil lies on moderate slopes on the upland. Much of it is still in woods. The erosion hazard is moderately severe, but less than 25 percent of the original surface soil has been removed by erosion. A few small areas have a few shallow gullies. Pockets of gravel and sand are common in the subsoil and substratum. In part of the areas the surface soil has a loam texture. The profile is otherwise like that of Renova silt loam, 2 to 6 percent slopes.

Renova silt loam, 6 to 12 percent slopes, moderately eroded (ReC2) (Capability unit IIIe–1).—This soil is on moderate slopes on the upland. About 25 to 50 percent of the original surface soil has been removed by erosion. A few areas have shallow or deep gullies. The plow layer is a mixture of the subsurface soil and the rest of the surface soil. Some areas have a loam texture in the surface soil. Pockets of gravel and sand are common in the substratum and subsoil. In other respects the profile is like that of Renova silt loam, 2 to 6 percent slopes.

The hazard of further erosion is moderately severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion.

Renova silt loam, 12 to 18 percent slopes (ReD) (Capability unit IVe–1).—This soil lies on moderately steep slopes on the upland, where the erosion hazard is severe. Many areas are still in woods, however, and less than 25 percent of the original surface soil has been removed by erosion. A few areas have a few shallow and deep gullies. Pockets of gravel and sand in the subsoil and substratum are common. The surface soil is loam in places. The profile is, with these exceptions, like that of Renova silt loam, 2 to 6 percent slopes.

Renova silt loam, 12 to 18 percent slopes, moderately eroded (ReD2) (Capability unit IVe–1).—This soil is on moderately steep slopes on the upland. About 25 to 50 percent of the original surface soil is gone because of erosion, and a few areas have a few shallow and deep gullies. The remainder of the surface soil, the subsurface soil, and, in a few places, some of the subsoil, are mixed together in the plow layer. Pockets of gravel and sand are very common in the subsoil and substratum. Some areas have a loam texture in the surface soil. The profile is otherwise similar to that of Renova silt loam, 2 to 6 percent slopes.

The hazard of erosion is severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by past erosion.

Renova silt loam, 18 to 25 percent slopes (ReE) (Capability unit VIe–1).—This soil is on steep slopes on the upland. The erosion hazard is very severe, but, because many areas are still in woods, less than 25 percent of the original surface soil has been lost. A few areas have a few shallow and deep gullies. Pockets of gravel and sand are very common in the subsoil and substratum. In some areas the surface soil is loam. The profile is otherwise similar to that of Renova silt loam, 2 to 6 percent slopes.

Renova silt loam, 18 to 25 percent slopes, moderately eroded (ReE2) (Capability unit VIe–1).—This soil is on steep slopes on the upland. The profile is like that of Renova silt loam, 2 to 6 percent slopes, except for the effects of erosion. Most areas have lost from 25 to 75 percent of the original surface soil, and a few areas are even more severely eroded. Some areas have a few shallow and deep gullies. Pockets of gravel and sand in the subsoil and substratum are very common. Part of this soil has a loam surface texture.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately to severely reduced by erosion. The hazard of further erosion is very severe.

Renova silt loam, 25 to 35 percent slopes, eroded (ReF2) (Capability unit VIIe–1).—This soil is on very steep slopes on the upland. Most of it is used for permanent pasture and woodland. From 25 to 75 percent of the original surface soil is gone from most of the areas, and some areas have a few shallow and deep gullies. Some areas have a loam surface texture. Pockets of gravel and sand are very common in the subsoil and substratum. The profile is otherwise similar to that of Renova silt loam, 2 to 6 percent slopes.

The hazard of erosion is extremely severe. On much of this unit, erosion has already moderately to severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water.

Renova soils, 2 to 6 percent slopes, severely eroded (RfB3) (Capability unit IIe–2).—Part of this unit is Renova silt loam, and part of it is Renova loam. These soils occupy gentle slopes on the upland. About 50 to 75 percent of the original surface soil has been lost through erosion, and a few small areas have a few shallow gullies. The plow layer consists of the remaining surface soil, the platy subsurface soil, and part of the subsoil. Pockets of gravel and sand are common in the subsoil and substratum. With these exceptions, the profile is similar to that of Renova silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion. The hazard of further erosion is moderate.

Renova soils, 6 to 12 percent slopes, severely eroded (RfC3) (Capability unit IIIe–1).—These soils lie on moderate slopes on the upland. Over most of the area, about 50 to 75 percent of the original surface soil has been removed by erosion. A few areas have been more severely eroded. About 25 percent of the area has a few shallow and deep gullies. The plow layer consists of the remaining surface soil, the subsurface soil, and part of the subsoil.

In some areas the surface texture is silt loam, and in some it is loam. Pockets of gravel and sand in the subsoil and substratum are very common. Otherwise, the profile is similar to that of Renova silt loam, 2 to 6 percent slopes.

The erosion hazard is moderately severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced already by erosion.

Renova soils, 12 to 18 percent slopes, severely eroded (RfD3) (Capability unit IVe–1).—Part of this unit is silt loam, and part is loam. These soils occupy moderately steep slopes on the upland. From 50 to 75 percent of the original surface soil has been lost through erosion. A few areas are more severely eroded. In some areas there are a few shallow and deep gullies. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. Except for the effects of erosion, the profile is similar to that of Renova silt loam, 2 to 6 percent slopes.

Erosion has severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is severe.

Renova soils, 18 to 25 percent slopes, severely eroded (RfE3) (Capability unit VIe–1).—These soils are on steep slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil, and some have lost even more. The remaining surface soil, the subsurface soil, and part of the subsoil are mixed together in the plow layer. Pockets of gravel and sand are common in the subsoil and substratum. The profile is similar to that of Renova silt loam, 2 to 6 percent slopes.

The erosion hazard is very severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion.

Rockton soils

The Rockton soils are well drained to moderately well drained, medium textured, and dark colored to moderately dark colored. They developed under grass or a mixture of trees and grass. The parent material was a thin capping of silt over a thin layer of glacial till over limestone bedrock.

The normal Rockton soils are less than 2 feet deep over bedrock. The largest areas are on slopes of 12 to 18 percent. These shallow Rockton soils on slopes of more than 18 percent have been included in the Rough broken and stony land mapping unit. The moderately deep soils are 24 to 42 inches deep over bedrock and are chiefly on slopes of 2 to 6 percent. The moderately deep Rockton soils on slopes of 18 to 25 percent were included in the moderately deep units of Whalan silt loam.

The Rockton soils are in the eastern part of the county. They are closely associated with the Racine soils, which developed in similar but deeper parent materials, and with Rough broken and stony land. The Rockton soils have a thicker and darker colored surface soil, a slightly darker subsurface soil, and a weaker structure in the subsoil than the Whalan soils.

These soils are generally easy to work. Where the silt cap is more than 7 inches thick, the plow layer is free of gravel and stones. Where the silt cap is shallower, gravel and cobblestones are common. Scattered fragments of limestone are also present where the bedrock is within 12 to 15 inches of the surface. Limestone quarries have been developed on some of these areas.

The surface soil and subsoil are generally medium acid. They are high to moderately high in fertility. The shallow Rockton soils have a moderately low available water holding capacity and are moderately droughty. The moderately deep Rockton soils have a moderate available water holding capacity and are slightly droughty.

Rockton silt loam, 2 to 6 percent slopes, moderately eroded (RoB2) (Capability unit IIIs–2).—This soil lies principally on gentle slopes on the upland, but one small area is nearly level. Most areas have lost from 25 to 50 percent of the original surface soil. Some areas have more erosion and some have less. The plow layer is a mixture of the remaining surface soil and the subsurface soil.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, very dark gray to very dark grayish-brown silt loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 12 inches, dark-brown to brown silt loam; moderate, fine, subangular blocky structure; a few blocks are coated with grayish-brown films; friable when moist; medium acid.

Subsoil—
- 12 to 16 inches, dark-brown to brown clay loam; moderate, fine to medium, angular blocky structure; a few blocks are coated with grayish-brown films; firm when moist; medium acid.
- 16 to 21 inches, dark-brown to dark reddish-brown clay loam to clay; strong, medium, angular blocky structure; blocks are heavily coated with very dark gray films; extremely firm when moist; contains many fragments of limestone; neutral.

Substratum—
- 21 inches +, limestone, shattered and somewhat disintegrated in the upper part.

The surface soil ranges from black to very dark grayish brown. In some areas it has a loam texture. Areas that are only slightly eroded have a thin subsurface layer similar to that of Racine silt loam, 2 to 6 percent slopes. The original silt cap on this soil ranged from 0 to 18 inches in thickness. On the moderately eroded areas, the present depth of this material is not more than 10 or 12 inches.

The thin layer of glacial till is loam to clay loam. In many places it contains numerous cobblestones. Generally it is mixed with the upper part of the residuum, or material that weathered from the limestone bedrock. The residuum ranges from 2 to 12 inches in thickness, but is most commonly 4 or 5 inches. Its reaction ranges from slightly acid to mildly calcareous. There may be few or many limestone fragments in this layer.

The subsoil is faintly mottled in some places near its contact with the limestone residuum. It is somewhat more mottled where the underlying bedrock contains shale.

In many areas the upper 6 to 12 inches of limestone contain a considerable proportion of acid sandstone. In a few places in Milton Township, layers of shale are present in the limestone. The depth to bedrock, whether limestone or shale, ranges from 12 to 24 inches but is most commonly 18 to 21 inches. The upper part of the limestone is shattered in most places.

The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity of this soil have been moderately reduced by the erosion that has occurred. The hazard of further erosion is moderate.

Rockton silt loam, 12 to 18 percent slopes (RoD) (Capability unit VIs–1).—This soil occupies moderately steep slopes on the upland. Many areas are still in woods.

The hazard of erosion is severe, but less than 25 percent of the original surface soil has been lost. A few areas have a few shallow to deep gullies. Nearly half of the area has a loam surface soil. The profile is otherwise similar to that of Rockton silt loam, 2 to 6 percent slopes, moderately eroded.

Rockton silt loam, 12 to 18 percent slopes, moderately eroded (RoD2) (Capability unit VIs–1).—This soil lies on moderately steep slopes on the upland. Most areas are used for permanent pasture.

Most of the soil has lost up to 50 percent of its original surface soil, and some areas have lost more than that. A few small areas have a few shallow and deep gullies. About half of the soil has a loam surface soil. In other respects the profile is like that of Rockton silt loam, 2 to 6 percent slopes, moderately eroded.

A few acres of Rockton silt loam, moderately deep, are included in this unit; their depth to bedrock is 24 to 27 inches.

Erosion has moderately reduced the level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity. The hazard of further erosion is severe.

Rockton silt loam, moderately deep, 0 to 2 percent slopes (RpA) (Capability unit IIs–1).—This soil occupies nearly level areas on the upland, where the hazard of erosion is slight or nonexistent. Little or no surface soil has been lost. A few small areas have a surface soil of loam instead of silt loam. The profile is otherwise similar to that of Rockton silt loam, moderately deep, 2 to 6 percent slopes.

Rockton silt loam, moderately deep, 2 to 6 percent slopes (RpB) (Capability unit IIe–3).—This soil is on gentle slopes on the upland. Most of it has lost less than 25 percent of its original surface soil. A few acres have lost from 25 to 75 percent. The hazard of further erosion is moderate.

Profile in a cultivated field—

Surface soil—
- 0 to 8 inches, very dark gray to very dark grayish-brown silt loam; fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 8 to 11 inches, dark grayish-brown to grayish-brown silt loam; weak, thin, platy structure to weak, fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 11 to 16 inches, dark-brown to brown silt loam; moderate, fine, subangular blocky structure; a few blocks are coated with grayish-brown films; friable when moist; medium acid.
- 16 to 27 inches, dark yellowish-brown clay loam; moderate to strong, medium, angular blocky structure; a few blocks are coated with grayish-brown films; firm when moist; gravel and cobblestones are common in the upper part of this horizon; medium acid.

Substratum—
- 27 to 30 inches, dark-brown to dark reddish-brown clay loam to clay with many streaks of very dark gray; massive (structureless); extremely firm when moist; contains many fragments of limestone; neutral.
- 30 inches +, limestone, shattered and somewhat disintegrated at its upper boundary.

About 15 percent of the area has a loam surface soil. The color of the surface soil ranges from black to very dark grayish brown. The subsurface soil ranges from very dark brown to grayish brown.

The silt cap from which the upper layers of this soil developed ranges in thickness from 6 to 24 inches, but about 15 inches is most common. The upper part of the subsoil is silt loam or silty clay loam if it developed from part of the silt cap. The lower part of the subsoil is loam to clay loam. In most places it contains considerable amounts of gravel and cobblestones, and in a few places, pockets and bands of coarse-textured materials. In a few places the subsoil is faintly mottled just above the limestone residuum. Where the bedrock is shale, the subsoil is distinctly mottled.

The limestone residuum ranges in thickness from 2 to 12 inches but is generally 3 to 4 inches. The reaction ranges from mildly calcareous to slightly acid. The content of limestone or shale fragments in this layer varies considerably.

The depth to bedrock ranges from 24 to 42 inches but is generally 30 to 32 inches. The upper 6 to 12 inches of the limestone in many places contains a large proportion of acid sandstone. In some areas, mostly in Milton Township, shale is interbedded with the limestone. The upper part of the limestone is generally shattered.

Rockton silt loam, moderately deep, 6 to 12 percent slopes (RpC) (Capability unit IIIe–2).—This soil occupies moderate slopes on the upland. About half of the area has lost less than 25 percent of the original surface soil, some areas have lost 25 to 50 percent, and a few small areas have lost more than 50 percent. One small area has many shallow gullies. Some areas that have a loam surface soil are included. Some areas are underlain by shale interbedded with limestone, and these areas have somewhat poorer drainage and more mottling in the subsoil than is typical. With these exceptions, the profile is like that of Rockton silt loam, moderately deep, 2 to 6 percent slopes.

In the areas that have lost more than 25 percent of the original surface soil, the level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced. The hazard of further erosion is moderately severe.

Rockton soils, 6 to 12 percent slopes, severely eroded (RsC3) (Capability unit IVs–1).—These soils are on moderate slopes on the upland. Most of the acreage has lost about 50 to 75 percent of the original surface soil through erosion, and, in places, a few shallow gullies have been cut. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. A few spots are less eroded, and a few are more so. Some areas have a silt loam surface soil, and some have a loam surface soil. The profile is otherwise like that of Rockton silt loam, 2 to 6 percent slopes, moderately eroded.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have already been severely reduced by erosion.

Rockton soils, 12 to 18 percent slopes, severely eroded (RsD3) (Capability unit VIs–1).—These soils occupy moderately steep slopes on the upland. About 50 to 75 percent of the original surface soil has been lost through erosion. A few areas are more severely eroded and have shallow to deep gullies. The remainder of the original surface soil, the subsurface soil, and part of the subsoil are mixed together in the plow layer. Most of these areas have a silt loam surface soil, and some small areas have a loam surface soil. In other respects, the profile is similar to that of Rockton silt loam, 2 to 6 percent slopes, moderately eroded.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion. The hazard of further erosion is severe.

Rough broken and stony land

This miscellaneous land type contains a considerable variety of upland soils. Nearly half of the unit consists of soils that are on slopes of more than 25 percent and are less than 12 inches deep over bedrock. About half is soils that are on slopes of 18 to 25 percent and range from 12 to 24 inches in depth over bedrock. A small part of this land type consists of light-colored soil 24 to 42 inches deep over bedrock on slopes steeper than 25 percent.

The erosion hazard on these soils is severe to extremely severe. The inherent fertility level is low, and the available water holding capacity is low to very low.

Rough broken and stony land (Ru) (Capability unit VIIe–1).—This unit consists of soils that are so steep, shallow, and stony as to overshadow their other characteristics. The principal soils in this mapping unit are Rockton silt loam on slopes of more than 18 percent, Whalan silt loam on slopes of more than 18 percent, and Whalan silt loam, moderately deep, on slopes of more than 25 percent. All degrees of erosion are represented.

The level of fertility, the quality of tilth, the rate of infiltration of water, and the available water holding capacity vary considerably, according to the depth to bedrock, the vegetative cover, and the degree of erosion.

Most of the soils in this unit are used for permanent pasture, woodland, or wildlife shelter.

Sargeant soils

The Sargeant soils are deep, nearly level, somewhat poorly drained, and light colored. They developed under hardwood forest on the upland. The parent material was a thin silt cap over firm loam to clay loam glacial till.

The Sargeant soils are closely associated with the Vlasaty, Skyberg, and Floyd soils. They differ from the light-colored Vlasaty soils, which developed in similar parent material under the same vegetation but were better drained, in that the Sargeant soils are mottled in all of the profile except the surface layer. The moderately dark colored Skyberg soils developed in the same parent material with the same drainage as the Sargeant soils, but their vegetation was a transition between forest and prairie grass. The Sargeant soils have a thinner, lighter colored surface soil and a thicker and grayer subsurface soil than the Skyberg. The Floyd soils are darker and more poorly drained than the Sargeant.

Where the silt cap is less than 7 inches thick, the surface soil contains gravel and cobblestones, but generally it is free of stones. In most places the surface soil and subsoil are medium acid to strongly acid. The available water holding capacity is high, but the fertility is moderately low.

Sargeant silt loam, 0 to 2 percent slopes (SaA) (Capability unit IIIw–1).—Most of this soil is on nearly level areas of the upland, but some is on gentle slopes. Some of it is still in woods. Little or no erosion has occurred, and there is little hazard of any. Most areas are somewhat poorly drained.

Areas of Vlasaty silt loam and Skyberg silt loam that are too small to separate on the map have been included in this unit.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark-gray to gray silt loam; weak, fine, granular structure to weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 12 inches, light brownish-gray silt loam; common, faint mottles; moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 12 to 19 inches, dark grayish-brown and brown silt loam to silty clay loam; common, distinct mottles; moderate, fine to medium, subangular blocky structure; blocks are coated with light brownish-gray films; friable when moist; strongly acid.
- 19 to 30 inches, grayish-brown and yellowish-brown clay loam; many, distinct mottles; weak, coarse, prismatic structure to strong, medium and coarse, angular blocky structure; blocks and prisms are coated with dark-gray films; very firm when moist; pebbles and small stones are concentrated in the upper part of the horizon; strongly acid.
- 30 to 38 inches, grayish-brown and yellowish-brown clay loam; many, distinct mottles; weak, coarse, prismatic structure to moderate, coarse, angular blocky structure; many blocks and prisms are coated with dark-gray films; firm when moist; medium acid.

Substratum—
- 38 to 45 inches, yellowish-brown and grayish-brown clay loam; many, distinct mottles; massive (structureless) to moderate, medium, subangular blocky structure; firm when moist; old root channels are coated with very dark gray films; slightly acid.
- 45 inches +, yellowish-brown and grayish-brown clay loam; many, distinct mottles; massive (structureless); firm when moist; mildly calcareous.

The silt cap in which the upper layers of this soil developed ranges from 12 to 24 inches in thickness; the average is 16 inches. The surface soil rarely is more than 4 inches thick, even in virgin areas. The plow layer generally includes part of the subsurface soil.

The lower part of the subsoil and the substratum range in texture through loam, sandy clay loam, and clay loam. Gravel and cobblestones are common in these layers, but they tend to be concentrated in a thin pebble band just below the silt cap. Pockets and bands of coarse-textured material are present in a few places below the silt cap.

The calcareous, firm till lies at an average depth of 4 feet, but the depth ranges from 3½ to 6 feet. One small area in Canisteo Township is only 3 feet deep over limestone bedrock.

Seaton soils

The Seaton soils are deep, well drained, and light colored. They developed under hardwood forest, mostly on the upland in the northeastern and eastern one-third of the county. The largest areas are on slopes of 2 to 12 percent, and smaller areas are on slopes up to 35 percent. The Seaton soils on slopes of more than 18 percent have been included in the Fayette and Seaton silt loams mapping units. The parent material is loess of silt and very fine sandy loam texture. It is 8 to 10 feet deep over loam to clay loam glacial till. These soils lie on the upland near major streams, along the edges of the loess-covered areas, and on spots where loess has collected within the areas of glacial till.

Seaton soils are commonly associated with Fayette soils. They developed from similar material, but the Seaton soils contain coarser silt throughout the profile. The Seaton soils have a more weakly developed structure in the subsoil, and the calcareous substratum lies at a lesser depth.

The Seaton soils are free of stones and easy to work. The surface soil and subsoil range from slightly acid to medium acid. The available moisture holding capacity is moderately high. The fertility is moderate.

Seaton silt loam, 2 to 6 percent slopes (SeB) (Capability unit IIe–2).—This soil is on gentle slopes on the upland. Although the hazard of erosion is moderate, less than 25 percent of the original surface soil has been lost.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark grayish-brown to grayish-brown silt loam; weak, fine, granular structure to weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 11 inches, grayish-brown to light brownish-gray silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 11 to 18 inches, dark yellowish-brown to yellowish-brown silt loam; weak, medium, subangular blocky structure; blocks are heavily coated with gray films; friable when moist; medium acid.
- 18 to 27 inches, yellowish-brown silt loam; weak to moderate, medium, subangular blocky structure; many blocks are coated with gray films; friable when moist; medium acid.
- 27 to 34 inches, yellowish-brown silt loam; weak, medium to coarse, subangular blocky structure; many blocks are coated with gray films; friable when moist; medium acid.

Substratum—
- 34 to 56 inches, yellowish-brown to light yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; slightly acid.
- 56 inches +, light yellowish-brown to very pale brown very fine sandy loam; massive (structureless); loose when dry; mildly calcareous.

The thickness of the original surface soil was rarely more than 6 inches. The color ranges from very dark grayish brown to grayish brown. In a few places the texture is very fine sandy loam. The subsurface soil ranges in thickness from 2 to 6 inches and in color from dark grayish brown to light gray.

The subsoil is silt loam. The structure is moderately developed in a few places, but a weak development is more common. Where the surface soil is slightly darker than typical, the subsoil colors are somewhat darker and the gray coatings are not so distinct.

The texture of the upper part of the substratum ranges from silt loam to very fine sandy loam. In some places the very fine sandy loam material is within 24 inches of the surface. The texture of the lower substratum ranges from very fine sandy loam to fine sand. The fine sand is most common along the boundary of the loess-covered areas.

This soil is underlain by loam to clay loam glacial till. In some areas the loess is only 42 to 48 inches thick. The depth to calcareous material ranges from 30 to 96 inches. It is most commonly between 48 and 54 inches.

Seaton silt loam, 2 to 6 percent slopes, moderately eroded (SeB2) (Capability unit IIe–2).—This soil lies on gentle slopes on the upland. About 25 to 50 percent of the original surface soil has been removed by erosion. In several small, more severely eroded areas, a few shallow gullies have been cut. The plow layer is a mixture of the remaining surface soil and the subsurface soil. Otherwise, the profile is like that of Seaton silt loam, 2 to 6 percent slopes.

Erosion has moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderate.

Seaton silt loam, 6 to 12 percent slopes (SeC) (Capability unit IIIe–1).—This soil occupies moderate slopes on the upland. Much of it is still in woods. Less than 25 percent of the surface soil has been lost through erosion. The profile is very similar to that of Seaton silt loam, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. Because of the coarse silt and very fine sand in the substratum, this soil can be damaged quickly and severely by gullies.

Seaton silt loam, 6 to 12 percent slopes, moderately eroded (SeC2) (Capability unit IIIe–1).—This soil is on moderate slopes on the upland. About 25 to 50 percent of the original surface soil is gone, and several small areas have a few shallow gullies. The remaining surface soil and the subsurface soil are mixed in the plow layer. Except for these effects of erosion, the profile is like that of Seaton silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderately severe. Gullies can damage this soil quickly and severely because of the coarse silt and very fine sand in the substratum.

Seaton silt loam, 6 to 12 percent slopes, severely eroded (SeC3) (Capability unit IIIe–1).—This soil occupies moderate slopes on the upland. Most of it has lost from 50 to 75 percent of the original surface soil through erosion. Several small areas are more severely eroded or have a few shallow gullies. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. In other respects, the profile is like that of Seaton silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion. The hazard of further erosion is moderately severe. This soil can be damaged quickly and severely by gullies because of the coarse silt and very fine sand in the substratum.

Seaton silt loam, 12 to 18 percent slopes (SeD) (Capability unit IVe–1).—This soil is on moderately steep slopes on the upland. Although the hazard of erosion is severe, many areas are still in woods and therefore have lost less than 25 percent of the original surface soil. This soil can be damaged quickly and severely by gullies because of the coarse silt and very fine sand in the substratum.

The loess on these slopes varies more in depth and texture from place to place than that on the more gentle slopes. With this exception, the profile is like that of Seaton silt loam, 2 to 6 percent slopes.

Seaton silt loam, 12 to 18 percent slopes, moderately eroded (SeD2) (Capability unit IVe–1).—This soil lies on moderately steep slopes. Most areas have lost from 25 to 50 percent of the original surface soil, and some areas have a few shallow gullies. The plow layer is a mixture of the remaining surface soil and the subsurface soil. The loess from which this soil developed varies more in depth and texture than that on more gentle slopes. Otherwise, the profile is like that of Seaton silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is severe. Because of the coarse silt and very fine sand in the substratum, this soil can be damaged quickly and severely by gullies.

Seaton silt loam, 12 to 18 percent slopes, severely eroded (SeD3) (Capability unit IVe–1).—This soil occupies moderately steep slopes on the upland. Most of it has lost from 50 to 75 percent of the original surface soil through erosion. In several small areas where erosion has been more severe, a few deep and shallow gullies are present. The remaining surface soil, the subsurface soil, and part of the subsoil are mixed in the plow layer. The depth and texture of the loess vary more on these slopes than on the more gentle slopes. In other ways, this soil has a profile like that of Seaton silt loam, 2 to 6 percent slopes.

The hazard of erosion is severe, and because of the coarse silt and very fine sand in the substratum, this soil can be damaged quickly and severely by gullies. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced.

Skyberg soils

The Skyberg soils are deep, somewhat poorly drained, and moderately dark colored. They developed under a mixture of hardwood forest and prairie grass on the upland. Almost all of their area is on slopes of 1 to 2 percent, but a little is on slopes of 3 percent. The parent material was a thin silt cap over firm loam to clay loam glacial till.

Skyberg soils are associated principally with the Kasson, Floyd, and Sargeant soils. They differ from the moderately well drained, moderately dark colored Kasson soils in that their poorer drainage has caused mottling to develop in all except the surface layer. They have a thicker, darker colored surface soil and a thinner, darker colored subsurface soil than the light colored Sargeant soils, which had similar parent material and drainage, but forest vegetation.

The Floyd soils developed from a thicker silt cap than the Skyberg soils did, their drainage is poorer, and their vegetation was water-tolerant grass. As a result, the Skyberg soils have a thinner and lighter colored surface soil (fig. 7). The Skyberg soils have coatings of light brownish-gray sand on the vertical faces of the fractures and structure particles in the subsoil and upper substratum.

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Figure 7.—**Plowed field, showing typical contrast between appearance of light-colored surface soil of Skyberg silt loam and dark-colored surface soil of Floyd silty clay loam.**

The surface soil is generally free of gravel and cobblestones, except where the silt cap is less than 7 inches thick. In most places the surface soil and subsoil are medium acid to strongly acid. The available water holding capacity is high, and the fertility is moderate.

Skyberg silt loam, 0 to 2 percent slopes (SkA) (Capability unit IIIw–1).—This soil occupies nearly level areas on the upland. Little or no erosion has occurred or is likely to occur.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, very dark gray silt loam; fine, granular structure; soft when dry, very friable when moist, slight sticky when wet; slightly acid.

Subsurface soil—
- 7 to 11 inches, dark grayish-brown silt loam; few, faint mottles; weak, thin, platy structure to weak, fine, subangular blocky structure; friable when moist; medium acid.

Subsoil—
- 11 to 18 inches, dark grayish-brown and dark yellowish-brown silty clay loam to silt loam; common, distinct mottles; moderate, very fine to fine, subangular blocky structure; a few blocks are coated with grayish-brown films; friable when moist; strongly acid.
- 18 to 26 inches, dark grayish-brown and dark yellowish-brown clay loam; common, distinct mottles; moderate, medium, subangular blocky structure; many blocks are coated with grayish-brown films; firm when moist; cobblestones and small stones are very common in the upper part of this horizon; strongly acid.
- 26 to 38 inches, grayish-brown and dark yellowish-brown clay loam; many, distinct mottles; moderate, medium, prismatic structure to strong, medium, subangular blocky structure; vertical cracks are heavily coated with grayish-brown sand; firm when moist; strongly acid.

Substratum—
- 38 to 54 inches, yellowish-brown and grayish-brown clay loam; many, distinct mottles; massive (structureless) to weak, coarse, angular blocky structure; many vertical cracks are coated with grayish-brown sand; firm when moist; medium acid.
- 54 inches +, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless); firm when moist; mildly calcareous.

The thickness of the silt cap ranges from 12 to 30 inches but is most commonly 16 to 18 inches. The surface soil is about 6 to 7 inches thick in most places. Near the Floyd soils, it may be as much as 10 inches thick.

The subsoil and substratum below the silt cap have a loam, sandy clay loam, or clay loam texture. Gravel and cobblestones are common in these layers, but they tend to be concentrated in a thin pebble band just below the silt cap. A few pockets and bands of coarse-textured materials are present in the subsoil and substratum. The average depth to the calcareous, firm till is 4½ feet, but the depth ranges from 3½ to 8 feet.

Some small areas of Kasson silt loam are included in this mapping unit.

Skyberg silt loam, 2 to 6 percent slopes (SkB) (Capability unit IIIw–3).—This soil is on the upland, on gentle slopes that rarely exceed 3 percent. Most of it has lost less than 25 percent of its original surface soil through erosion, and a few small areas have lost 25 to 50 percent. The profile is otherwise similar to that of Skyberg silt loam, 0 to 2 percent slopes. The hazard of erosion is moderate.

Many spots of Kasson silt loam are included in this unit.

Tama soils

The Tama soils are deep, well drained, and dark colored. They developed under prairie grass, principally on ridgetops in the southeastern part of Mantorville Township. The parent material was silty loess about 6 to 8 feet thick, underlain by loam and clay loam glacial till.

The chief associated soils are the Judson soils, which are in waterways. The Tama soils have a thicker, darker surface soil than the Downs soils, which developed in similar materials under a mixture of trees and grass, or the Fayette soils, which developed in loess under forest. The Tama soils do not have the gray, platy subsurface soil that the soils of the other two series have.

These soils are free of stones and easy to work. Generally they are medium acid. They have a high available moisture holding capacity and high fertility.

Tama silt loam, 0 to 2 percent slopes (TaA) (Capability unit I–1).—This soil occupies nearly level ridgetops. There is little or no damage from erosion and little hazard of erosion.

Profile—

Surface soil—
- 0 to 12 inches, black to very dark brown silt loam; moderate, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; medium acid.

Subsurface soil—
- 12 to 18 inches, very dark brown to very dark grayish-brown silt loam; weak, fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 18 to 25 inches, dark-brown silt loam; weak to moderate, fine to medium, subangular blocky structure; friable when moist; medium acid.
- 25 to 35 inches, brown silt loam to silty clay loam; weak to moderate, fine to medium, subangular blocky structure; friable when moist; medium acid.
- 35 to 40 inches, brown silt loam; very weak, medium, subangular blocky structure; friable when moist; medium acid.

Substratum—
- 40 to 48 inches, dark yellowish-brown silt loam; massive (structureless); very friable when moist; medium acid.
- 48 to 72 inches, yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; medium acid.
- 72 inches +, light yellowish-brown silt loam to very fine sandy loam; massive (structureless); very friable when moist; moderately calcareous.

The surface soil ranges from 12 to 15 inches in thickness. In a few places the calcareous material in the substratum is within 4 feet of the surface. Where the clay loam glacial till is within 3½ to 5 feet of the surface, the substratum is faintly mottled in places.

Tama silt loam, 2 to 6 percent slopes (TaB) (Capability unit IIe–1).—This soil occupies gently sloping ridgetops on the upland. Less than 25 percent of the original surface soil has been removed by erosion. The profile is like that of Tama silt loam, 0 to 2 percent slopes, except that the surface soil is only 10 to 12 inches thick. The hazard of further erosion is moderate.

Tama silt loam, 2 to 6 percent slopes, moderately eroded (TaB2) (Capability unit IIe–1).—This soil lies on gentle slopes on the upland. About 25 to 50 percent of the original surface soil has been lost through erosion. The profile is like that of Tama silt loam, 0 to 2 percent slopes, except that the thickness of the surface soil has been reduced to 6 to 7 inches.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been somewhat reduced by the erosion that has occurred, and the hazard of further erosion is moderate.

Terrace escarpments

This miscellaneous land type contains a considerable variety of soils on the upland, on stream terraces, and on glacial outwash plains. All of these soils are underlain by very coarse textured materials at depths of 9 to 18 inches. Most of the soils are about 15 inches deep over the coarse materials. Slopes normally are steeper than 12 percent.

These soils are very droughty; their available water holding capacity is low to very low. Fertility is low.

Terrace escarpments (Te) (Capability unit VIIe–1).—This unit contains the following soils, in all degrees of erosion:

- Bixby loam on slopes of more than 12 percent.
- Bixby loam, shallow, on slopes of more than 12 percent.
- Dakota sandy loam on slopes of more than 12 percent.
- Thurston loam on slopes of more than 18 percent.
- Wykoff and Thurston soils on slopes of more than 18 percent.
- Escarpments or slopes of more than 6 percent at the edge of terraces.

The depth to bedrock or coarse materials, the vegetation, and the degree of erosion vary considerably from one area of this unit to another. The present level of fertility, the quality of tilth, the rate of infiltration of water, and the available water holding capacity depend on these factors. The hazard of further erosion is severe to very severe.

Most of the soils in this unit are used for permanent pasture, woodland, or wildlife shelter.

Thurston soils

These soils are well drained and dark colored to moderately dark colored. Most of them are moderately deep, and some are shallow. They developed under prairie grass or a mixture of prairie grass and hardwood forest. Their parent material was medium textured glacial material overlying very coarse textured to coarse textured glacial till. The substratum contains gravel, and in many places the upper horizons of the profile also contain gravel.

The Thurston soils are closely associated with the Dickinson soils. The profiles are very similar, except that the Dickinson profile is free of gravel and the Thurston profile contains gravel in the substratum and also, in many places, in the subsoil and surface layers. Where Dickinson soils are present in this county, the soils of the two series are mapped in undifferentiated units.

The Thurston soils are also associated with the medium-textured Ostrander and Racine soils, which developed in a thin silt cap over glacial till. They differ in that they have a coarser textured surface soil and a coarse textured substratum. They have darker colored surface and subsurface layers than the Wykoff soils, and they do not have gray films coating the blocks in the subsoil.

The Thurston soils occupy slopes of 2 to 18 percent, but slopes of 2 to 6 percent are most common. Thurston soils on slopes of more than 18 percent have been included in the Terrace escarpments mapping unit.

The soils are somewhat difficult to work in many places because of gravel and cobblestones in the plow layer. The surface soil and subsoil are generally medium acid to strongly acid. The soils have a moderate to moderately severe drought hazard and have only a moderate to moderately low available moisture holding capacity. The fertility is moderately high to high.

Thurston loam, 2 to 6 percent slopes, moderately eroded (ThB2) (Capability unit IIe–3).—This soil lies on undulating areas on the upland. From 25 to 50 percent of the original surface soil has been removed by erosion, and the remainder has been mixed with the subsurface soil in the plow layer. Very little of the area has a silt loam surface texture. In other respects, the profile is similar to that of Thurston loam, 6 to 12 percent slopes.

Small amounts of Dickinson loam are included in this unit.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion, and the hazard of further erosion is moderate.

Thurston loam, 2 to 6 percent slopes, severely eroded (ThB3) (Capability unit IIe–3).—This soil is on undulating slopes on the upland. From 50 to 75 percent of the original surface soil has been removed by erosion, and the plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. Outcrops of gravel and cobblestones are very common. Very little of this soil has a silt loam surface texture. With these exceptions, the profile is like that of Thurston loam, 6 to 12 percent slopes.

A few small areas of Dickinson loam are included in this unit.

The hazard of erosion is moderate. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced by erosion.

Thurston loam, 6 to 12 percent slopes (ThC) (Capability unit IIIe–3).—This soil is on rolling slopes on the upland. The hazard of erosion is moderately severe, but less than 25 percent of the original surface soil has been lost through erosion. A few small areas have a few shallow gullies.

Profile of Thurston loam in a cultivated field—

Surface soil—
- 0 to 9 inches, very dark brown loam to silt loam; weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 9 to 14 inches, very dark grayish-brown to brown loam to silt loam; weak, very fine to fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 14 to 26 inches, dark yellowish-brown to brown loam to clay loam; weak to moderate, medium, subangular blocky structure; friable when moist; contains some pieces of fine and medium gravel; medium acid.
- 26 to 30 inches, dark yellowish-brown gravelly loam; weak, coarse, subangular blocky structure; friable when moist; medium acid.

Substratum—
- 30 to 54 inches, yellowish-brown gravelly sand and sand; single grain (structureless); loose; slightly acid.
- 54 inches +, light yellowish-brown gravelly sand; single grain (structureless); loose; mildly calcareous.

The surface soil ranges from silt loam to sandy loam. Where Racine soils are nearby, the surface soil has a lighter color. Pockets and outcrops of gravel and cobblestones are common in the plow layer.

The average depth to the very coarse textured substratum is 30 inches, but depths ranging from 24 to 42 inches are common. A few bands and pockets of glacial till are present in the substratum. The depth to calcareous material in the substratum ranges from 3 to 10 feet, but it is commonly 4 to 5 feet.

Small areas of Thurston sandy loam are included in this unit. They have a profile like Thurston loam, except that the surface soil is sandy loam and the subsoil is sandy loam, loam, or gravelly sandy loam. Some small areas have a gravelly sandy loam surface soil. Thurston sandy loam is not mapped separately in this county because of its small extent. Some small areas of Dickinson loam are also included.

Thurston loam, 6 to 12 percent slopes, moderately eroded (ThC2) (Capability unit IIIe–3).—This soil lies on rolling slopes on the upland. It has lost about 25 to 50 percent of its original surface soil through erosion. The plow layer is a mixture of the remainder of the surface soil, the subsurface soil, and a little of the subsoil. Pockets of gravel and cobblestones are very common in the surface soil. A few areas have a silt loam surface texture. With these exceptions, the profile is like that of Thurston loam, 6 to 12 percent slopes.

A few small areas of Dickinson loam are in this unit.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderately severe.

Thurston loam, 6 to 12 percent slopes, severely eroded (ThC3) (Capability unit IIIe–3).—This soil is on rolling slopes on the upland. About 50 to 75 percent of the original surface soil has been lost through erosion. In some small areas, erosion has been more severe, and a few shallow gullies have been cut. The plow layer consists of the remainder of the surface soil, the subsurface soil, and part of the subsoil. Outcrops of gravel and cobblestones are very common in the plow layer. The profile is otherwise similar to that of Thurston loam, 6 to 12 percent slopes.

A few small areas of Dickinson loam are included.

This soil has a moderately severe hazard of erosion. The erosion has already severely reduced the level of fertility, the quality of tilth, and the rate of infiltration of water.

Thurston loam, 12 to 18 percent slopes, severely eroded (ThD3) (Capability unit VIs–1).—This soil is on hilly areas of the upland. Most areas have lost from 50 to 75 percent of the original surface soil through erosion; the other areas have lost less than 50 percent. The plow layer is a mixture of the remainder of the surface soil, the subsurface soil, and part of the subsoil.

Most areas in this unit are Thurston loam, but a few small areas of Thurston sandy loam are included. Some areas contain considerable amounts of gravel and cobblestones in the plow layer. The depth to the very coarse textured substratum ranges from about 20 to 30 inches. The profile is otherwise similar to that of Thurston loam, 6 to 12 percent slopes.

The hazard of erosion is severe. The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have already been moderately to severely reduced by erosion.

Thurston soils, 2 to 6 percent slopes, severely eroded (TsB3) (Capability unit IIIs–3).—This unit consists mostly of Thurston loam, but some areas are Thurston sandy loam. Small areas of Dickinson sandy loam are included. These soils lie on undulating slopes on the upland.

These soils have lost about 50 to 75 percent of the original surface soil through erosion. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. Some areas of the Thurston sandy loam have considerable amounts of gravel and cobblestones in the plow layer. With these exceptions, the profile is like that of Thurston loam, 6 to 12 percent slopes.

Erosion has severely reduced the level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity of these soils. The hazard of further erosion is moderate.

Thurston soils, 6 to 12 percent slopes, moderately eroded (TsC2) (Capability unit IVs–1).—These soils are on rolling slopes on the upland. Most of the unit is Thurston loam, but some areas of Thurston sandy loam and Dickinson sandy loam are included. Some areas have a considerable amount of gravel and cobblestones in the plow layer.

From 25 to 50 percent of the original surface soil has been lost through erosion on most of the areas. A few small areas are less eroded. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and, in a few places, part of the subsoil. The profile is otherwise similar to that of Thurston loam, 6 to 12 percent slopes.

The erosion hazard on these soils is moderately severe. The level of fertility, the quality of tilth, the rate of infiltration of water, and the available water holding capacity have already been moderately reduced by erosion.

Thurston soils, 6 to 12 percent slopes, severely eroded (TsC3) (Capability unit IVs–1).—These soils lie on rolling slopes on the upland. The unit consists of Thurston loam, Thurston sandy loam, and a few small areas of Dickinson sandy loam. The plow layer of part of it contains a considerable amount of gravel and cobblestones.

About 50 to 75 percent of the original surface soil has been removed by erosion, and a few small areas are more severely eroded. The remaining surface soil, the subsurface soil, and part of the subsoil are mixed in the plow layer. In other respects, the profile is like that of Thurston loam, 6 to 12 percent slopes.

The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have been severely reduced by erosion. The hazard of further erosion is moderately severe.

Thurston and Dickinson loams, 0 to 2 percent slopes (TtA) (Capability unit IIs–1).—These soils lie on nearly level areas on the upland and are associated with Racine and Kasson soils. The individual areas are rarely more than 5 acres in size.

Some of this unit consists of Thurston loam, and a considerable part is Dickinson loam. The Thurston soil has gravel in the subsoil and substratum, and in a few areas in the surface soil. The Dickinson loam is free of gravel throughout the profile. A few bands and pockets of fine textured material are intermixed in some places with the coarse textured to very coarse textured glacial till. All of these soils are well drained to excessively drained, except where the coarse textured till is very thin over the finer textured till; in these places the soil is moderately well drained.

A typical profile of Thurston loam is described under Thurston loam, 6 to 12 percent slopes. Dickinson soils occupy such small areas in this county and are so consistently associated with the Thurston soils that they are not mapped separately.

Little or no erosion has occurred on the soils of this unit.

Profile of Dickinson loam—

Surface soil—
- 0 to 10 inches, very dark brown loam; weak, fine, granular structure; friable when moist; slightly acid.

Subsurface soil—
- 10 to 15 inches, very dark grayish-brown loam; weak, very fine to fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 15 to 27 inches, dark yellowish-brown to brown loam to clay loam; weak to moderate, medium, subangular blocky structure; friable when moist; medium acid.
- 27 to 31 inches, dark yellowish-brown loam; weak, coarse, subangular blocky structure; friable when moist; medium acid.

Substratum—
- 31 to 55 inches, yellowish-brown sand; single grain (structureless); loose; slightly acid.
- 55 inches +, light yellowish-brown sand; single grain (structureless); loose; mildly calcareous.

The texture of the surface soil may be loam, sandy loam, or fine sandy loam. The texture of the subsoil ranges from sandy loam to clay. Included are some areas of Dickinson sandy loam, which has a substratum of loose sand at depths of 12 to 24 inches, instead of at depths of 24 to 42 inches as in Dickinson loam.

Thurston and Dickinson loams, 2 to 6 percent slopes (TtB) (Capability unit IIe–3).—These soils are on undulating slopes on the upland. About 30 percent of the area is Dickinson loam, and the rest is principally Thurston loam. Up to 25 percent of the original surface soil has been removed by erosion. Otherwise, the profiles are like those described under Thurston loam, 6 to 12 percent slopes, and Thurston and Dickinson loams, 0 to 2 percent slopes.

The hazard of further erosion is moderate.

Thurston and Dickinson soils, 0 to 2 percent slopes (TuA) (Capability unit IIIs–1).—This unit consists of Thurston loam, Dickinson sandy loam, and Thurston sandy loam. It occupies nearly level areas on the upland in association with Racine soils, Ostrander soils, and Thurston and Dickinson loams. The individual areas are rarely more than 3 acres in size.

These soils differ from the Thurston and Dickinson loams in that they are only 12 to 24 inches deep over the coarse textured to very coarse textured substratum. The Thurston and Dickinson loams are 24 to 42 inches deep. In a few places, these soils have gravel and cobblestones in the surface soil. A few pockets of fine-textured material are present in the coarse-textured glacial till. No erosion has occurred, and none is likely. In other respects, the profiles of these soils are like those described under Thurston loam, 6 to 12 percent slopes, and Thurston and Dickinson loams, 0 to 2 percent slopes.

Thurston and Dickinson soils, 2 to 6 percent slopes (TuB) (Capability unit IIIs–2).—This unit consists of Thurston loam, Dickinson sandy loam, and Thurston sandy loam. A small area of loamy sand is included. These soils lie on undulating slopes on the upland. Up to 25 percent of the original surface soil has been removed by erosion. The profiles are otherwise similar to those described under Thurston loam, 6 to 12 percent slopes, and Thurston and Dickinson loams, 0 to 2 percent slopes.

The hazard of erosion is moderate.

Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded (TuB2) (Capability unit IIIs–2).—This unit, on undulating slopes on the upland, contains Thurston loam, Dickinson sandy loam, and Thurston sandy loam. Erosion has removed about 25 to 50 percent of the original surface soil. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and, in a few places, part of the subsoil. The profiles are, with these exceptions, similar to those described under Thurston loam, 6 to 12 percent slopes, and Thurston and Dickinson loams, 0 to 2 percent slopes.

The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have been moderately reduced by erosion. The hazard of further erosion is moderate.

Udolpho soils

The Udolpho soils are moderately deep, moderately dark colored, and somewhat poorly drained. They developed under a mixture of grass and hardwood forest on moderately thick, medium textured materials over coarse textured to very coarse textured glacial outwash.

These soils are closely associated with the Hayfield and Kato soils on the stream terraces and outwash plains. They differ from the better drained Hayfield soils in that their profile is mottled in the subsoil and subsurface soil. They are slightly better drained and have a thinner, lighter colored surface soil than the Kato soils, which developed from the same parent material under water-tolerant grass.

The Skyberg soils had similar vegetation and drainage, but their parent material was a thin silt cap over glacial till. The Udolpho soils have a weaker structure in the subsoil and a much coarser substratum.

These soils are free of stones and easy to work. The surface soil and subsoil are generally medium acid to strongly acid. Because of the coarse textured to very coarse textured substratum, these soils have only a moderate water holding capacity. The fertility is moderate.

Udolpho silt loam (Ud) (Capability unit IIIw–2).—This soil developed on nearly level stream terraces and outwash plains. Erosion is not a problem.

Profile—

Surface soil—
0 to 7 inches, very dark gray to very dark grayish-brown silt loam; weak, fine, granular structure; soft when dry, very friable when moist; slightly sticky when wet; medium acid.

Subsurface soil—
7 to 11 inches, dark grayish-brown silt loam; few, faint mottles; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
11 to 18 inches, grayish-brown and yellowish-brown silty clay loam to silt loam; common, distinct mottles; weak, fine, subangular blocky structure; friable to firm when moist; medium acid.
18 to 25 inches, grayish-brown and yellowish-brown clay loam; common, distinct mottles; weak, medium, subangular blocky structure; friable when moist; strongly acid.
25 to 27 inches, strong-brown and grayish-brown sandy clay loam; common, distinct mottles; massive (structureless); friable when moist; contains fine gravel; strongly acid.

Substratum—
27 to 48 inches, grayish-brown sand; massive (structureless) to single grain (structureless); loose; contains many thin bands of dark-brown sandy clay loam that include a considerable amount of shale fragments; slightly acid.
48 inches +, light yellowish-brown, medium to coarse sand; massive (structureless) to single grain (structureless); loose; contains fine gravel; contains a few bands of darker colored sandy loam that include a considerable amount of shale fragments; mildly calcareous.

The texture of the surface soil and subsurface soil ranges from loam to silt loam. The surface soil ranges from 6 to 10 inches in thickness. In a few places the subsurface soil has no mottles.

The upper part of the subsoil ranges in texture from silt loam to clay loam. There is considerable variation in the degree of mottling in the subsoil. The lower part of the subsoil ranges from clay loam to loam. A thin layer of sandy clay loam to sandy loam, which contains more gravel than the rest of the subsoil, is generally just above the coarse-textured substratum. The depth to the coarse-textured substratum ranges from 24 to 36 inches but is most commonly between 27 and 30 inches.

The substratum consists principally of medium to coarse sand that contains fine to medium-sized gravel. The bands of darker colored material range from loamy sand to sandy clay loam. The content of shale fragments varies from place to place.

The depth to the calcareous material in the substratum is generally between 48 and 54 inches but ranges from 42 to 72 inches. The dense, fine-textured glacial till that generally underlies the coarse-textured substratum is at depths of between 5 and 10 feet. There are a few areas in this unit where the substratum is only 12 to 18 inches thick and the glacial till is within 4 to 5 feet of the surface.

Some small areas of moderately well drained Hayfield soils are included in this unit.

Vlasaty soils

The Vlasaty soils are deep, moderately well drained, and light colored. They developed under hardwood forest on nearly level to gently sloping areas on the upland. The parent material was a thin blanket of silt over firm loam to clay loam glacial till.

These soils are closely associated with the well drained Renova soils and the somewhat poorly drained Sargeant soils, which developed in the same kind of parent material. Unlike the Renova soils, they are mottled in the lower part of the subsoil, but they do not have mottles in the upper part of the subsoil and subsurface soil as the Sargeant soils do. The Vlasaty soils have a thinner, lighter colored surface soil and a thicker, grayer, subsurface soil than the Kasson soils, which had similar parent material and drainage but a vegetation of mixed grass and trees.

The surface soil is generally free of gravel and cobblestones, except where the silt cap is less than 7 inches thick. The surface soil and subsoil are generally medium acid to strongly acid. The water-holding capacity is high, but the fertility is moderately low.

Vlasaty silt loam, 0 to 2 percent slopes (VaA) (Capability unit IIs–1).—This soil lies on nearly level areas on the upland. Little or no erosion has occurred, and little is likely. Most of the areas are moderately well drained.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark-gray to grayish-brown silt loam; weak, fine, granular structure to weak, thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 7 to 11 inches, light brownish-gray silt loam; moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 11 to 17 inches, dark-brown silt loam; moderate, medium, angular blocky structure; blocks are heavily coated with pale-brown films; firm when moist; strongly acid.
- 17 to 28 inches, brown clay loam; few, faint mottles; weak, coarse, prismatic structure to strong, medium, angular blocky structure; many blocks and prisms are coated with pale-brown films; very firm when moist; cobblestones are common in the upper part of this horizon; strongly acid.
- 28 to 35 inches, dark yellowish-brown clay loam; common, distinct mottles; weak, coarse, prismatic structure to strong, coarse, angular blocky structure; a few blocks and prisms are coated with pale-brown films and many others are coated with dark grayish-brown films; very firm when moist; medium acid.

Substratum—
- 35 to 46 inches, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless) to weak, coarse, angular blocky structure; firm when moist; old root channels are coated with very dark gray films; slightly acid.
- 46 inches +, yellowish-brown and grayish-brown clay loam; common, distinct mottles; massive (structureless); firm when moist; mildly calcareous.

The silt cap normally ranges from 6 to 30 inches in thickness, but 16 to 18 inches is most common. Where the silt cap is very thin or missing, the surface soil may have a loam texture. The original surface soil was rarely thicker than 4 inches, and the plow layer generally includes part of the subsurface soil.

The subsoil and substratum below the silt cap range through loam, sandy clay loam, and clay loam. Gravel and cobblestones are common in these layers, but they tend to be concentrated in a thin pebble band just below the silt cap. Pockets and bands of coarse-textured materials are common below the silt cap. The depth to the calcareous, firm till ranges from 3½ to 6 feet but averages 4 feet.

Some areas of Sargeant silt loam too small to separate were included in this unit.

Vlasaty silt loam, 2 to 6 percent slopes (VaB) (Capability unit IIe–2).—This soil is on the upland, on gentle slopes that rarely exceed 3 percent. Although the erosion hazard is moderate, much of the area is still in woods, and less than 25 percent of the original surface soil has been lost. The profile is somewhat similar to that of Vlasaty silt loam, 0 to 2 percent slopes.

This unit contains fewer small areas of Sargeant silt loam than does the nearly level soil.

Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded (VaB2) (Capability unit IIe–2).—The slopes of this soil are predominantly 4 to 5 percent. About 25 to 50 percent of the original surface soil has been removed by erosion. The remaining surface soil, the subsurface soil, and part of the subsoil are mixed in the plow layer. In other respects, the profile is like that of Vlasaty silt loam, 0 to 2 percent slopes.

The hazard of erosion is moderate. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion.

Inclusions of Sargeant silt loam are rare in this unit.

Waukegan soils

The Waukegan soils are dark colored, well drained to moderately well drained, and medium textured. They developed under grass on stream terraces and glacial outwash plains. They are normally on nearly level areas, but a few acres near drainageways occupy slopes of up to 12 percent. The parent materials were moderately thick, medium textured materials over coarse textured to very coarse textured glacial outwash. The typical Waukegan soils are moderately deep over the coarse-textured materials, but in some places deep Waukegan soils are mapped.

The Waukegan soils are associated with the moderately well drained Hayfield and the poorly drained Kato soils. The Bixby and Dakota soils developed from similar material, but the material above the glacial outwash was coarser. Above the gravel and sand, the Waukegan soils normally have 24 to 42 inches of silt loam that contains fine sand and is more than 20 percent clay; the Dakota and Bixby soils have 15 to 24 inches of loam or sandy loam that contains coarser sand and is less than 20 percent clay. The Waukegan soils have a thicker, darker colored surface soil than the Bixby soils, which developed under forest.

These soils are free of stones and easy to work. The surface soil and subsoil are normally slightly acid to medium acid. The available moisture holding capacity is moderately high, but the soils are somewhat droughty during dry spells of 2 or 3 weeks in summer. The fertility is high.

Waukegan silt loam, 0 to 2 percent slopes (WaA) (Capability unit IIs–1).—This soil lies on level terraces and outwash plains. There is little or no erosion or hazard of erosion.

Profile in a cultivated field—

Surface soil—
- 0 to 12 inches, black silt loam; moderate, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 12 to 17 inches, very dark brown to very dark grayish-brown silt loam; weak to moderate, very fine to fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 17 to 25 inches, dark-brown silt loam to silty clay loam; weak to moderate, fine to medium, subangular blocky structure; blocks are coated with very dark grayish-brown films; friable when moist; medium acid.
- 25 to 28 inches, dark-brown to brown clay loam to loam; weak to moderate, medium, subangular blocky structure; blocks are coated with very dark grayish-brown films; friable when moist; medium acid.
- 28 to 33 inches, dark-brown to dark yellowish-brown gravelly sandy clay loam; weak, medium, subangular blocky structure; friable when moist; medium acid.

Substratum—
- 33 to 48 inches, dark-brown to dark yellowish-brown loamy sand; single grain (structureless); loose when moist; contains fine gravel; slightly acid.
- 48 inches +, yellowish-brown loamy sand; single grain (structureless); loose when moist; contains fine to medium gravel; mildly calcareous.

Some areas have a loam surface soil. A few areas where the soil developed under mixed grass and hardwood forest have a very dark gray to very dark grayish-brown surface soil, a lighter colored subsurface soil, and a few gray films coating the blocks in the subsoil.

The thickness of the silt cap ranges from 12 to 30 inches, but it is generally 21 to 24 inches. Where the surface soil is silt loam, the upper part of the subsoil is silt loam to silty clay loam. Where the surface soil is loam, the upper part of the subsoil is loam to clay loam. The lower part of the subsoil of both types is loam, sandy clay loam, or clay loam. In most places it contains fine gravel.

The coarser textured part of the substratum may be sand, loamy sand, gravelly sand, gravelly loamy sand, or gravelly sandy loam. In most areas it contains thin bands of dark-colored gravelly sandy clay loam material, and in many places a considerable number of fragments of dark-colored shale. The depth to the substratum ranges from 24 to 42 inches. In the watershed of the lower North Branch of the Zumbro River, it is commonly 33 to 36 inches. Elsewhere it is generally 27 to 30 inches. The depth to calcareous material is most commonly 4 feet, but it may range from 3 to 6 feet.

In areas next to the somewhat poorly drained Kato soils, drainage is only moderately good, the lower part of the subsoil is faintly to distinctly mottled, and the brown colors are more pale.

Waukegan silt loam, 2 to 6 percent slopes (WaB) (Capability unit IIe–3).—This soil occupies short gentle slopes on stream terraces and glacial outwash areas. The hazard of erosion is moderate, but less than 25 percent of the original surface soil has been lost. The profile is like that of Waukegan silt loam, 0 to 2 percent slopes.

A few areas of Waukegan loam are included in this unit, and also a small area of deep Waukegan silt loam.

Waukegan silt loam, 2 to 6 percent slopes, moderately eroded (WaB2) (Capability unit IIe–3).—This soil is on short gentle slopes on terraces and outwash plains. It has lost about 25 to 50 percent of the original surface soil, and several small areas are even more severely eroded. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and, in a few places, a small part of the subsoil. The profile is otherwise like that of Waukegan silt loam, 0 to 2 percent slopes.

Part of this soil has a loam surface texture.

The hazard of erosion is moderate. The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion.

Waukegan silt loam, deep, 0 to 2 percent slopes (WdA) (Capability unit I–1).—This is a deep, dark colored to moderately dark colored, well drained to moderately well drained soil on terraces. It developed under grass or a mixture of grass and hardwood forest. The silt cap in which it developed was more than 3½ feet deep over coarse textured to very coarse textured glacial outwash.

Little or no erosion has occurred on this soil.

Profile—

Surface soil—
- 0 to 12 inches, black silt loam; moderate, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
- 12 to 19 inches, very dark brown to very dark grayish-brown silt loam; weak to moderate, very fine to fine, subangular blocky structure; very friable when moist; medium acid.

Subsoil—
- 19 to 26 inches, dark-brown silt loam to silty clay loam; weak to moderate, fine to medium, subangular blocky structure; blocks are coated with very dark grayish-brown films; friable when moist; medium acid.
- 26 to 34 inches, dark-brown to brown silt loam to silty clay loam; few, faint mottles; weak, medium, subangular blocky structure; very friable when moist; medium acid.
- 34 to 40 inches, dark yellowish-brown to yellowish-brown silty clay loam; few, faint mottles; massive (structureless) to weak, coarse, subangular blocky structure; very friable when moist; medium acid.

Substratum—
- 40 to 44 inches, dark yellowish-brown to yellowish-brown sandy clay loam to clay loam; massive (structureless); friable when moist; contains fine gravel; slightly acid.
- 44 to 50 inches, dark yellowish-brown to yellowish-brown loamy sand; single grain (structureless); loose when moist; contains fine gravel; slightly acid.
- 50 inches +, yellowish-brown sand; single grain (structureless); loose when moist; contains fine to medium gravel; slightly acid.

About 15 percent of this soil developed under a mixture of grass and hardwood forest. In these areas, the surface soil is lighter colored and thinner, the subsurface soil is lighter colored, and the subsoil is more likely to have gray films coating the blocks than the corresponding layers in the profile described.

The depth of the silt cap ranges from 35 to 48 inches; 40 inches is most common. The part of the subsoil within the silt cap has a silt loam or silty clay loam texture and in some places is faintly mottled. The upper part of the substratum and the part of the subsoil below the silt cap have a loam, sandy clay loam, or clay loam texture and generally contain a considerable amount of fine gravel.

The coarse textured to very coarse textured part of the substratum ranges from sand to gravelly sandy loam. Thin bands of dark-colored gravelly sandy clay loam are included in many places.

The calcareous part of the substratum generally lies at a depth of 4 feet, but the depth ranges from 3½ to 6 feet.

Waukegan silt loam, thick surface variant, 0 to 2 percent slopes (WkA) (Capability unit I–1).—This soil is deep, dark colored, and well drained. It developed from deep, medium-textured, slightly acid to neutral, alluvial materials over mildly calcareous sand or gravelly sand.

This soil is on high bottoms and low terraces. It lies about 3 to 5 feet above the Alluvial land, and 3 to 5 feet below the terraces of Waukegan silt loam, which are between it and the uplands. This soil is flooded about once in 25 years.

The surface soil contains enough medium and coarse sand to give it a gritty texture. It is free of stones and easy to work. The available moisture holding capacity is moderately high, and the fertility is very high.

Profile—

Surface soil—
- 0 to 14 inches, black, gritty silt loam; weak, fine, granular structure; very friable when moist; slightly acid.

Subsurface soil—
- 14 to 24 inches, black to very dark brown, gritty silt loam to silty clay loam; weak, very fine, subangular blocky structure; very friable when moist; slightly acid.

Subsoil—
- 24 to 34 inches, very dark brown to very dark grayish-brown, gritty silt loam to silty clay loam; weak, fine, subangular blocky structure; friable when moist; slightly acid.
- 34 to 40 inches, dark-brown heavy loam; weak, fine to medium, subangular blocky structure; friable when moist; slightly acid.
- 40 to 43 inches, dark yellowish-brown light sandy loam; massive (structureless); very friable when moist; slightly acid.

Substratum—
- 43 to 52 inches, yellowish-brown coarse sand; loose; slightly acid.
- 52 inches +, light yellowish-brown gravelly sand; loose; mildly calcareous.

In some places this soil has a loam surface soil, a loam subsurface soil, and a subsoil of loam to heavy loam.

The thickness of the surface soil and subsurface soil ranges from 18 to 30 inches. The reaction is slightly acid, neutral, or mildly calcareous.

The substratum is dominantly sand and contains bands of gravelly sand. The depth to the coarse-textured substratum ranges from 30 to 60 inches but is generally more than 42 inches.

Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded (WmC2) (Capability unit IIIe–3).—These soils occupy short, moderate slopes on terraces and outwash plains. Over most of the area, from 25 to 50 percent of the original surface soil has been removed by erosion. Some areas that are more eroded and some that are less eroded are included.

The dominant soil in this unit is Waukegan silt loam. In some areas the soil is Waukegan loam. Nearly half of this unit consists of Bixby loam, which has a thinner, lighter colored surface soil than Waukegan silt loam. The areas of each are so small that they were difficult to separate on the map.

The Waukegan silt loam in this unit has a profile that, except for erosion, is like that of Waukegan silt loam, 0 to 2 percent slopes. Except for the effects of erosion, the Bixby soil has a profile like that of Bixby loam, 0 to 2 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderately severe.

Whalan soils

The Whalan soils are well drained to moderately well drained, medium textured, and light colored. They developed under hardwood forest in a thin silt cap over a thin layer of glacial till above limestone bedrock. The shallow Whalan soils are 12 to 24 inches deep over bedrock, and the moderately deep Whalan soils are 24 to 42 inches deep. The largest areas have slopes of 12 to 18 percent, but other slopes range from 2 to 25 percent. Whalan soils on slopes steeper than 25 percent were included in Rough broken and stony land.

The Whalan soils are associated with Renova and Fayette soils and Rough broken and stony land in the eastern part of the county. They differ from the Rockton soils in that they have a thinner and lighter colored surface soil, a thicker and lighter colored subsurface soil, a stronger development of structure in the subsoil, and thicker clay films on structure blocks in the subsoil. The Renova soils are deeper over bedrock than the deepest Whalan soils.

These soils are generally easy to work. Where the silt cap is less than 7 inches thick, the plow layer contains gravel and cobblestones. Where the bedrock is less than 15 inches below the surface, the plow layer contains scattered fragments of limestone. Limestone quarries have been developed on some areas of Whalan soils.

The surface soil and subsoil are normally medium acid. Depending on the depth over bedrock, these soils will be slightly or moderately droughty and will have a moderately low or a moderate available water holding capacity. The fertility is moderate.

Whalan silt loam, 2 to 6 percent slopes (WnB) (Capability unit IIIs–3).—Most of this soil is on gentle slopes on the upland, and a small area is nearly level. The hazard of erosion is moderate, but less than 25 percent of the original surface soil has been lost.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark grayish-brown to grayish-brown silt loam; weak, fine, granular structure; slightly hard when

dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
7 to 11 inches, grayish-brown to light brownish-gray silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
11 to 15 inches, dark-brown to brown silt loam to silty clay loam; moderate, fine, subangular blocky structure; blocks are heavily coated with grayish-brown films; friable when moist; medium acid.
15 to 19 inches, dark-brown to brown clay loam; moderate to strong, fine to medium, angular blocky structure; blocks are heavily coated with grayish-brown films; firm when moist; gravel and cobblestones are common in the upper part of this horizon; medium acid.
19 to 22 inches, dark-brown to dark reddish-brown clay loam to clay; strong, medium, angular blocky structure; many blocks are coated with very dark gray films; extremely firm when moist; contains many fragments of limestone; neutral.

Substratum—
22 inches +, limestone, shattered and somewhat disintegrated in the upper part.

Some areas in this unit have a loam surface soil. The original surface soil was rarely more than 6 inches thick. The color ranges from dark gray to grayish brown.

The silt cap ranges in thickness from 18 inches to practically nothing. It is most commonly 12 to 15 inches thick. Below the silt cap is glacial till and below that, limestone bedrock.

The glacial till ranges from loam to clay loam. In many places it contains a considerable amount of gravel and cobblestones. The subsoil is generally mixed with the upper part of the residuum that weathered from the limestone. In some places the subsoil is mottled near its contact with the residuum. It is more strongly mottled where the bedrock contains shale.

The limestone residuum is 2 to 12 inches, but most commonly 3 to 5 inches, in thickness. In some places it is slightly acid. The number of fragments of limestone in the residuum varies greatly.

The bedrock is generally at a depth of 18 to 22 inches, but the depth may be as much as 24 inches or as little as 12 inches. The bedrock is generally somewhat shattered at its upper boundary. The upper 6 to 12 inches in many places contains a high percentage of acid sandstone. In a few places in Milton Township, shale is associated with the limestone in the bedrock.

Whalan silt loam, 2 to 6 percent slopes, moderately eroded (WnB2) (Capability unit IIIs–3).—This soil lies on gentle slopes on the upland. Most of it has lost from 25 to 50 percent of its original surface soil, and a few areas have lost 50 to 75 percent. The plow layer is a mixture of the remainder of the surface soil, the subsurface soil, and small parts of the subsoil. Some areas have a loam surface texture. Otherwise, the profile is like that of Whalan silt loam, 2 to 6 percent slopes.

Erosion has moderately to severely reduced the level of fertility, the quality of tilth, the rate of infiltration of water, and the available water holding capacity. The hazard of further erosion is moderate.

Whalan silt loam, 6 to 12 percent slopes (WnC) (Capability unit IVs–1).—This soil occupies moderate slopes on the upland. Some areas have a loam surface texture. Less than 25 percent of the original surface soil has been removed by erosion. In other respects, the profile is like that of Whalan silt loam, 2 to 6 percent slopes. The hazard of erosion is moderately severe.

Whalan silt loam, 6 to 12 percent slopes, moderately eroded (WnC2) (Capability unit IVs–1).—This soil is on moderate slopes on the upland. Some areas have a loam surface texture. Most of the areas have lost from 25 to 50 percent of the original surface soil. A few areas have a few shallow or deep gullies. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and in a few places a part of the subsoil. Fragments of limestone and a few outcrops of rock are present in the plow layer in some places. With these exceptions, the profile is like that of Whalan silt loam, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have already been moderately reduced by erosion.

Whalan silt loam, 12 to 18 percent slopes (WnD) (Capability unit VIs–1).—This soil occupies moderately steep slopes on the upland. Much of it is still in woods. The hazard of erosion is severe, but less than 25 percent of the original surface soil has been lost through erosion. A few small areas have a few shallow and deep gullies.

Part of the area has a loam surface soil. Fragments of limestone and outcrops of limestone are more common in this unit than in Whalan silt loam, 2 to 6 percent slopes. Otherwise the profiles are similar.

Whalan silt loam, 12 to 18 percent slopes, moderately eroded (WnD2) (Capability unit VIs–1).—This soil is on moderately steep slopes on the upland. Part of the soil has a silt loam surface texture, and some has loam. Outcrops of limestone and scattered fragments of limestone in the plow layer are very common. In one small area, the layer of glacial till is missing.

Most areas have lost from 25 to 50 percent of the original surface soil. A few areas have a few shallow gullies. With these exceptions, the profile is like that of Whalan silt loam, 2 to 6 percent slopes.

The hazard of erosion is severe. The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity have already been moderately reduced by erosion. Much of the area is now in permanent pasture.

Whalan silt loam, moderately deep, 2 to 6 percent slopes (WoB) (Capability unit IIe–3).—Most of this soil is on gentle slopes on the upland, and several small areas are nearly level. Less than 25 percent of the original surface soil has been removed by erosion. The hazard of further erosion is moderate.

Profile in a cultivated field—

Surface soil—
0 to 7 inches, dark grayish-brown to grayish-brown silt loam; weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid.

Subsurface soil—
7 to 11 inches, grayish-brown to light brownish-gray silt loam; weak, thin, platy structure; very friable when moist; medium acid.

Subsoil—
11 to 18 inches, dark grayish-brown to brown silt loam; weak to moderate, fine, subangular blocky structure; many blocks are coated with grayish-brown films; friable when moist; medium acid.

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18 to 28 inches, brown to yellowish-brown clay loam; moderate to strong, medium, angular blocky structure; blocks are heavily coated with grayish-brown films; firm when moist; gravel and cobblestones are common in the upper part of this horizon; medium acid.

Substratum—

28 to 32 inches, dark yellowish-brown to dark reddish-brown clay loam to clay with streaks of very dark gray; massive (structureless); contains many fragments of limestone; extremely firm when moist; neutral.

32 inches +, limestone, shattered and somewhat disintegrated in the upper part.

The depth of the original surface soil was rarely more than 6 inches. The colors range from dark gray to grayish brown. Some areas have a loam texture.

The silt cap ranges from 6 to 30 inches in thickness, but 18 to 20 inches is most common. The glacial till ranges in texture from loam to clay loam and normally contains a considerable amount of gravel and cobblestones. In many places it contains pockets and bands of coarse-textured materials. In a few areas, the glacial till layer is missing, and the silt cap lies directly on the residuum, or material weathered from the limestone bedrock.

The subsoil is generally faintly mottled just above the limestone residuum. Where the bedrock and residuum contain shale, the lower part of the subsoil is distinctly mottled and more poorly drained.

The thickness of the residuum ranges from 2 to 12 inches, but is most commonly 3 to 4 inches. It ranges from slightly acid to mildly calcareous in reaction. The number of fragments of limestone or shale in the residuum varies widely.

The depth to bedrock ranges from 24 to 42 inches. It is commonly 30 to 32 inches. The limestone bedrock is generally shattered at its upper boundary. The upper 6 to 12 inches in many places contains a high percentage of acid sandstone. In a few places in Milton Township, shale is associated with the limestone.

Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded (WoB2) (Capability unit IIe–3).—This soil is on gentle slopes on the upland. Part of this soil has a loam surface texture. One small area has no glacial till layer between the silt cap and the residuum.

Most areas of this soil have lost from 25 to 50 percent of the original surface soil. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and a little of the subsoil. In other respects, this soil has a profile like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate.

Whalan silt loam, moderately deep, 6 to 12 percent slopes (WoC) (Capability unit IIIe–2).—This soil lies on moderate slopes on the upland. Less than 25 percent of the original surface soil has been removed by erosion. In some areas the soil has a loam surface texture. In a few areas the layer of glacial till between the silt cap and the residuum is missing. A small area of soil in Milton Township is underlain by acid shale. With these exceptions, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been slightly reduced by erosion.

Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded (WoC2) (Capability unit IIIe–2).—This soil occupies moderate slopes on the upland. Most of the soil has lost 25 to 50 percent of its original surface soil, and in a few small areas a few shallow gullies have been cut. The plow layer is a mixture of the remainder of the surface soil, the subsurface soil, and, in a few places, a little of the subsoil. In some areas the surface soil is loam. The layer of glacial till between the silt cap and the residuum is missing in a few places. The profile of this soil is otherwise like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. Erosion has already moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water.

Whalan silt loam, moderately deep, 12 to 18 percent slopes (WoD) (Capability unit IVe–1).—This soil is on moderately steep slopes. The erosion hazard is severe, but much of the area is still in woods and therefore has lost less than 25 percent of its surface soil by erosion. A few small areas have a few shallow and deep gullies.

In some areas the surface texture is loam. Pockets and bands of coarse-textured material are more common in the subsoil of this soil. A few areas lack the glacial till layer between the silt cap and the residuum. With these exceptions, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded (WoD2) (Capability unit IVe–1).—This soil occupies moderately steep slopes on the upland. Most areas have lost from 25 to 50 percent of the original surface soil. The remaining surface soil, the subsurface soil, and, in a few places, a little of the subsoil are mixed together in the plow layer.

Some areas have a loam surface soil. Pockets and bands of coarse-textured material are more common in the subsoil. In a few areas the layer of glacial till between the silt cap and the residuum is lacking. The profile is otherwise like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

This soil has a severe hazard of erosion. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion.

Whalan silt loam, moderately deep, 18 to 25 percent slopes (WoE) (Capability unit VIe–1).—This soil is on short, steep slopes on the upland. Most of it is still in woods and pasture and has therefore lost less than 25 percent of its original surface soil through erosion. A few areas have a few shallow and deep gullies.

The surface soil is loam in some areas. Pockets and bands of coarse-textured material are very common in the subsoil. In a few areas the soil has no layer of glacial till between the silt cap and the residuum. With these exceptions, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

This soil has a very severe hazard of erosion. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been slightly reduced by erosion.

Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded (WoE2) (Capability unit VIe-1).—This soil is on short, steep slopes on the upland. Most of it is used for permanent pasture. Most of the soil has lost from 25 to 50 percent of its original surface soil, and some has lost more than that. Many areas have a few shallow to deep gullies.

In some areas the surface texture is loam. Pockets and bands of coarse-textured material are common in the subsoil. In some areas there is no layer of glacial till between the silt cap and the residuum. In other respects, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The hazard of erosion is very severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion.

Whalan soils, 6 to 12 percent slopes, severely eroded (WpC3) (Capability unit IVs-1).—These soils are on moderate slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil and have a few shallow to deep gullies. The plow layer is a mixture of the remaining surface soil and part of the subsoil. In many areas the plow layer is loam instead of silt loam. In many places the plow layer contains fragments of limestone, and there are a few rock outcrops. Except for these variations, the soils have a profile like that of Whalan silt loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture supplying capacity have been severely reduced by erosion. The hazard of further erosion is moderately severe.

Whalan soils, 12 to 18 percent slopes, severely eroded (WpD3) (Capability unit VIs-1).—These soils are on moderately steep slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil. Some more severely eroded areas have many shallow to deep gullies. Most of the areas are now in permanent pasture.

Many areas have a loam surface soil. Outcrops of limestone and scattered fragments of limestone in the plow layer are quite common. With these exceptions, these soils have a profile like that of Whalan silt loam, 2 to 6 percent slopes.

The hazard of erosion is severe. Past erosion has already severely reduced the level of fertility, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity.

Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded (WsB3) (Capability unit IIe-3).—These soils lie on gentle slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil, and some areas have many shallow to deep gullies. The plow layer is a mixture of subsoil and the remainder of the surface soil. Many areas have a loam surface soil instead of silt loam. The profile of the soils is otherwise like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The hazard of erosion is moderate. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced.

Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded (WsC3) (Capability unit IIIe-2).—These soils occupy moderate slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil. A few more severely eroded areas have many shallow to deep gullies. The plow layer is a mixture of the remaining surface soil and part of the subsoil. The surface soil is loam instead of silt loam in many areas. In some areas, there is no glacial till layer between the silt cap and the residuum. With these exceptions, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

These soils have a moderately severe hazard of erosion. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced.

Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded (WsD3) (Capability unit IVe-1).—These soils are on moderately steep slopes on the upland. Most areas have lost from 50 to 75 percent of the original surface soil. Some more severely eroded areas have many shallow to deep gullies. The remaining surface soil is mixed with the subsoil in the plow layer.

In many areas the surface texture is loam instead of silt loam. Pockets and bands of coarse-textured material are common in the subsoil. In a few areas, the layer of glacial till between the silt cap and the residuum is missing. In other respects, the profile is like that of Whalan silt loam, moderately deep, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been severely reduced by erosion, and the hazard of further erosion is severe.

Wykoff soils

These are light-colored soils on the upland. Some of them are moderately deep and well drained, and some are shallow and somewhat excessively drained. They developed under hardwood forest in medium textured to moderately coarse textured glacial material over coarse textured to very coarse textured glacial till. Some areas are nearly level, some are as steep as 18 percent, but the principal areas are on undulating to rolling slopes. Slopes steeper than 18 percent are mapped in the Terrace escarpments unit.

These soils are closely associated with the Renova soils, which developed in a thin silt cap over glacial till material. The substratum of the Renova soils is medium textured, but that of the Wykoff soils is coarse textured to very coarse textured.

The Wykoff soils have a lighter colored, thinner surface soil than the Thurston and Dickinson soils. The subsurface soil is lighter colored and has a platy structure. The subsoil has a stronger development of structure and gray films coating the blocks.

These soils are generally medium acid to strongly acid. In many places they are somewhat difficult to work because of the gravel and cobblestones in the plow layer. The moderately deep Wykoff soils have a moderate available moisture holding capacity, a moderate hazard of drought, and a moderate level of fertility; the shallow Wykoff soils have a moderately low available moisture holding capacity, a moderately severe hazard of drought, and a moderately low level of fertility.

Wykoff loam, 0 to 2 percent slopes (WuA) (Capability unit IIs–1).—This soil is on the upland, in nearly level areas that rarely exceed 5 acres in size. Most of it is well drained, but where the coarse textured glacial till is thin over the finer textured till, it is only moderately well drained. The coarse till contains a few pockets of fine-textured material. This soil rarely has gravel or cobblestones in its surface soil, and in a few places it has none in the entire profile. With these exceptions, this soil has a profile like that of Wykoff loam, 2 to 6 percent slopes.

This soil has little or no hazard of erosion or effects of past erosion.

Wykoff loam, 2 to 6 percent slopes (WuB) (Capability unit IIe–3).—This soil occupies undulating slopes on the upland. Up to 25 percent of the original surface soil has been lost, and the hazard of further erosion is moderate.

Profile in a cultivated field—

Surface soil—
- 0 to 7 inches, dark-gray to dark grayish-brown loam to silt loam; weak, thin, platy structure to weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; medium acid.

Subsurface soil—
- 7 to 11 inches, grayish-brown to light brownish-gray loam to silt loam; weak to moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 11 to 18 inches, dark-brown loam; weak to moderate, medium, subangular blocky structure; blocks are heavily coated with grayish-brown films; very friable when moist; strongly acid.
- 18 to 23 inches, dark yellowish-brown loam to clay loam; moderate, medium, angular blocky structure; many blocks are coated with grayish-brown films; firm when moist; strongly acid.
- 23 to 28 inches, dark yellowish-brown clay loam; strong, medium, angular blocky structure; very firm when moist; contains considerable gravel; strongly acid.
- 28 to 30 inches, brown to reddish-brown gravelly sandy clay loam; massive (structureless) to weak, coarse, angular blocky structure; firm when moist, weakly cemented when dry; strongly acid.

Substratum—
- 30 to 60 inches, reddish-brown gravelly sand; loose; contains many thin bands of dark-brown gravelly sandy clay loam that are massive (structureless) and weakly cemented; the number of these bands decreases with depth; medium acid.
- 60 inches +, yellowish-brown gravelly sand; single grain (structureless); loose; mildly calcareous.

The original surface soil had a thickness of 4 to 6 inches before it was plowed. The texture of the plow layer ranges from loam to silt loam. Pockets of gravel and cobblestones are present in the surface soil of the loam.

The texture of the subsoil ranges from loam to clay loam. The amount of gravel and cobblestones in the subsoil varies considerably from one place to another, but generally increases with depth. Several areas, however, have no gravel or cobblestones in the entire profile. The depth to the coarse textured to very coarse textured substratum ranges from 24 to 42 inches but is most commonly about 30 inches. In the substratum, the color ranges from yellowish red to light yellowish brown, and the texture ranges from sand to gravelly sandy loam. In some places a few pockets of loam or clay loam glacial till are in the substratum.

The calcareous material lies at a depth that ranges from 3 to 10 feet, but is generally between 5 and 6 feet. In a large area south of Wasioja, limestone bedrock underlies this soil at a depth of 6 to 10 feet.

Wykoff loam, 2 to 6 percent slopes, moderately eroded (WuB2) (Capability unit IIe–3).—This soil lies on undulating slopes on the upland. Most of it has lost from 25 to 50 percent of the original surface soil, and one small area is even more severely eroded. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and in a few places part of the subsoil. The profile is otherwise like that of Wykoff loam, 2 to 6 percent slopes. Very little of this soil has a silt loam texture.

The level of fertility, the quality of tilth, and the rate of infiltration of water have been moderately reduced by erosion. The hazard of further erosion is moderate.

Wykoff loam, 6 to 12 percent slopes (WuC) (Capability unit IIIe–3).—This soil is on rolling slopes on the upland. Most of it has lost less than 25 percent of the surface soil through erosion. Gravel and cobblestones are common in the plow layer. A few areas with a silt loam surface soil are included. With these exceptions, the profile is like that of Wykoff loam, 2 to 6 percent slopes.

This soil has a moderately severe hazard of erosion.

Wykoff loam, 6 to 12 percent slopes, moderately eroded (WuC2) (Capability unit IIIe–3).—This soil lies on rolling slopes on the upland. About 25 to 50 percent of the original surface soil has been removed by erosion from most areas. The remaining surface soil, the subsurface soil, and in a few places part of the subsoil have been mixed together in the plow layer. Pockets of gravel and cobblestones are common in the plow layer. A few small areas with a silt loam surface texture are included. The profile is otherwise like that of Wykoff loam, 2 to 6 percent slopes.

Erosion has moderately reduced the level of fertility, the quality of tilth, and the rate of infiltration of water. The hazard of further erosion is moderately severe.

Wykoff loam, 6 to 12 percent slopes, severely eroded (WuC3) (Capability unit IIIe–3).—This soil occupies rolling slopes on the upland. Most of it has lost from 50 to 75 percent of its original surface soil. Small areas have more severe erosion and a few shallow gullies. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. Gravel and cobblestones are very common in the plow layer. Except for these variations, the profile is like that of Wykoff loam, 2 to 6 percent slopes.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced by erosion.

Wykoff loam, 12 to 18 percent slopes, eroded (WuD2) (Capability unit IVe–1).—This soil is on hilly areas on the upland. Many areas have lost from 25 to 50 percent of the original surface soil, but some areas have lost less than 25 percent. In the more eroded areas, the plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil. Gravel and cobblestones are very common in the plow layer. In other respects, the profile is like that of Wykoff loam, 2 to 6 percent slopes.

The hazard of erosion is severe. The level of fertility, the quality of tilth, and the rate of infiltration of water have already been moderately reduced by erosion in many areas of this soil.

Wykoff loam, 12 to 18 percent slopes, severely eroded (WuD3) (Capability unit IVe–1).—This soil occupies hilly areas on the upland. Most areas have lost from 50 to 75 percent of the original surface soil through erosion, and the plow layer now consists of the remainder mixed with subsoil material. Gravel and cobblestones are common in the plow layer. The profile is otherwise like that of Wykoff loam, 2 to 6 percent slopes.

The level of fertility, the quality of tilth, and the rate of infiltration of water have already been severely reduced by erosion, and the hazard of further erosion is severe.

Wykoff soils, 2 to 6 percent slopes (WyB) (Capability unit IIIs–3).—These soils are on the upland, on undulating slopes. Most areas are less than 5 acres in size. In some areas the surface texture is loam, and in other areas it is sandy loam. The profile is like that of Wykoff soils, 2 to 6 percent slopes, moderately eroded, except that less than 25 percent of the surface soil has been lost from most areas. These soils differ from Wykoff loam, 2 to 6 percent slopes, chiefly in that they are only 12 to 24 inches deep over the coarse-textured substratum. The hazard of erosion is moderate.

Wykoff soils, 2 to 6 percent slopes, moderately eroded (WyB2) (Capability unit IIIs–3).—This mapping unit consists of Wykoff loam and Wykoff sandy loam on undulating slopes on the upland. The areas are rarely larger than 5 acres. Most of the area has lost from 25 to 50 percent of the original surface soil through erosion, and a small acreage is more severely eroded. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and part of the subsoil.

The fertility level, the quality of tilth, the rate of infiltration of water, and the available moisture holding capacity of these soils have been moderately reduced by erosion. The hazard of further erosion is moderate.

Profile of a shallow Wykoff loam in a cultivated field—

Surface soil—
- 0 to 7 inches, dark grayish-brown to grayish-brown loam; weak, thin, platy structure to weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; medium acid.

Subsurface soil—
- 7 to 9 inches, grayish-brown to light grayish-brown loam; weak to moderate, thin, platy structure; very friable when moist; medium acid.

Subsoil—
- 9 to 15 inches, dark yellowish-brown loam; weak to moderate, medium, subangular blocky structure; blocks are heavily coated with grayish-brown films; friable when moist; strongly acid.
- 15 to 18 inches, brown to reddish-brown gravelly loam to gravelly sandy clay loam; moderate, medium, subangular blocky structure; many blocks are coated with gray films; friable when moist; strongly acid.

Substratum—
- 18 to 60 inches, reddish-brown gravelly sand; loose; contains a few thin bands of dark-brown gravelly sandy clay loam that is massive (structureless) and weakly cemented; medium acid.
- 60 inches +, yellowish-brown gravelly sand; single grain (structureless); loose; mildly calcareous.

The original surface soil of the shallow areas of Wykoff loam was about 4 to 6 inches thick. The depth to the coarse textured to very coarse textured substratum ranges from 12 to 24 inches, but is most commonly 18 to 21 inches. The depth to calcareous material in the substratum ranges from 3 to 10 feet, but is generally about 5 to 6 feet.

The surface texture is gritty silt loam in a few places, gravelly loam in others, and loamy sand in several spots. Pockets of gravel and cobblestones are common. The subsoil ranges in texture from loam to clay loam. The colors in the substratum range from yellowish brown to reddish brown, and the dark-colored bands are not present in all places.

Part of this unit has a surface texture of sandy loam or gravelly sandy loam and a subsoil of loam, sandy loam, or gravelly loam, but the profile is otherwise similar to the one described. Some of it is free of gravel and cobblestones.

Wykoff soils, 6 to 12 percent slopes, eroded (WyC2) (Capability unit IVs–1).—These soils occupy rolling slopes on the upland. Most of this unit consists of shallow areas of Wykoff loam, but some areas of Wykoff sandy loam are included. About 25 to 50 percent of the original surface soil has been removed by erosion from most areas, and less than 25 percent from the others. The plow layer is a mixture of the remaining surface soil, the subsurface soil, and in a few places part of the subsoil. In a few areas the plow layer contains considerable amounts of gravel and cobblestones. With these exceptions, the profile is like that described under Wykoff soils, 2 to 6 percent slopes, moderately eroded.

The hazard of erosion is moderately severe. The level of fertility, the quality of tilth, and the available moisture holding capacity have already been moderately reduced.

Wykoff soils, 6 to 12 percent slopes, severely eroded (WyC3) (Capability unit IVs–1).—These soils are on rolling slopes on the upland. About half of the unit is Wykoff loam, and the rest is Wykoff sandy loam. Erosion has removed about 50 to 75 percent of the original surface soil, and the plow layer now consists of the remaining surface soil, the subsurface soil, and the subsoil. The plow layer contains a considerable amount of gravel and cobblestones in some areas. The profile is otherwise similar to that of Wykoff soils, 2 to 6 percent slopes, moderately eroded.

These soils have a moderately severe hazard of erosion. The level of fertility, the quality of tilth, and the available moisture holding capacity have already been severely reduced by erosion.

Wykoff and Thurston soils, 12 to 18 percent slopes, eroded (WzD2) (Capability unit VIs–1).—These soils lie in hilly areas on the upland. About half of the unit consists of Wykoff soils and about half of Thurston soils. Some soils have lost less than 25 percent of the original surface soil through erosion, but most of them have lost from 25 to 50 percent. The plow layer in the more eroded areas is a mixture of subsoil and the remaining surface soil. In some areas the plow layer contains considerable amounts of gravel and cobblestones. The Wykoff soils have a profile that is otherwise similar to that described under Wykoff soils, 2 to 6 percent slopes, moderately eroded. The Thurston soils have a profile similar to that of Thurston loam, 6 to 12 percent slopes, but the surface is more commonly sandy loam and the depth to gravel and sand is 15 to 18 inches.

The level of fertility, the quality of tilth, and the available moisture holding capacity have been moderately reduced by erosion, and the hazard of further erosion is severe.

Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded (WzD3) (Capability unit VIs-1).—These soils are in hilly areas on the upland. About half of the unit is Wykoff soils and about half is Thurston soils. Most areas have lost 50 to 75 percent of the original surface soil through erosion, and a few areas have lost more than 75 percent. The plow layer consists of the remaining surface soil and the subsoil. Some areas have a considerable amount of gravel and cobblestones in the plow layer. In other respects, the profile of the Wykoff soils is like that described for Wykoff soils, 2 to 6 percent slopes, moderately eroded. The profile of the Thurston soils is like that of Thurston loam, 6 to 12 percent slopes, except that the surface layer is more likely to be sandy loam and the depth to gravel and sand is 15 to 18 inches.

The hazard of further erosion is severe. The level of fertility, the quality of tilth, and the available moisture holding capacity have already been severely reduced by erosion.

Use and Management of Soils

This section has four main parts. The first explains the system the Soil Conservation Service uses to group soils according to their capability for agricultural uses and lists the capability units or management groups into which the soils of Dodge County can be placed. The second part lists the soils in each capability unit and suggests how each group of soils can be used and managed. The third part gives some general suggestions for management of soils used for pasture, woodland, wildlife shelter, or windbreaks and shelterbelts. The last part provides estimated yields of the principal crops on each soil.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, pasture, forests, and wildlife cover. It is a practical grouping based on the needs and limitations of the soils, on the risk of damage to them, and also on their response to management. There are three levels above the soil mapping unit in this classification. They are the class, the subclass, and the capability unit.

The broadest grouping, the land capability class, is identified by Roman numerals. All the soils in one class have limitations and management problems of about the same degree, but of different kinds, as shown by the subclass. All the land classes, except class I, may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops. More than 90 percent of the soils of Dodge County are in these classes.

Class I soils are those that have the widest range of use and the least risk of damage. They are level or 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 they do not have quite so wide a range of suitability as class I soils, and they need more care in management. Some class II soils are gently sloping and consequently need moderate care to prevent erosion. Other soils in class II may be slightly droughty, slightly wet, somewhat shallow, or somewhat limited in fertility.

Class III soils can be cropped regularly, but they have a narrower range of use than those in classes I and II. They need even more careful management.

In class IV are soils that have greater natural limitations than those in class III. They can be cultivated for some crops 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 can be used for pasture, for woodland, or for wildlife shelter.

Class V soils are nearly level or gently sloping. They are not likely to erode, but they have limitations of wetness, low fertility, or other problems that make them unsuitable for cultivation. There are no class V soils in Dodge County.

Class VI soils are not generally suitable for crops, because they are steep, droughty, or otherwise limited. Some soils in class VI can, without damage, be cultivated enough so that trees can be set out or special perennial crops or pastures can be seeded.

Class VII soils are severely limited. The soils have characteristics that restrict their use mainly to pasture and, in some places, to woodland.

Class VIII soils have practically no agricultural use. Some areas have value for watershed protection, wildlife shelter, or recreation. There are no class VIII soils in Dodge County.

The capability subclass is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained. The symbol "w" means that excess water retards plant growth or interferes with cultivation. The symbol "s" shows that the soils are shallow, droughty, or unusually low in fertility.

The capability unit, which can also be called a management group of soils, is the lowest level of capability grouping. A capability unit is made up of soils that are similar in kind of management needed, in risk of damage, and in general suitability for use. The capability units within each subclass are numbered.

The capability classes, subclasses, and units in Dodge County are as follows:

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

Unit I-1.—Deep, nearly level, well drained to moderately well drained, dark colored to moderately dark colored, medium-textured soils.

Unit I-2.—Deep, nearly level, well-drained, light-colored, medium-textured soils.

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

Subclass IIe.—Soils that have a moderate hazard of erosion if they are not protected.

Unit IIe-1.—Deep, gently sloping, well drained to moderately well drained, dark colored to moderately dark colored, medium-textured soils.

Unit IIe-2.—Deep, gently sloping, well drained to moderately well drained, light-colored, medium-textured soils.

Unit IIe-3.—Moderately deep, gently sloping, well drained to moderately well drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock or coarse-textured material.

Subclass IIw.—Soils that are moderately limited by excess water.

Unit IIw-1.—Deep, nearly level, poorly drained to somewhat poorly drained, dark-colored, moderately fine textured soils.

Unit IIw-2.—Deep, gently sloping, poorly drained to somewhat poorly drained, dark-colored, moderately fine textured soil.

Unit IIw-3.—Moderately deep, nearly level, somewhat poorly drained, dark-colored, moderately fine textured soil underlain at depths of 24 to 42 inches by sand and gravel.

Unit IIw-4.—Deep, nearly level, somewhat poorly drained to well drained, medium-textured soils on bottom lands and in waterways.

Unit IIw-5.—Deep, gently sloping, well drained to moderately well drained, medium-textured soils in waterways.

Subclass IIs.—Soils that have a slight hazard of drought.

Unit IIs-1.—Moderately deep, nearly level, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock or coarse-textured material.

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

Subclass IIIe.—Soils that can be cultivated safely if protected from erosion.

Unit IIIe-1.—Deep, moderately sloping, well-drained, medium-textured soils.

Unit IIIe-2.—Moderately deep, moderately sloping, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock.

Unit IIIe-3.—Moderately deep, moderately sloping, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by coarse-textured materials.

Subclass IIIw.—Soils that have serious problems of wetness.

Unit IIIw-1.—Deep, nearly level, somewhat poorly drained, medium-textured soils.

Unit IIIw-2.—Moderately deep, nearly level, somewhat poorly drained, medium-textured soil underlain at depths of 24 to 42 inches by sand and gravel.

Unit IIIw-3.—Deep, gently sloping, somewhat poorly drained, medium-textured soil.

Unit IIIw-4.—Deep, nearly level, very poorly drained, moderately fine textured soils.

Unit IIIw-5.—Moderately deep, nearly level, poorly drained to very poorly drained, moderately fine textured soils underlain at depths of 24 to 42 inches by sand and gravel.

Unit IIIw-6.—Deep to moderately deep, level peat and muck soils over medium-textured to fine-textured materials.

Unit IIIw-7.—Deep to moderately deep, level peat and muck soils over coarse-textured materials.

Subclass IIIs.—Droughty and slightly droughty soils that are subject to wind or water erosion.

Unit IIIs-1.—Shallow, nearly level, well-drained, moderately coarse textured and medium textured soils underlain at depths of 12 to 24 inches by sand or gravel.

Unit IIIs-2.—Shallow, gently sloping, well-drained, dark colored to moderately dark colored, medium textured and moderately coarse textured soils underlain at depths of 12 to 24 inches by sand and gravel or bedrock.

Unit IIIs-3.—Shallow, gently sloping, well-drained, light-colored, medium-textured soils underlain at depths of 12 to 24 inches by sand and gravel or bedrock.

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

Subclass IVe.—Soils that have a severe hazard of erosion if not protected.

Unit IVe-1.—Deep and moderately deep, moderately steep, well-drained, moderately dark colored to light colored, medium-textured soils.

Subclass IVs.—Soils that have a moderately severe hazard of drought and a moderately severe hazard of erosion.

Unit IVs-1.—Shallow, moderately sloping and rolling, well-drained, light colored to moderately dark colored, moderately coarse textured to medium textured soils underlain at depths of 12 to 24 inches by coarse materials or bedrock.

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

Subclass VIe.—Soils that have a very severe hazard of erosion.

Unit VIe-1.—Deep and moderately deep, steep, well-drained, light-colored, medium-textured soils.

Subclass VIw.—Soils that have a severe hazard of flooding or a severe wetness hazard.

Unit VIw-1.—Miscellaneous, frequently flooded, occasionally moderately droughty soils on bottom lands and in waterways.

Unit VIw–2.—Deep, gently sloping, very poorly drained, dark-colored, moderately fine textured soils and peat and muck soils.

Subclass VIs.—Soils that have a moderately severe hazard of drought and a severe hazard of erosion.

Unit VIs–1.—Shallow, moderately steep to hilly, well-drained, moderately dark colored to light colored, medium textured to moderately coarse textured soils underlain at depths of 12 to 24 inches by coarse materials or bedrock.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and restrict their use largely to pasture, woodland, and wildlife shelter.

Subclass VIIe.—Soils that have a severe to very severe hazard of erosion.

Unit VIIe–1.—Steep to very steep soils that are subject to severe erosion and rough broken and stony land that is very shallow over bedrock or coarse materials.

Capability Units

Each of the capability units in Dodge County is discussed in the following pages. The characteristics and suitabilities of the soils in each unit and also some suggestions for management are given. The crop rotations mentioned are given only as examples; they are not the only rotations suitable for the soils in the unit.

Capability unit I–1

Deep, nearly level, well drained to moderately well drained, dark colored to moderately dark colored, medium-textured soils

The soils in this unit are—

- Downs silt loam, 0 to 2 percent slopes.
- Kenyon silt loam, 0 to 2 percent slopes.
- Ostrander silt loam, 0 to 2 percent slopes.
- Racine silt loam, 0 to 2 percent slopes.
- Tama silt loam, 0 to 2 percent slopes.
- Waukegan silt loam, deep, 0 to 2 percent slopes.
- Waukegan silt loam, thick surface variant, 0 to 2 percent slopes.

These are very good soils for cultivation. All crops suitable for this climate can be successfully grown on them. There are no hazards of erosion, drought, or poor drainage.

If enough fertilizer is applied and all crop residues are returned, these soils can be used for row crops as often as 4 years out of 6. A suitable rotation consists of row crops for 4 years, a small grain, and meadow. Another good rotation is row crops for 3 years, a small grain, and meadow. Another is row crops for 2 years, a small grain, and meadow for 2 years. Where livestock are raised and there is considerable need for hay and pasture, a good rotation consists of a row crop, a small grain, and meadow.

Unless they have recently been limed, all of these soils except Waukegan silt loam, thick surface variant, 0 to 2 percent slopes, need lime. In most places moderate amounts of phosphate and potash are needed. Soil tests should be made to determine lime and fertilizer needs accurately.

It may be necessary to remove a few stones from the Kenyon, Ostrander, and Racine soils.

Capability unit I–2

Deep, nearly level, well-drained, light-colored, medium-textured soils

The soils in this unit are—

- Fayette silt loam, 0 to 2 percent slopes.
- Renova silt loam, 0 to 2 percent slopes.

These soils are very good for cultivation. All crops suitable for the climate can be grown on them. There are no hazards of erosion, poor drainage, or drought, but the fertility is slightly limited.

These soils can be used for row crops 3 years out of 5 if enough fertilizer is applied and all crop residues are returned. A good rotation consists of row crops for 3 years, a small grain, and meadow. Other suitable rotations are the following: Row crops for 2 years, a small grain, and meadow; or row crops for 2 years, a small grain, and meadow for 2 years; or a row crop, a small grain, and meadow.

These soils should be tested to determine the needs for lime and fertilizer. They generally need lime if they have not been limed recently. Except where good rotations have been used, the content of organic matter should be increased by heavy applications of manure or by growing legumes and grasses for a larger proportion of the time. Moderate amounts of phosphate and potash are generally needed.

It may be necessary to remove a few stones from the Renova soils.

Capability unit IIe–1

Deep, gently sloping, well drained to moderately well drained, dark colored to moderately dark colored, medium-textured soils

The soils in this unit are—

- Downs silt loam, 2 to 6 percent slopes.
- Downs silt loam, 2 to 6 percent slopes, moderately eroded.
- Kenyon silt loam, 2 to 6 percent slopes.
- Kenyon silt loam, 2 to 6 percent slopes, moderately eroded.
- Ostrander silt loam, 2 to 6 percent slopes.
- Ostrander silt loam, 2 to 6 percent slopes, moderately eroded.
- Racine silt loam, 2 to 6 percent slopes.
- Racine silt loam, 2 to 6 percent slopes, moderately eroded.
- Tama silt loam, 2 to 6 percent slopes.
- Tama silt loam, 2 to 6 percent slopes, moderately eroded.

These are good soils for cultivation, and all crops suitable for this climate can be successfully grown. The hazard of erosion is moderate. Some of these soils have already lost 25 to 50 percent of their original surface soil through erosion.

Special management is needed to control erosion. Contour farming, stripcropping, or terracing will provide control if used with a good rotation, enough fertilizer, and good management of crop residues (fig. 8).

For the following suggestions, an average slope gradient of 4 percent and an average slope length of 250 feet are assumed.

If the soils are not contoured, terraced, or stripcropped, they can be used for row crops no oftener than 1 year out of 3. A typical rotation consists of a row crop, a small grain, and meadow. Another is a row crop, a small grain, a row crop, a small grain, and meadow for 2 years. A row crop, a small grain, and meadow for 2 years is also acceptable.

Figure 8.—**Contour stripcropping on Kenyon silt loam and Ostrander silt loam.**

If crops are planted on the contour, these soils can be used for row crops up to 2 years out of 5. A suitable rotation consists of row crops for 2 years, a small grain, and meadow for 2 years.

Stripcropping provides adequate erosion control for a rotation consisting of a row crop, a small grain, and meadow for 2 years. Row crops for 2 years, a small grain, and meadow for 2 years is also suitable. The strips are normally 100 feet wide.

Terracing makes it possible to grow row crops up to 3 years out of 5. A good rotation consists of row crops for 3 years, a small grain, and meadow. Graded terraces rather than level terraces should be used.

These soils should be tested to determine needs for lime and fertilizer. Except where they have been recently limed, practically all of them need lime. Moderate applications of phosphate and potash are generally needed. The content of organic matter in the moderately eroded soils needs to be increased frequently by heavy applications of manure or by growing legumes and grasses more of the time.

A few stones should be removed from the Kenyon, Ostrander, and Racine soils. Drainage is not a problem.

Capability unit IIe-2

Deep, gently sloping, well drained to moderately well drained, light-colored, medium-textured soils

The soils in this unit are—

Fayette silt loam, 2 to 6 percent slopes.
Fayette silt loam, 2 to 6 percent slopes, moderately eroded.
Kasson silt loam, 2 to 6 percent slopes.
Kasson silt loam, 2 to 6 percent slopes, moderately eroded.
Racine soils, 2 to 6 percent slopes, severely eroded.
Renova silt loam, 2 to 6 percent slopes.
Renova silt loam, 2 to 6 percent slopes, moderately eroded.
Renova soils, 2 to 6 percent slopes, severely eroded.
Seaton silt loam, 2 to 6 percent slopes.
Seaton silt loam, 2 to 6 percent slopes, moderately eroded.
Vlasaty silt loam, 2 to 6 percent slopes.
Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded.

Erosion control measures are needed on the soils in this group. Where the slopes are uneven and irregular, contour farming may not always be practical. On such slopes, erosion can be controlled by using an adequate rotation supplemented by plow planting of row crops, heavy fertilization, and good management of crop residues. Row crops should be grown no more than 1 year out of 5. An adequate rotation would consist of a row crop for 1 year, a small grain for 1 year, and meadow for 3 years.

If the slopes are contoured, the soils of this group may be used for row crops 2 years out of 5. A typical rotation would be row crops for 2 years, a small grain, and legume-grass meadow for 2 years.

If the slopes are terraced, these soils may be used for row crops 3 years out of 5. A typical rotation would be 3 years of corn followed by 1 year of small grain and 1 year of meadow.

If the slopes are stripcropped, the rotation for contoured slopes may be used. However, this 5-year rotation is not as desirable as a 4-year rotation consisting of a row crop, a small grain, and 2 years of meadow. In the 4-year rotation, alternate strips should be in hay to provide more effective erosion control. On these slopes, 100 feet is the normal width of strips.

For the above recommendations, an average gradient of 4 percent and an average slope length of 200 feet are assumed.

Unless these soils have been recently limed, all of them need lime. Moderate applications of phosphate and potash are also needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations including more legumes and grasses will add organic matter.

Capability unit IIe-3

Moderately deep, gently sloping, well drained to moderately well drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock or coarse-textured material

The soils in this unit are—

Bixby loam, 2 to 6 percent slopes, eroded.
Hayfield silt loam, 2 to 6 percent slopes.
Rockton silt loam, moderately deep, 2 to 6 percent slopes.
Thurston loam, 2 to 6 percent slopes, moderately eroded.
Thurston loam, 2 to 6 percent slopes, severely eroded.
Thurston and Dickinson loams, 2 to 6 percent slopes.
Waukegan silt loam, 2 to 6 percent slopes.
Waukegan silt loam, 2 to 6 percent slopes, moderately eroded.
Whalan silt loam, moderately deep, 2 to 6 percent slopes.
Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded.
Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded.
Wykoff loam, 2 to 6 percent slopes.
Wykoff loam, 2 to 6 percent slopes, moderately eroded.

These soils have a moderate erosion hazard and a slight to moderate hazard of drought. They have lower moisture supplying capacity than the soils in capability unit IIe-2 and give lower yields. Erosion control measures are needed. Where the slopes are uneven and irregular, as they commonly are on Thurston and Wykoff soils, contour farming may not be practical. On such slopes, erosion can be controlled by using an adequate rotation supplemented by plow planting of row crops, heavy fertilization, and return of all crop residues to the soil. Row crops should be grown no more than 1 year out of 5. An adequate rotation would be a row crop for 1 year, a small grain for 1 year, and meadow for 3 years. If less intensive management is practiced, the rotation ought to be a row crop for 1 year, a small grain for 1 year, and meadow for 4 years.

For the following suggestions, an average gradient of 4 percent and an average slope length of 150 feet are assumed. The second of the suggested rotations is safer for these soils, in the long run.

If the slopes are contoured, the soils of this group may be used for row crops 2 years out of 5. A typical rotation would be row crops for 2 years, a small grain for 1 year, and meadow for 2 years. Another suitable rotation is a row crop for 1 year, a small grain for 1 year, and meadow for 1 year.

If the slopes are terraced, these soils may be used for row crops 3 years out of 5. A suitable rotation is row crops for 3 years, a small grain for 1 year, and meadow for 1 year. A safer rotation for these soils is row crops for 2 years, a small grain for 1 year, and meadow for 1 year.

If the slopes are stripcropped, these soils may be used for row crops 2 years out of 5. A suitable rotation is row crops for 2 years, a small grain for 1 year, and meadow for 2 years. This 5-year rotation is not as desirable as a 4-year rotation consisting of a row crop for 1 year, a small grain for 1 year, and meadow for 2 years. In the 4-year rotation, alternate strips should be in meadow, to provide more effective erosion control. On these slopes the normal width of the strips is 100 feet.

Unless these soils have been recently limed, all of them need lime. Moderate applications of phosphate and potash are also needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter.

Capability unit IIw-1

Deep, nearly level, poorly drained to somewhat poorly drained, dark-colored, moderately fine textured soils

The only soils in this unit are—

Floyd and Clyde silty clay loams.

These soils need drainage. Substantial increases in yields can be expected after adequate drainage. Tile lines should be placed 90 to 100 feet apart and 42 to 48 inches deep.

Figure 9.—Floyd and Clyde silty clay loams drained by tile drainage system and by grassed waterway, both emptying into drop box inlet structure just beyond road bridge in right foreground.

Open ditches are needed in places, to provide outlets for the drainage systems. The width, depth, and grade of the ditches will vary, depending on the size and nature of the watershed. The minimum bottom width is 4 feet. The side slopes should be 2 to 1. Drop box inlet structures are needed where waterways terminate in a roadside ditch or a drainage ditch (fig. 9).

When these soils are adequately drained and fertilized and all crop residues are returned, row crops can be grown 4 years out of 6.

A suitable rotation would be row crops for 4 years, a small grain for 1 year, and meadow for 1 year. Other good rotations are the following: Row crops for 3 years, a small grain for 1 year, and meadow for 1 year; or row crops for 3 years, a small grain for 1 year, and meadow for 2 years; or 1 year each of a row crop, a small grain, and meadow.

If these soils are not adequately drained, alfalfa and canning peas should not be grown.

These soils should be fall plowed to insure getting a good seedbed in spring. They should not be plowed when wet, because the clods that form are difficult to break up.

These soils may or may not need lime. Moderately large amounts of phosphate and potash are usually needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. As these soils tend to be somewhat wet and cold in the spring, starter fertilizers should include nitrogen, which helps to assure rapid initial growth of crops.

Capability unit IIw-2

Deep, gently sloping, poorly drained to somewhat poorly drained, dark-colored, moderately fine textured soil

The only soil in this unit is—

Floyd silty clay loam, 2 to 6 percent slopes.

This soil needs drainage for best crop production. Substantial increases in yields can be expected after adequate drainage. Tile lines should be placed 90 to 100 feet apart and 42 to 48 inches deep (fig. 10).

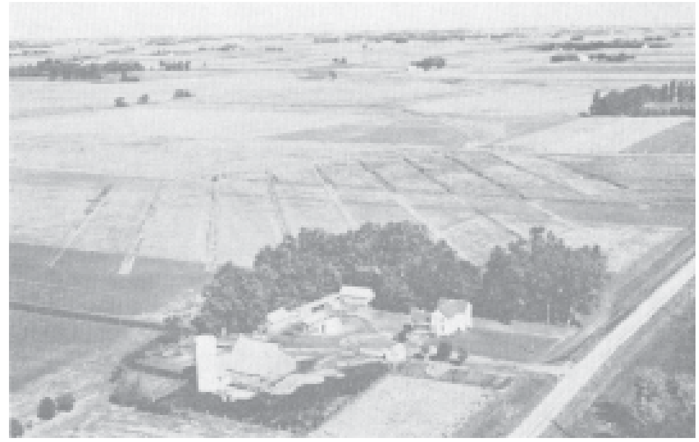

***Figure 10.*—Tile drainage system being laid out in a large area of Floyd silty clay loam, 2 to 6 percent slopes. Tile lines are 100 feet apart.**

Waterways can be used in some places to remove surface water. The design will vary, depending on the size and nature of the drainage area. The minimum width is 1 rod, and the minimum depth is 1 foot.

Where the slopes are 300 feet long or more, strips or terraces are necessary to prevent erosion. Both strips and terraces should have a slight grade. Diversion terraces can be built around the upper rim of this sloping soil to divert surface water that runs off adjoining higher lands.

Drop box inlet structures are needed where waterways and terrace outlets terminate in a roadside ditch or a drainage ditch.

If this soil is not contoured, terraced, or stripcropped, it should be farmed with a 4-year rotation consisting of a row crop for 1 year, a small grain for 1 year, and 2 years of meadow. With heavy fertilization and the return of all crop residues, row crops could be grown 2 years out of 5.

If this soil is adequately drained, fertilized, and contoured, and all crop residues are returned, row crops can be grown 2 years out of 4. A suitable rotation would consist of row crops for 2 years, a small grain for 1 year, and meadow for 1 year.

If this soil is stripcropped, it should be farmed with the same rotation as surrounding higher land, or else with a rotation consisting of row crops for 2 years, a small grain for 1 year, and meadow for 2 years.

If this soil is terraced, adequately drained, and heavily fertilized and all crop residues are returned, row crops can be grown 4 years out of 6. A suitable rotation is row crops for 4 years, a small grain for 1 year, and meadow for 1 year.

This soil should be fall plowed to insure getting a good seedbed in spring. It should not be plowed when wet, because the clods that form are difficult to break up. Unless drained, it is not suitable for alfalfa or canning peas.

This soil may or may not need lime. Moderately high amounts of phosphate and potash are usually needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. As this soil tends to be somewhat wet and cold in the spring, starter fertilizers should include nitrogen, which helps to assure rapid initial growth of crops.

Capability unit IIw-3

Moderately deep, nearly level, somewhat poorly drained, dark-colored, moderately fine textured soil underlain at depths of 24 to 42 inches by sand and gravel

The only soil in this unit is—

Kato silty clay loam.

This soil needs drainage for best crop production. Substantial increases in yields can be expected after adequate drainage, but the soil may be slightly droughty in dry years. Tile lines may be spaced as much as 200 feet apart and may be no more than 36 inches below the surface.

Open ditches are needed in places to provide outlets for the drainage systems. The width, depth, and grade of the ditches will vary, depending on the size and nature of the watershed. The minimum bottom width is 4 feet. Side slopes should be 1 to 1.

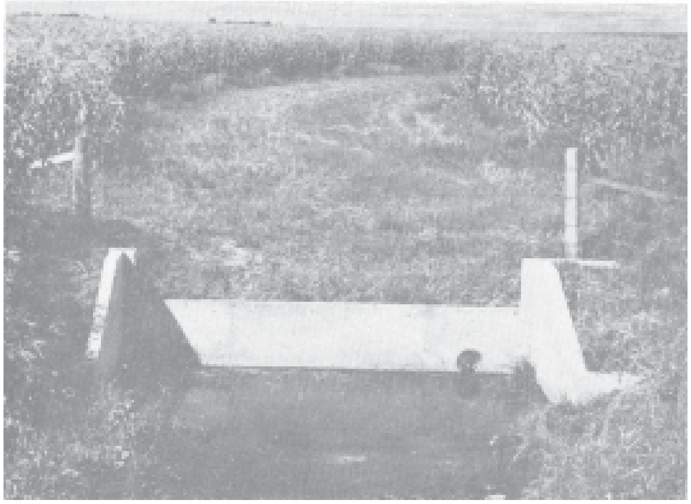

Figure 11.—**Drop box inlet structure that provides a safe outlet for runoff from the grassed waterway above and for the two outlets of a tile system.**

Drop box inlet structures are needed where waterways and terrace outlets terminate in a roadside ditch or drainage ditch (fig. 11).

If this soil is adequately drained and fertilized and all crop residues are returned, row crops can be grown 4 years out of 6. A suitable rotation would be row crops for 4 years, a small grain for 1 year, and meadow for 1 year. Other good rotations are the following: Row crops for 3 years, a small grain for 1 year, and meadow for 1 year; or row crops for 3 years, a small grain for 1 year, and meadow for 2 years; or 1 year each of a row crop, a small grain, and meadow.

This soil should be fall plowed to insure getting a good seedbed in the spring. It should not be plowed when wet, because the clods that form are difficult to break up. Unless adequately drained, it is not suitable for alfalfa or canning peas.

This soil may or may not need lime. Moderately large amounts of phosphate and potash are usually needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. As this soil tends to be somewhat wet and cold in the spring, starter fertilizers should include nitrogen to get crops off to a rapid initial growth.

Capability unit IIw-4

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

The soils in this unit are—

Alluvial land.
Chaseburg silt loam, 0 to 2 percent slopes.
Judson silt loam, 0 to 2 percent slopes.
Lawson and Orion silt loams.

All of these soils have a moderate flood hazard. Occasional floods depress yields of all crops. Lodging of oats is often a problem. Late-maturing crops are occasionally damaged by frost.

If these soils are adequately fertilized and all crop residues are returned, row crops can be grown 4 years out of 6. A suitable rotation would be row crops for 4 years, a small grain for 1 year, and meadow for 1 year. Frequently, the Judson and Chaseburg soils are farmed with the rotations used on the surrounding land.

These soils can be protected from occasional floods by dikes or by flood control measures farther up the watershed. Each area must be judged to see if the cost of preventing an occasional flood is justified.

These soils seldom need lime. Nitrogen, phosphate, and potash requirements are moderate to low because of the fertility of the sediment left by floods. The Chaseburg soil needs somewhat more fertilizer than the other soils in this group. Lime, phosphate, and potash should be applied in accordance with soil tests.

Although the Lawson and Orion soils are somewhat poorly drained and occasionally have a high water table, tile drainage is not recommended because of lack of suitable outlets.

Waterways are normally needed to carry water through areas of these soils. Specifications will vary, depending on the grade of the waterway and the size and nature of the watershed. The minimum width is 1 rod, and the minimum depth is 1 foot. Streambank stabilization is needed where a river or creek adjoins, or makes sharp turns into, areas of these soils.

Capability unit IIw-5

Deep, gently sloping, well drained to moderately well drained, medium-textured soils in waterways

The soils in this unit are—

Chaseburg silt loam, 2 to 6 percent slopes.
Judson silt loam, 2 to 6 percent slopes.

These soils have a moderate flood hazard. Occasional floods depress yields of all crops. Lodging of oats is often a problem. Late-maturing crops are occasionally damaged by frost.

Grassed waterways should be established and maintained through these sloping soils. Specifications will vary, depending on the grade and the size and nature of the watershed. The minimum width is 1 rod, and the minimum depth is 1 foot. Flood damage can be reduced by controlling erosion on adjacent soils and by channeling excess water through grassed waterways. Rotations identical to those used on surrounding slopes should be used on the part of these soils not used for waterways.

These soils seldom need lime. Nitrogen, phosphate, and potash requirements are moderate to low because of the fertility of the sediment left by floods. The Chaseburg soil needs somewhat more fertilizer than the Judson soil. Lime, phosphate, and potash should be applied in accordance with soil tests.

Capability unit IIs-1

Moderately deep, nearly level, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock or coarse-textured material

The soils in this unit are—

Bixby loam, 0 to 2 percent slopes.
Hayfield silt loam, 0 to 2 percent slopes.

Kasson silt loam, 0 to 2 percent slopes.[1]
Rockton silt loam, moderately deep, 0 to 2 percent slopes.
Thurston and Dickinson loams, 0 to 2 percent slopes.
Vlasaty silt loam, 0 to 2 percent slopes.[1]
Waukegan silt loam, 0 to 2 percent slopes.
Wykoff loam, 0 to 2 percent slopes.

These soils can be used for row crops 3 years out of 5 if they are adequately fertilized and if all crop residues are returned. An example of a suitable rotation is row crops for 3 years, a small grain for 1 year, and meadow for 1 year. Other good rotations for these soils are the following: Row crops for 2 years, a small grain for 1 year, and meadow for 2 years; 1 year each of a row crop, a small grain, and meadow; or a row crop for 1 year, a small grain for 1 year, and meadow for 2 years.

These soils can be either fall or spring plowed. If they are spring plowed, it is suggested that plow planting be used to reduce the number of equipment trips across the field and prevent soil compaction.

Unless these soils have been recently limed, all of them need lime. Moderate applications of phosphate and potash are also needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter.

Capability unit IIIe-1

Deep, moderately sloping, well-drained, medium-textured soils

The soils in this unit are—

Downs silt loam, 6 to 12 percent slopes, moderately eroded.
Downs silt loam, 6 to 12 percent slopes, severely eroded.
Fayette silt loam, 6 to 12 percent slopes.
Fayette silt loam, 6 to 12 percent slopes, moderately eroded.
Fayette silt loam, 6 to 12 percent slopes, severely eroded.
Ostrander silt loam, 6 to 12 percent slopes, moderately eroded.
Racine silt loam, 6 to 12 percent slopes.
Racine silt loam, 6 to 12 percent slopes, moderately eroded.
Racine soils, 6 to 12 percent slopes, severely eroded.
Renova silt loam, 6 to 12 percent slopes.
Renova silt loam, 6 to 12 percent slopes, moderately eroded.
Renova soils, 6 to 12 percent slopes, severely eroded.
Seaton silt loam, 6 to 12 percent slopes.
Seaton silt loam, 6 to 12 percent slopes, moderately eroded.
Seaton silt loam, 6 to 12 percent slopes, severely eroded.

These soils have a moderately severe erosion hazard, and erosion control measures are necessary. Contour cultivation, contour strips, or terraces, combined with adequate rotations, fertilization, and residue management, can provide the necessary control. For the following recommendations, an average gradient of 8 percent and an average slope length of 200 feet are assumed. On steeper or longer slopes, additional meadow in the rotation is required to hold soil losses to safe limits.

If terraced, these soils can be used for row crops up to 2 years out of 4. A typical rotation would consist of row crops for 2 years, a small grain for 1 year, and meadow for 1 year.

If crops are planted on the contour, row crops should be grown no more than 1 year out of 5. A typical rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 3 years.

For fields that are stripcropped, a typical rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 2 years. Alternate strips should be in meadow. The usual width of the strips is 80 to 90 feet.

If these soils are farmed without contouring, stripcropping, or terracing, they should not be used for row crops. With plow planting, row crops may be grown 1 year out of 6. A suitable rotation would consist of a row crop for 1 year, a small grain for 1 year, and meadow for 4 years.

Grassed waterways are needed wherever water collects and for terrace outlets. Specifications will vary, depending on the grade of the waterway and the size and nature of the watershed. The minimum width is 1 rod, and the minimum depth is 1 foot.

Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Unless these soils have been recently limed, all except the Seaton soils usually need lime. Adequate lime is usually present just below the subsoil in the Seaton soils; consequently, they are excellent soils for legumes. Moderate applications of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Manure should be applied to eroded areas and terrace channels first. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter. Soybeans are not suited to these soils.

Capability unit IIIe-2

Moderately deep, moderately sloping, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by bedrock

The soils in this unit are—

Rockton silt loam, moderately deep, 6 to 12 percent slopes.
Whalan silt loam, moderately deep, 6 to 12 percent slopes.
Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded.
Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded.

These soils have a moderately severe erosion hazard and a slight to moderate hazard of drought. If not contoured, stripcropped, or terraced, they should not be used for row crops. Plow planting, heavy fertilization, and return of all crop residues would make it possible to use these soils for row crops 1 year out of 6. A suitable rotation would be a row crop for 1 year, a small grain for 1 year, and meadow for 4 years.

For the following recommendations, an average slope of 10 percent and an average slope length of 200 feet are assumed.

If these soils are farmed on the contour, they can be used for row crops 1 year out of 6. A typical rotation is a row crop for 1 year, a small grain for 1 year, and meadow for 4 years.

If these soils are stripcropped, the rotation should be half meadow. The most common rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow

[1] Deep soils over glacial till.

for 2 years. Alternate strips should be in meadow. The usual width of the strips is 80 to 90 feet.

If these soils are terraced, they can be used for row crops 1 year out of 3. A suitable rotation is 1 year each of a row crop, a small grain, and meadow.

Grassed waterways are needed wherever water collects and for terrace outlets. Specifications will vary, depending on the grade of the waterway and the size and nature of the watershed. The minimum width is 1 rod, and the minimum depth is 1 foot.

Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Unless these soils have been recently limed, all of them usually need lime. Moderate applications of phosphate and potash are usually needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Manure should be applied to eroded spots and terrace channels first. Unless good rotations have been used, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter. Soybeans are not suited to these soils.

Capability unit IIIe-3

Moderately deep, moderately sloping, well-drained, medium-textured soils underlain at depths of 24 to 42 inches by coarse-textured materials

The soils in this unit are—

- Thurston loam, 6 to 12 percent slopes.
- Thurston loam, 6 to 12 percent slopes, moderately eroded.
- Thurston loam, 6 to 12 percent slopes, severely eroded.
- Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded.
- Wykoff loam, 6 to 12 percent slopes.
- Wykoff loam, 6 to 12 percent slopes, moderately eroded.
- Wykoff loam, 6 to 12 percent slopes, severely eroded.

These soils have a moderately severe erosion hazard and a moderate hazard of drought. Because of uneven and irregular slopes in some areas, contour strips, terraces, or contour cultivation may not always be practical. Adequate rotations, fertilization, and crop-residue management can provide the necessary control in these instances.

If these soils are not farmed on the contour, stripcropped, or terraced, they should not be used for row crops. Plow planting, heavy fertilization, and return of all crop residues would make it possible to grow row crops 1 year out of 6. A suitable rotation would consist of a row crop for 1 year, a small grain for 1 year, and meadow for 4 years.

For the following recommendations, an average slope of 8 percent and an average slope length of 100 feet are assumed.

If these soils are farmed on the contour, they can be used for row crops 1 year out of 5. A typical rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 3 years.

If these soils are stripcropped, the rotation should be half meadow. The most common rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 2 years. Alternate strips should be in meadow. The strips are normally 80 to 90 feet wide.

If these soils are terraced, they can be used for row crops 2 years out of 5. A suitable rotation is row crops for 2 years, a small grain for 1 year, and meadow for 2 years.

Grassed waterways are needed wherever water collects and for terrace outlets. Specifications will vary, depending on the grade of the waterway and the size and nature of the watershed. The minimum width is 1 rod, and the minimum depth is 1 foot.

Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Unless these soils have been recently limed, all of them usually need lime. Moderate applications of phosphate and potash are usually needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Manure should be applied to eroded spots and terrace channels first. Unless good rotations have been used, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter. Soybeans are not suited to these soils.

Capability unit IIIw-1

Deep, nearly level, somewhat poorly drained, medium-textured soils

The soils in this unit are—

- Sargeant silt loam, 0 to 2 percent slopes.
- Skyberg silt loam, 0 to 2 percent slopes.

These soils have moderate drainage problems and moderately severe fertility limitations. Much of the Sargeant soil and some of the Skyberg are still wooded.

Although these soils are somewhat poorly drained, only small increases in yields are obtained by draining them. Because of the dense, firm substratum, tile should be placed 42 to 48 inches deep and 60 to 80 feet apart. This close spacing is expensive, and the substratum sometimes prevents drainage even at close spacing. Therefore, draining large areas is not economically feasible at the present time. Draining small areas of these soils along with areas of Floyd soils is usually feasible.

Both the Sargeant and the Skyberg soils occupy a slightly higher position on the landscape than the adjoining Floyd soils, so some surface drainage can be obtained. Waterways or very shallow open ditches will remove surface water.

If these soils are adequately limed and fertilized and all crop residues are returned, row crops can be grown up to 2 years out of 4. A typical rotation would be row crops for 2 years, a small grain for 1 year, and meadow for 1 year; or 1 year each of a row crop, a small grain, and meadow.

It is best to plow these soils in fall to insure getting a good seedbed in spring and to avoid plowing when the soil is too wet.

These are the most acid soils in the county. Lime is needed unless heavy applications have recently been made. Moderately high amounts of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Since the surface soils are thin, frequent applications of manure or commercial nitrogen should be made.

Capability unit IIIw-2

Moderately deep, nearly level, somewhat poorly drained, medium-textured soil underlain at depths of 24 to 42 inches by sand and gravel

The only soil in this unit is—

Udolpho silt loam.

This soil has a moderate drainage problem and a moderately severe fertility limitation. If adequately drained it may be slightly droughty in dry years. Some of it is still wooded.

Drainage is feasible, although the increase in yields may be less than can be expected from draining the Floyd or Kato soils. Tile lines can be spaced up to 200 feet apart and should be 36 to 42 inches deep. The spacing will vary somewhat, depending on the type of sand under this soil.

Some improvement in drainage can be obtained by using grassed waterways or very shallow open ditches to remove surface water.

If this soil is adequately limed and fertilized and all crop residues are returned, row crops can be grown up to 2 years out of 4. A suitable rotation would consist of row crops for 2 years, a small grain for 1 year, and meadow for 1 year; or 1 year each of a row crop, a small grain, and meadow.

Fall plowing is best for this soil, to insure getting a good seedbed in spring and to avoid plowing when the soil is too wet.

This is one of the most acid soils in the county. Lime is needed unless heavy applications have been made recently. Moderately large amounts of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Since the surface layer is thin, frequent applications of manure or commercial nitrogen should be made also.

Capability unit IIIw-3

Deep, gently sloping, somewhat poorly drained, medium-textured soil

The only soil in this unit is—

Skyberg silt loam, 2 to 6 percent slopes.

This soil has a moderate drainage problem and a moderately severe fertility limitation. Some of it is still wooded.

Because of the dense, firm substratum, tile should be placed 42 to 48 inches deep and 60 to 80 feet apart. This close spacing is expensive, and the substratum sometimes prevents drainage even at close spacing. Drainage is not considered economically feasible, although a line here and there to drain a low spot may be beneficial. Surface drainage can be improved by using grassed waterways or very shallow open ditches to remove surface water.

If this soil is adequately limed and fertilized and all crop residues are returned, row crops can be grown 2 years out of 5. A typical rotation is row crops for 2 years, a small grain for 1 year, and meadow for 2 years; or 1 year each of a row crop, a small grain, and meadow.

Fall plowing is best for this soil, to insure getting a good seedbed in spring and to avoid plowing when the soil is too wet.

This is one of the most acid soils in the county. Lime is needed unless heavy applications have been made recently. Moderately large amounts of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Since the surface soil is thin, frequent applications of manure or commercial nitrogen should be made also.

Capability unit IIIw-4

Deep, nearly level, very poorly drained, moderately fine textured soils

The soils in this unit are—

Canisteo silty clay loam.
Clyde silty clay loam, 0 to 2 percent slopes.

These soils have a moderate to severe drainage problem, and Canisteo silty clay loam has special fertility problems. Because these soils are in depressions, there is also a frost hazard, and only early-maturing varieties of corn and soybeans are suitable.

Draining these soils is profitable. Without drainage, they can be farmed only in dry years. Most undrained areas are kept in permanent pasture.

Tile lines should be spaced 70 to 90 feet apart and 42 to 48 inches deep. Open ditches are commonly used to provide outlets for drainage systems. The width, depth, and grade of the ditch will vary, depending on the size and nature of the watershed to be drained. The minimum width of the bottom should be 4 feet. Side slopes should be 2 to 1. Some saving in tiling cost can be accomplished by using grassed waterways with the tile to remove surface water. The design will vary, depending on the size and nature of the drainage area. The minimum width is 1 rod, and the minimum depth is 1 foot. Drop box inlet structures are needed where waterways and tile systems empty into open ditches.

If these soils are adequately drained and fertilized and all crop residues are returned, row crops can be grown 4 years out of 6. A suitable rotation consists of row crops for 4 years, a small grain for 1 year, and meadow for 1 year. Other good rotations are the following: Row crops for 2 years, a small grain for 1 year, and meadow for 1 year; or row crops for 2 years, a small grain for 1 year, and meadow for 2 years. If these soils are not adequately fertilized or if crop residues are not returned, a rotation with more meadow should be used. If these soils are not adequately drained, a rotation is very difficult to establish. Undrained areas probably should be used for permanent pasture.

These soils should be fall plowed to insure getting a good seedbed in spring and to avoid plowing when the soils are too wet. A few stones or boulders should be removed.

The Canisteo soil has an excess of lime. It needs very large applications of potash and large applications of phosphate. Lime is seldom needed on the Clyde soil. Phosphate and potash should be applied in accordance with soil tests. Both of the soils tend to be wet and cold in the spring, so starter fertilizers should include nitrogen, which encourages rapid initial growth of crops. Fertilizing these soils before they are adequately drained is a very poor investment.

Capability unit IIIw-5

Moderately deep, nearly level, poorly drained to very poorly drained, moderately fine textured soils underlain at depths of 24 to 42 inches by sand and gravel

The soils in this unit are—

Canisteo silty clay loam, coarse substratum.
Marshan silty clay loam.

These soils have a moderate to severe drainage problem, and Canisteo silty clay loam, coarse substratum, has special problems of fertility. Because these soils are in depressions, there is also a frost hazard, and only early-maturing varieties of corn and soybeans are suitable.

Draining these soils is profitable. Without drainage, they can be farmed only in dry years. Most undrained areas are kept in permanent pasture.

Figure 12.—**Recently cleaned and deepened open ditch that removes surface water and serves as an outlet for tile drainage systems along its length. Canisteo silty clay loam, coarse substratum, is the principal soil along the ditch.**

Tile lines can be spaced up to 200 feet apart and 36 to 42 inches deep. The spacing will vary, depending on the nature of the sand in which the tile are placed. A few quicksand pockets will be encountered. In these spots, some reinforcement beneath the tile will be needed to hold them in place. Open ditches are commonly used to provide outlets for drainage systems (fig. 12). The width, depth, and grade of the ditch will vary, depending on the size and nature of the watershed to be drained. The minimum width of the bottom should be 4 feet. The side slopes should be 1 to 1. Some of the tiling cost can be saved by using grassed waterways with the tile to remove surface water. The design will vary, depending on the size and nature of the drainage area. The minimum width is 1 rod, and the minimum depth is 1 foot. Drop box inlet structures are needed where waterways and tile systems empty into open ditches.

If these soils are adequately drained and fertilized and all crop residues are returned, row crops can be grown 4 years out of 6. A suitable rotation consists of row crops for 4 years, a small grain for 1 year, and meadow for 1 year. Other good rotations are the following: Row crops for 2 years, a small grain for 1 year, and meadow for 1 year; or row crops for 2 years, a small grain for 1 year, and meadow for 2 years. If these soils are not adequately drained, a rotation is very difficult to establish. Undrained areas probably should be used for permanent pasture.

These soils should be fall plowed to insure getting a good seedbed in the spring and to avoid plowing when the soils are too wet.

The Canisteo soil has an excess of lime. Very large applications of potash and large applications of phosphate are needed. Lime is seldom needed on the Marshan soil. Phosphate and potash should be applied in accordance with soil tests. Because these soils tend to be wet and cold in the spring, starter fertilizers should include nitrogen, which encourages rapid initial growth of crops. Fertilizing these soils before they are adequately drained is a very poor investment.

Capability unit IIIw-6

Deep to moderately deep, level peat and muck soils over medium-textured to fine-textured materials

The only soil in this unit is—

Peat and Muck, medium textured substrata, 0 to 2 percent slopes.

This soil has a moderately severe drainage problem and a moderate fertility limitation. Unless drained, it is suited only to pasture. If drained, it is well suited to corn, soybeans, potatoes, onions, and other vegetable crops. Oats can be grown after drainage, but lodging is a serious problem. Because of frost hazards, only early-maturing varieties of crops should be planted.

Tile lines are placed 70 to 90 feet apart and 36 to 42 inches deep in this soil. Open ditches are commonly used to provide outlets for drainage systems. The width, depth, and grade of the ditches will vary, depending on the size and nature of the watershed. The minimum bottom width is 4 feet. The side slopes should be 2 to 1.

If this soil is adequately drained and fertilized, it can be used continuously for row crops. Occasional seeding with legumes and grasses is beneficial because it puts fresh organic matter into the soil.

This soil seldom needs lime. It requires very large applications of phosphate and potash. Soil testing is necessary to determine lime and fertilizer needs accurately. When the soil is first drained, an application of manure will be helpful in getting decomposition of the peat started.

Capability unit IIIw-7

Deep to moderately deep, level peat and muck soils over coarse-textured materials

The only soil in this unit is—

Peat and Muck, coarse substrata, 0 to 2 percent slopes.

This soil has a moderately severe drainage problem and a moderate fertility limitation. Unless drained, it is suited only to pasture. If drained, it is well suited to corn, soybeans, potatoes, onions, and other vegetable crops. Oats can be grown after drainage, but lodging is a serious problem. Because of frost hazards, only early-maturing varieties of crops should be planted.

Tile lines may be placed up to 200 feet apart and 36 to 42 inches deep. The spacing will vary, depending on the nature of the sand in which the tile is placed. A few quicksand pockets will be encountered. Reinforcements beneath the tile to hold them in place on these sites may be needed. Open ditches are commonly used to provide outlets for drainage systems. The width, depth, and grade of the ditches will vary, depending on the size and nature of the watershed. The minimum bottom width is 4 feet. The side slopes should be 1 to 1.

If this soil is adequately drained and fertilized, it can be used continuously for row crops. Occasional seeding with legumes and grasses is beneficial because it puts fresh organic matter into the soil.

This soil seldom needs lime. It requires very large applications of phosphate and potash. Soil testing is necessary to determine lime and fertilizer needs accurately. When the soil is first drained, an application of manure will be helpful in getting decomposition of the peat started.

Capability unit IIIs-1

Shallow, nearly level, well-drained, moderately coarse textured and medium textured soils underlain at depths of 12 to 24 inches by sand and gravel

The soils in this unit are—

Bixby loam, shallow, 0 to 2 percent slopes.
Dakota sandy loam, 0 to 2 percent slopes.
Thurston and Dickinson soils, 0 to 2 percent slopes.

These soils have a moderately severe hazard of drought. They can be used for row crops 2 years out of 4, if they are adequately fertilized and if all crop residues are returned. A suitable rotation is row crops for 2 years, a small grain for 1 year, and meadow for 1 year. Other good rotations are the following: Row crops for 2 years, a small grain for 1 year, and meadow for 2 years; or a row crop for 1 year, a small grain for 1 year, and meadow for 1 year.

These soils can be plowed either in fall or in spring. If they are spring plowed, it is suggested that plow planting be used to reduce the number of equipment trips across the field and reduce soil compaction.

Unless these soils have been limed recently, all of them usually need lime. Moderate to heavy applications of phosphate and potash are also needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter.

Capability unit IIIs-2

Shallow, gently sloping, well-drained, dark colored to moderately dark colored, medium textured and moderately coarse textured soils underlain at depths of 12 to 24 inches by sand and gravel or bedrock

The soils in this unit are—

Dakota sandy loam, 2 to 6 percent slopes, moderately eroded.
Rockton silt loam, 2 to 6 percent slopes, moderately eroded.
Thurston and Dickinson soils, 2 to 6 percent slopes.
Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded.

These soils have a moderately severe hazard of drought and a moderate erosion hazard. Because of the uneven and irregular slopes of the Thurston and Dickinson soils, contour stripcropping and contour farming may not be practical. On these soils erosion can be controlled by adequate rotations, fertilization, and return of all crop residues.

For the following recommendations, an average gradient of 4 percent and an average length of slope of 150 feet are assumed.

If these soils are not contour farmed, they should not be used for row crops more than 1 year out of 4. A suitable rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 2 years.

If these soils are farmed on the contour, they can be used for row crops up to 2 years out of 5. A typical rotation is row crops for 2 years, a small grain for 1 year, and meadow for 2 years.

With stripcropping, the usual rotation is a row crop for 1 year, a small grain for 1 year, and meadow for 2 years. Alternate strips should be in meadow. The strips vary up to 100 feet in width.

Because the average depth to bedrock or gravel and sand is less than 24 inches, terracing is not recommended.

Unless these soils have been recently limed, all of them usually need lime. Moderately heavy applications of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. It may be necessary to raise the organic-matter level by applying large amounts of manure or by including more legumes and grasses in the rotation.

Capability unit IIIs-3

Shallow, gently sloping, well-drained, light-colored, medium-textured soils underlain at depths of 12 to 24 inches by sand and gravel or bedrock

The soils in this unit are—

Bixby loam, shallow, 2 to 6 percent slopes, eroded.
Thurston soils, 2 to 6 percent slopes, severely eroded.
Whalan silt loam, 2 to 6 percent slopes.

Whalan silt loam, 2 to 6 percent slopes, moderately eroded.
Wykoff soils, 2 to 6 percent slopes.
Wykoff soils, 2 to 6 percent slopes, moderately eroded.

These soils have a moderately severe hazard of drought and a moderate erosion hazard. Because of the uneven and irregular slopes of the Thurston and Wykoff soils, contour stripcropping and contour farming may not be practical. On these soils erosion can be controlled by adequate rotations, fertilization, and the return of all crop residues.

For the following recommendations, an average gradient of 4 percent and an average length of slope of 150 feet are assumed.

If these soils are not contour farmed, they should not be used for row crops more than 1 year out of 5. A suitable rotation consists of a row crop for 1 year, a small grain for 1 year, and meadow for 3 years.

If these soils are farmed on the contour, they can be used for row crops 1 year out of 3. A typical rotation is 1 year each of a row crop, a small grain, and meadow.

With stripcropping, the usual rotation is a row crop for 1 year, a small grain for 1 year, and meadow for 2 years. Alternate strips should be in meadow. The width of the strips may vary up to 100 feet.

Because the average depth to bedrock or gravel and sand is less than 24 inches, terracing is not recommended.

Unless these soils have recently been limed, all of them usually need lime. Moderately large applications of phosphate and potash are needed. Lime, phosphate, and potash should be applied in accordance with soil tests. Nitrogen should be applied according to crop needs. Unless good rotations have been used and all crop residues returned to the soil, the organic-matter level may be low. Heavy applications of manure and rotations that include more legumes and grasses will add organic matter.

Capability unit IVe-1

Deep and moderately deep, moderately steep, well-drained, moderately dark colored to light colored, medium-textured soils

The soils in this unit are—

Downs silt loam, 12 to 25 percent slopes, moderately eroded.
Fayette silt loam, 12 to 18 percent slopes.
Fayette silt loam, 12 to 18 percent slopes, moderately eroded.
Fayette silt loam, 12 to 18 percent slopes, severely eroded.
Renova silt loam, 12 to 18 percent slopes.
Renova silt loam, 12 to 18 percent slopes, moderately eroded.
Renova soils, 12 to 18 percent slopes, severely eroded.
Seaton silt loam, 12 to 18 percent slopes.
Seaton silt loam, 12 to 18 percent slopes, moderately eroded.
Seaton silt loam, 12 to 18 percent slopes, severely eroded.
Whalan silt loam, moderately deep, 12 to 18 percent slopes.
Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded.
Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded.
Wykoff loam, 12 to 18 percent slopes, eroded.
Wykoff loam, 12 to 18 percent slopes, severely eroded.

These soils are fairly good for cultivation, but they should be cultivated only occasionally. They have a severe hazard of erosion. Many of them are already moderately to severely eroded. They have a slight limitation on fertility. The Wykoff and Whalan soils are moderately droughty. The principal crops grown are corn, oats, hay, pasture, and trees.

For the following suggestions, an average slope gradient of 14 percent and an average slope length of 150 feet are assumed.

Unless erosion is controlled, these soils should not be used for row crops at all, but a small grain can be grown at intervals to help reestablish a hay or pasture stand. The small grain is generally followed by 3 years of meadow.

These soils are too steep for contour cultivation or terracing. Stripcropping is the only erosion control practice that is suitable. Even when stripcropped, these soils should be used for row crops only 1 year in 6. A suitable rotation consists of a row crop, a small grain, and meadow for 4 years. The row crop should be plow planted. If the row crop is corn, the disked stalks should be left on the field while the small grain is seeded. Plowing should be done only in spring.

Waterways must be maintained, and it may be necessary to establish new ones. Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

All of these soils except the Seaton soils generally need lime, unless they have been limed recently. The Seaton soils have plenty of lime just below the subsoil; this makes them excellent soils for legumes. Moderate applications of phosphate and potash are needed on all of the soils. The content of organic matter should be increased by heavy applications of manure or by rotations that include more years of legumes and grasses. The soils should be tested to make certain of the needs for lime and fertilizer.

It may be necessary to remove a few stones from the Renova, Whalan, and Wykoff soils.

Capability unit IVs-1

Shallow, moderately sloping and rolling, well-drained, light colored to moderately dark colored, moderately coarse textured to medium textured soils underlain at depths of 12 to 24 inches by coarse materials or bedrock

The soils in this unit are—

Dakota sandy loam, 6 to 12 percent slopes, moderately eroded.
Rockton soils, 6 to 12 percent slopes, severely eroded.
Thurston soils, 6 to 12 percent slopes, moderately eroded.
Thurston soils, 6 to 12 percent slopes, severely eroded.
Whalan silt loam, 6 to 12 percent slopes.
Whalan silt loam, 6 to 12 percent slopes, moderately eroded.
Whalan soils, 6 to 12 percent slopes, severely eroded.
Wykoff soils, 6 to 12 percent slopes, eroded.
Wykoff soils, 6 to 12 percent slopes, severely eroded.

These soils are fairly good for cultivation, but they should be cultivated only occasionally. The hazard of erosion is moderately severe, and the hazard of drought is also moderately severe. Some of these soils have slight to moderate limitations on their fertility. Many of them are already moderately or severely eroded.

Corn, oats, hay, and pasture are the major crops grown on these soils. It is important to select varieties that mature early. Yields vary widely, depending on the weather; the highest yields are in wet years.

For the following suggestions, an average slope gradient of 8 percent and an average slope length of 100 feet are assumed.

Unless measures are taken to control erosion, row crops should not be grown. On the Thurston, Dakota, and Wykoff soils, the topography is so uneven that contouring and stripcropping may be difficult to plan. Terraces should not be built, because the soils are shallow over bedrock or sand and gravel.

If these soils are farmed on the contour, they can be used for row crops, but not oftener than 1 year in 5. A typical rotation consists of a row crop, a small grain, and meadow for 3 years. If the soils are stripcropped, row crops can be grown 1 year in 4. A suitable rotation is a row crop, a small grain, and meadow for 2 years. Plowing should be done only in spring.

Waterways must be maintained, and some need to be reestablished. Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Soil tests should be made to determine the needs of these soils for lime and fertilizer. All of them need lime unless it has recently been applied. Large applications of phosphate and potash are needed on the sandy loam soils of the Dakota, Thurston, and Wykoff series. Moderate applications of phosphate and potash are necessary on the other soils. All of the soils need more organic matter. This can be supplied by applying manure or by including more years of legumes and grasses in the rotation.

There are a few rock outcrops on the Rockton and Whalan soils; the areas where these occur should be kept in permanent vegetation. It may be necessary to remove a few stones from the Rockton and Whalan soils and many from the Thurston and Wykoff soils.

Capability unit VIe-1

Deep and moderately deep, steep, well-drained, light-colored, medium-textured soils

The soils in this unit are—

- Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded.
- Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded.
- Renova silt loam, 18 to 25 percent slopes.
- Renova silt loam, 18 to 25 percent slopes, moderately eroded.
- Renova soils, 18 to 25 percent slopes, severely eroded.
- Whalan silt loam, moderately deep, 18 to 25 percent slopes.
- Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded.

These soils are suitable for pasture, woodland, or wildlife shelter. The erosion hazard is very severe. Many of the soils are already moderately to severely eroded. The fertility is slightly to moderately limited.

The major crops are hay and pasture. Oats are grown only to help reestablish permanent hay or pasture. Trees and permanent vegetation for wildlife shelter are also suitable crops.

A good vegetative cover should be maintained on all cleared areas. Pastures should be fertilized with adequate amounts of manure and phosphate or with commercial nitrogen, phosphate, and potash. Lime may improve pasture on the Renova and Whalan soils. When pastures need renovating, they should be reseeded in oats. The oats should be clipped, pastured off, or harvested for grain. Plowing should always be done in the spring.

It may be necessary to remove a few stones from the Renova and Whalan soils to make pasture renewal easier.

Areas that are now in permanent vegetation should not be cleared. Trees can be planted to improve woodland or to retire cropland and pasture to woods. White pine, red pine, and black walnut are suitable for north-facing and east-facing slopes. Red pine, white pine, and redcedar are suitable for south-facing and west-facing slopes.

To develop these sites for wildlife shelter, use a combination of white pine, red pine, white spruce, redcedar, honeysuckle, lilac, caragana, legumes, and grasses. Sweetclover is especially good.

Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Capability unit VIw-1

Miscellaneous, frequently flooded, occasionally moderately droughty soils on bottom lands and in waterways

The soils in this unit are—

- Mixed alluvial land, moderately well drained.
- Mixed alluvial land, poorly drained.

These soils are suitable for pasture, woodland, and wildlife shelter. The hazard of flooding is severe. The poorly drained areas have a moderate to severe problem of drainage. Some sandy areas within the moderately well drained unit occasionally are moderately droughty.

The frequency of floods varies considerably, but floods come often enough that it is not safe to use these areas for crops. Occasionally a row crop is successfully grown. The major uses are permanent hay or pasture, woods, and wildlife shelter.

Areas now in woods should be left in woods. The stand of trees can be reinforced by planting. Cottonwood, black walnut, and basswood are suitable for the moderately well drained areas, and cottonwood is best for the poorly drained areas.

When developing these areas for wildlife shelter, use a combination of conifers, shrubs, hedges, and grasses that will tolerate wet soils and flooding.

Cleared areas should be developed as permanent hay and pasture land. A good vegetative cover should be maintained. If the stand becomes weedy, or if infertile sediment buries the established sod, renovation becomes necessary. These soils can be plowed, but they should be reseeded as quickly as possible. When oats is used as a companion crop in seeding pasture grasses, it should be clipped or pastured off, because it is likely to lodge and kill the new seedlings.

Varieties of grass and legumes that tolerate flooding should be used. It is difficult to renovate pasture in the poorly drained areas because the soil is wet throughout the year. It is not practical to drain these areas. Reed canarygrass or other species that tolerate both flooding and wet soil should be used.

Lime is not needed on these areas.

Streambank stabilization is needed in places to keep creeks and rivers from cutting into cropland or pastureland at sharp turns.

Capability unit VIw-2

Deep, gently sloping, very poorly drained, dark-colored, moderately fine textured soils and peat and muck soils

The soils in this unit are—

- Clyde silty clay loam, 2 to 6 percent slopes.
- Peat and Muck, medium textured substrata, 2 to 6 percent slopes.

These soils are not suitable for cultivation, but they are suitable for occasional grazing and for wildlife. The major limitation is the very poor drainage, which is extremely difficult to correct.

These soils are covered by swamp vegetation. Limited pasture is available during the driest periods late in summer and in fall. Livestock should be kept off these soils at other times. These areas can be fenced and developed as wildlife shelter.

Drainage is usually too expensive to be practical, but these soils can be drained by tile lines and interception tile at or near the source of the seepage water. Tile lines should be 50 to 70 feet apart and 42 to 48 inches deep. It is difficult to place the interception tile properly because the high water table may be the result of artesian pressure from below as well as seepage from above.

If drained, these soils should be managed in the same way as the soils in capability units IIIw-4 and IIIw-6. Some adjustments should be made in rotations and other practices to compensate for the stronger slopes.

Capability unit VIs-1

Shallow, moderately steep to hilly, well-drained, moderately dark colored to light colored, medium textured to moderately coarse textured soils underlain at depths of 12 to 24 inches by coarse materials or bedrock

The soils in this unit are—

- Rockton silt loam, 12 to 18 percent slopes.
- Rockton silt loam, 12 to 18 percent slopes, moderately eroded.
- Rockton soils, 12 to 18 percent slopes, severely eroded.
- Thurston loam, 12 to 18 percent slopes, severely eroded.
- Whalan silt loam, 12 to 18 percent slopes.
- Whalan silt loam, 12 to 18 percent slopes, moderately eroded.
- Whalan soils, 12 to 18 percent slopes, severely eroded.
- Wykoff and Thurston soils, 12 to 18 percent slopes, eroded.
- Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded.

These soils are suitable for pasture, woodland, or wildlife shelter. The hazard of erosion is severe, and most of the soils are already moderately eroded to severely eroded. The hazard of drought is moderately severe. These soils have slight to moderate limitations on their fertility.

Hay and pasture are the major crops. Oats are grown only to reestablish permanent hay or pasture. Other good crops are trees and permanent vegetation for wildlife shelter.

Gullies should be shaped and seeded as grassed waterways. Some may require engineering structures to stabilize them enough to grow grass.

Areas now in permanent vegetation should remain so. Trees can be planted to improve woodland or to return cropland or pasture to woodland. Suitable trees for north-facing and east-facing slopes are white pine, red pine, redcedar, and white spruce. For south-facing and west-facing slopes, red pine, white pine, and redcedar are suitable. When developing these areas for wildlife shelter, use a combination of white pine, red pine, white spruce, redcedar, honeysuckle, lilac, caragana, legumes, and grasses. Sweetclover is especially good.

A good cover of vegetation should be maintained on cleared areas. To do this will require adequate fertilization with manure and phosphate or with commercial nitrogen, phosphate, and potash. Lime may also be of benefit. Pastures should be renovated when necessary by seeding in oats. In some places plowing is very difficult because there are many stones on the Thurston and Wykoff soils and a few rock outcrops and stones on the Rockton and Whalan soils. If plowing is possible, it should always be done in the spring. If plowing is not possible, other means should be used to renovate pasture.

Capability unit VIIe-1

Steep to very steep soils that are subject to severe erosion and rough broken and stony land that is very shallow over bedrock or coarse materials

The soils and land types in this unit are—

- Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded.
- Renova silt loam, 25 to 35 percent slopes, eroded.
- Rough broken and stony land.
- Terrace escarpments.

These areas are suitable for permanent pasture, woodland, or wildlife shelter. The hazard of erosion is severe to very severe, and most of the areas are already moderately to severely eroded. The hazard of drought varies from moderately severe to severe. The Renova, Fayette, and Seaton soils are not so droughty as the other areas in this unit. There is a moderate limitation on fertility.

Gullies should be shaped and seeded. Some may need engineering structures to stabilize them enough to grow grass.

A good vegetative cover should be maintained on pastured areas. Manure and phosphate should be used, or commercial nitrogen, phosphate, and potash. Lime may benefit all areas except the Rough broken and stony land.

Pastures need to be renovated occasionally. Renovation is difficult because of steep to very steep slopes, rock outcrops, numerous stones, or a combination of these problems.

Areas that are wooded should remain so. Trees can be planted to improve woodland or to reforest pastureland. On the north-facing and east-facing slopes, red pine, white pine, and redcedar are suitable. On the south-facing and west-facing slopes, red pine, jack pine, or redcedar are suitable. To provide wildlife shelter, use a combination of conifers, shrubs, hedges, grasses, and legumes that are suitable for very droughty and shallow soils.

General Management Practices

Different soils, when used intensively for crops, differ in their needs for various conservation practices, as explained under the individual capability units. When soils are used less intensively, the needs for certain practices of management and conservation are common to all of them. Soils that are not used for crops may be used for pasture, for woodland, for wildlife shelter, or for windbreaks and shelterbelts.

Pasture

Pastures can be improved by reseeding to a suitable combination of grasses and legumes or by proper management of the existing forage.

Before reseeding a pasture, test the soil to determine its need for lime and fertilizer. Apply lime 6 months before seeding, and phosphorus and potassium at the time of seeding. The fertilizer can be broadcast, then worked into the soil before seeding. Drilling fertilizer in a band 1 inch below the grass and legume seeds will help the plants to establish themselves early.

A good seedbed should be prepared by contour plowing land that is level to moderately sloping. If it is not too expensive, stones, stumps, and other obstructions should be removed so that farm equipment can be used more easily. On steeper slopes it is best not to plow, but to work the land so as to leave a mulch on the surface. Weeds should be eradicated by chemical treatment or cultivation several weeks or months before seeding.

Legumes and grasses that will grow on the kind of soil available and that will be productive at the season of the year when pasture is needed should be chosen for seeding. Inoculate the legumes. A companion crop should be used for erosion control only. One bushel of oats per acre is enough.

Cover the seed lightly. A cultipacker-seeder places seed at the proper depth. When seed is broadcast, a cultipacker is useful to cover the seed and firm the seedbed.

When the oats or other companion crop is about 8 inches high, pasture it to reduce its competition with the young forage plants.

After the pasture has been established, it can be maintained and improved by adding fertilizer, controlling grazing, and controlling weeds and brush.

Acid soils should be limed to encourage legumes, such as whiteclover. The legumes will furnish nitrogen to the grasses in the mixture. Apply topdressings of phosphorus and potassium as needed to increase yields.

Nitrogen applied on grass early in the spring will provide earlier grazing. If there is enough moisture to support the faster growth, the extra nitrogen will increase the total yield and the protein content of the grass. Repeated application of nitrogen will encourage the supremacy of grass over legumes.

Grazing should be controlled by dividing the pasture into 3 or more sections and rotating the grazing. This practice prolongs the life of legumes and grasses by allowing the roots to store up reserves of plant nutrients. Delay grazing in the spring until growth is well started and the ground is firm enough that the roots will not be damaged by trampling. Legume pastures need protection from grazing for 1 month in the fall before frost, preferably during September. Do not allow overgrazing of the pasture during any part of the season.

Weeds and brush should be controlled by mowing them before they have a chance to set seed. Mow the weeds before the stock are moved to other pastures, because cattle will eat wilted weeds and vegetation from urine spots after they have been mowed. In some pastures it is more economical or more effective to destroy weeds and brush by spraying.

Woodland

Protection from fire and from grazing are the first requirements for good management of woodland. Trees that are dead, dying, or deformed should be cut down. Trees of undesirable species should be taken out. Two den trees should be left on each acre for shelter for wildlife.

Open areas should be planted to suitable species. In some places it is worthwhile to plant young trees under an existing stand. Scotch pine should not be planted except for Christmas trees. Jack pine should be planted only on the droughtiest sites.

If the woodland contains timber that is already marketable or usable, consult forestry technicians for information on how to get the highest returns from cutting it.

Wildlife shelter

Many areas that cannot be used economically to produce other crops are well suited to the production of useful wildlife. For example, small eroded areas in crop fields, bare knobs, abandoned roads and railroad rights-of-way, borrow pits, gravel pits, or bits of land cut off from the rest of the fields by a stream or drainage ditch are all suitable for wildlife shelter. Such areas are generally small, but they should be at least a quarter of an acre in size to be useful for wildlife. Land that is primarily suitable for use as cropland, pasture, or woodland can produce wildlife as a secondary crop.

Do not spray or burn the vegetation in fence rows, along roadsides, or in odd areas or sloughs. Plant low-growing shrubs along permanent fences, and leave the existing shrubs. Remove trees that are near enough to take water from crops. Odd areas can be improved for wildlife by planting evergreens, shrubs, and legumes. Keep livestock from grazing these areas.

Do not drain natural ponds and potholes that are suitable for wildlife. Marshy areas can be improved by level ditching or other measures that control the water level.

Windbreaks and shelterbelts

Most farms need windbreaks to protect the farmstead and thus save fuel. Feedlots also need protection from wind.

The soil should be well prepared before planting trees for windbreaks and shelterbelts. Choose suitable species that will survive. Include some shrubs to catch snow and to provide food and cover for wildlife. Until the trees and shrubs are well established, cultivate to control weeds. Provide protection from fire and from grazing.

Estimated Yields

Table 2 shows the estimated average yields of the principal crops on the soils of Dodge County, over a period of years, under average management and under the improved management described in the section on capability units. These estimates are based on records and observations of representatives of the Soil Conservation Service, the Extension Service, and the University of Minnesota Institute of Agriculture, and on interviews with farmers in the county.

Yields were not estimated for crops that were not considered suitable for a particular soil. The major crops can be grown on such soils, but, because of shallowness, steep slopes, severe erosion, poor drainage, or hazard of flooding, they are not likely to be successful. For soils on which adequate drainage makes a considerable difference in suitability for crops, yields are given both with and without adequate drainage.

It is assumed that rotation pasture consists of a mixture of suitable legumes and grasses. Permanent pasture, under average management, consists principally of native grass. Under improved management, in which permanent pasture is renovated at intervals, a mixture of suitable grasses and legumes is the principal cover.

Actual yields may vary considerably from the figures given in this table. Variations in soil characteristics, slight differences in management, damage by diseases and insects, and especially variations in weather will affect crop yields. Weather records show that, in this county, rainfall is 6 inches or more above normal 1 year in 6, that it is 6 inches below normal 1 year in 10, and that it is within 2 inches above or below normal 1 year in 3. These variations in rainfall alone cause considerable differences in yields from one year to another.

These yield figures represent an average to be expected over a period of 10 years. They are useful chiefly in judging the yield increases that can be expected from improving management and from draining the soil.

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

[Yields in columns A are those to be expected under average management. Under this level of management, the rotation consists mainly of cultivated crops; it includes meadow only 1 year in 5 or 6. Lime is applied, and starter fertilizer is used on corn. Available manure is spread on land before planting corn. Erosion control measures are not used. Yields in columns B are those to be expected if the management practices described under the individual capability units are followed. Where no yield figure is given, the crop is not generally grown or the soil is unsuited to its production.]

Map symbol	Mapping unit	Corn		Soybeans		Oats		Rotation hay [1]		Rotation pasture		Permanent pasture	
		A	B	A	B	A	B	A	B	A	B	A	B
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Ad	Alluvial land	70	80	25	30	45	50	2.5	3.0	100	135	----	----
BbA	Bixby loam, 0 to 2 percent slopes	50	65	17	24	35	50	2.3	3.0	92	120	----	----
BbB2	Bixby loam, 2 to 6 percent slopes, eroded	45	60	15	22	30	45	2.2	2.9	88	116	----	----
BxA	Bixby loam, shallow, 0 to 2 percent slopes	30	35	10	15	25	35	1.5	2.0	60	80	----	----
BxB2	Bixby loam, shallow, 2 to 6 percent slopes, eroded	25	30	8	12	15	25	1.4	1.9	52	76	----	----
Ca	Canisteo silty clay loam:												
	Inadequately drained	35	45	15	22	25	30	1.5	2.0	90	130	50	92
	Adequately drained	55	80	22	32	40	55	2.0	2.8	120	180	----	----
Cb	Canisteo silty clay loam, coarse substratum:												
	Inadequately drained	35	45	15	22	25	30	1.5	2.0	90	130	50	92
	Adequately drained	50	75	22	32	40	55	2.0	2.8	110	170	----	----
ChA	Chaseburg silt loam, 0 to 2 percent slopes	60	75	20	25	40	45	2.0	2.5	90	120	----	----
ChB	Chaseburg silt loam, 2 to 6 percent slopes	60	75	20	25	40	45	2.0	2.5	90	120	----	----
CsA	Clyde silty clay loam, 0 to 2 percent slopes:												
	Inadequately drained	30	35	18	22	20	25	----	----	70	110	40	84
	Adequately drained	60	80	27	32	45	55	2.0	2.5	130	180	----	----
CsB	Clyde silty clay loam, 2 to 6 percent slopes (undrained)	----	----	----	----	----	----	----	----	----	----	32	72
DaA	Dakota sandy loam, 0 to 2 percent slopes	35	40	15	18	40	50	1.7	2.2	68	88	----	----
DaB2	Dakota sandy loam, 2 to 6 percent slopes, moderately eroded	30	35	12	15	20	30	1.5	2.0	60	80	----	----
DaC2	Dakota sandy loam, 6 to 12 percent slopes, moderately eroded	25	30	----	----	15	25	1.3	1.8	52	72	32	56
DoA	Downs silt loam, 0 to 2 percent slopes	65	80	25	32	50	65	3.0	4.0	120	160	----	----
DoB	Downs silt loam, 2 to 6 percent slopes	60	80	23	30	45	65	3.0	4.0	120	160	----	----
DoB2	Downs silt loam, 2 to 6 percent slopes, moderately eroded	55	75	21	28	40	60	2.8	3.8	108	152	----	----
DoC2	Downs silt loam, 6 to 12 percent slopes, moderately eroded	50	70	17	24	35	55	2.6	3.6	100	144	----	----
DoC3	Downs silt loam, 6 to 12 percent slopes, severely eroded	40	55	----	----	25	45	2.4	3.5	88	140	----	----
DoD2	Downs silt loam, 12 to 25 percent slopes, moderately eroded	40	60	----	----	30	45	2.2	3.3	88	140	60	112
FaA	Fayette silt loam, 0 to 2 percent slopes	55	75	21	30	40	60	3.0	4.0	120	160	----	----
FaB	Fayette silt loam, 2 to 6 percent slopes	50	75	18	27	35	55	3.0	4.0	120	160	----	----
FaB2	Fayette silt loam, 2 to 6 percent slopes, moderately eroded	45	70	15	24	30	50	2.8	3.8	108	152	----	----
FaC	Fayette silt loam, 6 to 12 percent slopes	45	70	15	24	35	55	2.8	3.8	104	148	----	----
FaC2	Fayette silt loam, 6 to 12 percent slopes, moderately eroded	40	65	12	21	30	50	2.8	3.8	96	144	----	----

See footnotes at end of table.

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

Map symbol	Mapping unit	Corn A	Corn B	Soybeans A	Soybeans B	Oats A	Oats B	Rotation hay [1] A	Rotation hay [1] B	Rotation pasture A	Rotation pasture B	Permanent pasture A	Permanent pasture B
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
FaD	Fayette silt loam, 12 to 18 percent slopes	35	60	----	----	30	45	2.5	3.5	92	140	56	108
FaD2	Fayette silt loam, 12 to 18 percent slopes, moderately eroded	30	55			25	40	2.5	3.5	88	140	52	104
FaC3	Fayette silt loam, 6 to 12 percent slopes, severely eroded	30	50	----	----	20	45	2.7	3.7	84	136	----	----
FaD3	Fayette silt loam, 12 to 18 percent slopes, severely eroded	20	40	----	----	15	30	2.4	3.4	76	132	44	96
FsE2	Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded	----	----	----	----	(3)	(3)	----	----	----	----	48	100
FsF2	Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	28	60
FsE3	Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded	----	----	----	----	(3)	(3)	----	----	----	----	40	88
FtB	Floyd silty clay loam, 2 to 6 percent slopes:												
	Inadequately drained	50	60	24	27	45	50	1.7	2.2	110	130	70	100
	Adequately drained	65	85	30	35	50	60	2.0	3.0	140	180	----	----
Fy	Floyd and Clyde silty clay loams:												
	Inadequately drained	45	55	22	25	40	45	1.5	2.0	110	130	70	100
	Adequately drained	65	85	30	35	50	60	2.0	3.0	140	180	----	----
HaA	Hayfield silt loam, 0 to 2 percent slopes	55	70	25	30	40	60	2.4	3.0	96	120	----	----
HaB	Hayfield silt loam, 2 to 6 percent slopes	50	65	22	27	35	55	2.2	2.8	88	112	----	----
JuA	Judson silt loam, 0 to 2 percent slopes	70	80	20	25	45	50	2.0	2.5	110	140	----	----
JuB	Judson silt loam, 2 to 6 percent slopes	70	80	20	25	45	50	2.0	2.5	110	140	----	----
KaA	Kasson silt loam, 0 to 2 percent slopes	55	75	25	32	40	60	2.0	3.3	88	132	----	----
KaB	Kasson silt loam, 2 to 6 percent slopes	50	70	22	29	35	55	1.8	3.1	80	124	----	----
KaB2	Kasson silt loam, 2 to 6 percent slopes, moderately eroded	40	60	19	26	25	50	1.7	3.0	72	120	----	----
Kc	Kato silty clay loam:												
	Inadequately drained	50	60	22	25	40	45	1.5	2.0	110	130	70	100
	Adequately drained	60	80	30	35	50	60	2.0	3.0	130	170	----	----
KnA	Kenyon silt loam, 0 to 2 percent slopes	70	85	29	34	50	65	2.3	3.5	108	162	----	----
KnB	Kenyon silt loam, 2 to 6 percent slopes	65	80	27	32	45	60	2.2	3.4	104	157	----	----
KnB2	Kenyon silt loam, 2 to 6 percent slopes, moderately eroded	55	70	24	29	35	55	2.2	3.4	92	153	----	----
Lo	Lawson and Orion silt loams	65	75	22	27	40	45	2.0	2.5	110	140	----	----
Ma	Marshan silty clay loam:												
	Inadequately drained	30	35	18	22	20	25	----	----	70	110	40	84
	Adequately drained	55	75	27	32	45	55	2.0	2.5	120	170	----	----
Mp	Mixed alluvial land, poorly drained	----	----	----	----	----	----	----	----	----	----	60	80
Mx	Mixed alluvial land, moderately well drained	----	----	----	----	----	----	----	----	----	----	80	112
OsA	Ostrander silt loam, 0 to 2 percent slopes	70	80	27	32	35	65	2.5	3.5	100	140	----	----
OsB	Ostrander silt loam, 2 to 6 percent slopes	65	80	25	30	50	60	2.5	3.5	100	140	----	----
OsB2	Ostrander silt loam, 2 to 6 percent slopes, moderately eroded	60	75	22	27	40	55	2.3	3.3	92	136	----	----
OsC2	Ostrander silt loam, 6 to 12 percent slopes, moderately eroded	55	70	20	25	35	50	2.3	3.3	92	136	----	----
PmA	Peat and Muck, coarse substrata, 0 to 2 percent slopes:												
	Undrained	----	----	----	----	----	----	----	----	----	----	30	80
	Adequately drained	45	70	20	30	35	45	----	----	120	144	----	----
PtA	Peat and Muck, medium textured substrata, 0 to 2 percent slopes:												
	Undrained	----	----	----	----	----	----	----	----	----	----	30	80
	Adequately drained	45	75	20	30	35	45	----	----	120	144	----	----
PtB	Peat and Muck, medium textured substrata, 2 to 6 percent slopes (undrained)	----	----	----	----	----	----	----	----	----	----	25	60
RaA	Racine silt loam, 0 to 2 percent slopes	60	75	23	30	45	60	2.5	3.5	100	140	----	----
RaB	Racine silt loam, 2 to 6 percent slopes	55	75	21	28	40	55	2.5	3.5	100	140	----	----
RaB2	Racine silt loam, 2 to 6 percent slopes, moderately eroded	50	70	18	25	35	50	2.4	3.4	96	136	----	----
RaC	Racine silt loam, 6 to 12 percent slopes	50	70	18	25	35	50	2.3	3.3	92	132	----	----
RaC2	Racine silt loam, 6 to 12 percent slopes, moderately eroded	45	65	15	22	30	45	2.3	3.3	88	132	----	----
RcB3	Racine soils, 2 to 6 percent slopes, severely eroded	40	55	12	17	25	45	2.3	3.3	92	132	----	----
RcC3	Racine soils, 6 to 12 percent slopes, severely eroded	35	50	----	----	20	40	2.2	3.2	80	128	----	----

See footnotes at end of table.

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

Map symbol	Mapping unit	Corn		Soybeans		Oats		Rotation hay [1]		Rotation pasture		Permanent pasture	
		A	B	A	B	A	B	A	B	A	B	A	B
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
ReA	Renova silt loam, 0 to 2 percent slopes	50	70	19	28	35	55	2. 3	3. 5	92	140		
ReB	Renova silt loam, 2 to 6 percent slopes	45	70	16	25	30	50	2. 3	3. 5	92	140		
ReB2	Renova silt loam, 2 to 6 percent slopes, moderately eroded	40	65	13	22	25	45	2. 3	3. 5	88	136		
ReC	Renova silt loam, 6 to 12 percent slopes	40	65		22	30	50	2. 1	3. 3	80	132		
ReC2	Renova silt loam, 6 to 12 percent slopes, moderately eroded	35	60		19	25	45	2. 1	3. 3	76	132		
ReD	Renova silt loam, 12 to 18 percent slopes	30	55			25	40	1. 9	3. 1	72	128	52	104
ReD2	Renova silt loam, 12 to 18 percent slopes, moderately eroded	25	50			20	35	1. 9	3. 1	68	128	48	100
ReE	Renova silt loam, 18 to 25 percent slopes					(3)	(3)					44	96
ReE2	Renova silt loam, 18 to 25 percent slopes, moderately eroded					(3)	(3)					40	88
ReF2	Renova silt loam, 25 to 35 percent slopes, eroded											24	56
RfB3	Renova soils, 2 to 6 percent slopes, severely eroded	30	45	10	17	20	40	2. 2	3. 4	80	132		
RfC3	Renova soils, 6 to 12 percent slopes, severely eroded	25	45			20	40	2. 0	3. 2	68	128		
RfD3	Renova soils, 12 to 18 percent slopes, severely eroded	20	40			15	25	1. 8	3. 0	72	120	40	88
RfE3	Renova soils, 18 to 25 percent slopes, severely eroded					(3)	(3)					36	84
RoB2	Rockton silt loam, 2 to 6 percent slopes, moderately eroded	40	50	15	20	30	45	2. 0	2. 5	80	100		
RoD	Rockton silt loam, 12 to 18 percent slopes					20	35	1. 8	2. 2	52	80	44	72
RoD2	Rockton silt loam, 12 to 18 percent slopes, moderately eroded					15	30	1. 6	2. 1			40	68
RpA	Rockton silt loam, moderately deep, 0 to 2 percent slopes	55	65	23	30	45	60	2. 4	3. 4	96	136		
RpB	Rockton silt loam, moderately deep, 2 to 6 percent slopes	45	60	21	28	40	55	2. 3	3. 3	92	132		
RpC	Rockton silt loam, moderately deep, 6 to 12 percent slopes	35	50			35	50	2. 0	3. 0	80	120		
RsC3	Rockton soils, 6 to 12 percent slopes, severely eroded	35	45			20	35	1. 8	2. 3	72	92	48	72
RsD3	Rockton soils, 12 to 18 percent slopes, severely eroded					(3)	(3)					30	56
Ru	Rough broken and stony land											20	32
SaA	Sargeant silt loam, 0 to 2 percent slopes:												
	Inadequately drained	30	45	14	18	25	40	1. 0	2. 3	72	92	44	72
	Adequately drained	35	55	16	22	30	50	1. 2	2. 8	84	120		
SeB	Seaton silt loam, 2 to 6 percent slopes	45	70	18	27	35	55	3. 2	4. 0	120	160		
SeB2	Seaton silt loam, 2 to 6 percent slopes, moderately eroded	40	65	15	24	30	50	3. 0	3. 8	112	152		
SeC	Seaton silt loam, 6 to 12 percent slopes	40	65		24	35	55	2. 8	3. 6	100	144		
SeC2	Seaton silt loam, 6 to 12 percent slopes, moderately eroded	35	60		21	30	50	2. 8	3. 6	92	140		
SeC3	Seaton silt loam, 6 to 12 percent slopes, severely eroded	25	45			20	45	2. 7	3. 5	80	132		
SeD	Seaton silt loam, 12 to 18 percent slopes	30	55			30	45	2. 6	3. 4	88	136	52	104
SeD2	Seaton silt loam, 12 to 18 percent slopes, moderately eroded	25	50			25	40	2. 5	3. 3	80	132	46	100
SeD3	Seaton silt loam, 12 to 18 percent slopes, severely eroded	20	40			15	30	2. 5	3. 3	72	128	40	92
SkA	Skyberg silt loam, 0 to 2 percent slopes:												
	Inadequately drained	40	55	17	22	30	45	1. 2	2. 5	80	112	48	80
	Adequately drained	45	65	20	27	35	55	1. 5	3. 0	92	135		
SkB	Skyberg silt loam, 2 to 6 percent slopes:												
	Inadequately drained	40	60	18	23	35	50	1. 4	2. 7	84	120	52	84
	Adequately drained	45	65	23	28	40	55	1. 7	3. 0	92	135		
TaA	Tama silt loam, 0 to 2 percent slopes	75	85	29	34	60	70	3. 0	4. 0	120	160		
TaB	Tama silt loam, 2 to 6 percent slopes	70	85	27	32	55	65	3. 0	4. 0	120	160		
TaB2	Tama silt loam, 2 to 6 percent slopes, moderately eroded	65	80	24	29	50	60	3. 0	4. 0	112	156		
Te	Terrace escarpments											20	44

See footnotes at end of table.

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

Map symbol	Mapping unit	Corn		Soybeans		Oats		Rotation hay [1]		Rotation pasture		Permanent pasture	
		A	B	A	B	A	B	A	B	A	B	A	B
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
ThB2	Thurston loam, 2 to 6 percent slopes, moderately eroded	45	55	16	21	40	50	1.4	2.4	56	96	---	---
ThB3	Thurston loam, 2 to 6 percent slopes, severely eroded	35	40	13	16	30	45	1.3	2.3	52	92	---	---
ThC	Thurston loam, 6 to 12 percent slopes	45	55	---	---	40	50	1.2	2.2	48	88	---	---
ThC2	Thurston loam, 6 to 12 percent slopes, moderately eroded	40	50	---	---	35	45	1.1	2.1	44	84	---	---
ThC3	Thurston loam, 6 to 12 percent slopes, severely eroded	30	35	---	---	25	40	1.0	2.0	40	80	---	---
ThD3	Thurston loam, 12 to 18 percent slopes, severely eroded	---	---	---	---	[3]	[3]	---	---	---	---	24	48
TsB3	Thurston soils, 2 to 6 percent slopes, severely eroded	25	30	8	10	15	25	1.1	1.9	44	76	---	---
TsC2	Thurston soils, 6 to 12 percent slopes, moderately eroded	25	30	---	---	20	30	1.0	1.8	40	72	32	56
TsC3	Thurston soils, 6 to 12 percent slopes, severely eroded	20	25	---	---	10	20	.9	1.7	36	68	28	52
TtA	Thurston and Dickinson loams, 0 to 2 percent slopes	55	65	22	27	50	60	1.5	2.5	60	100	---	---
TtB	Thurston and Dickinson loams, 2 to 6 percent slopes	50	60	19	24	45	55	1.5	2.5	60	100	---	---
TuA	Thurston and Dickinson soils, 0 to 2 percent slopes	40	45	15	18	35	45	1.2	2.0	48	80	---	---
TuB	Thurston and Dickinson soils, 2 to 6 percent slopes	35	40	13	16	30	40	1.2	2.0	48	80	---	---
TuB2	Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded	30	35	11	14	25	35	1.2	2.0	48	80	---	---
Ud	Udolpho silt loam:												
	Inadequately drained	35	50	17	20	30	45	1.2	2.5	80	112	48	80
	Adequately drained	40	60	20	25	35	55	1.5	3.0	92	135	---	---
VaA	Vlasaty silt loam, 0 to 2 percent slopes	45	65	21	28	30	50	1.5	3.2	80	124	---	---
VaB	Vlasaty silt loam, 2 to 6 percent slopes	40	60	18	25	25	45	1.5	3.2	76	124	---	---
VaB2	Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded	35	50	15	22	20	40	1.3	3.0	72	120	---	---
WaA	Waukegan silt loam, 0 to 2 percent slopes	60	70	25	30	55	65	2.7	3.2	108	128	---	---
WaB	Waukegan silt loam, 2 to 6 percent slopes	55	65	23	28	50	60	2.7	3.2	108	128	---	---
WaB2	Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	50	60	20	25	45	55	2.6	3.1	104	124	---	---
WdA	Waukegan silt loam, deep, 0 to 2 percent slopes	70	85	29	34	55	70	3.2	4.0	128	160	---	---
WkA	Waukegan silt loam, thick surface variant, 0 to 2 percent slopes	75	85	30	35	60	70	3.5	4.0	140	180	---	---
WmC2	Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded	45	60	---	---	35	50	2.5	3.0	100	120	---	---
WnB	Whalan silt loam, 2 to 6 percent slopes	35	50	12	18	25	35	1.8	2.5	72	100	---	---
WnB2	Whalan silt loam, 2 to 6 percent slopes, moderately eroded	30	40	10	15	20	30	1.5	2.3	60	92	---	---
WnC	Whalan silt loam, 6 to 12 percent slopes	30	45	---	---	20	30	1.5	2.3	60	92	40	68
WnC2	Whalan silt loam, 6 to 12 percent slopes, moderately eroded	25	35	---	---	10	20	1.0	1.8	48	72	36	60
WnD	Whalan silt loam, 12 to 18 percent slopes	---	---	---	---	[3]	[3]	1.0	1.8	48	72	36	60
WnD2	Whalan silt loam, 12 to 18 percent slopes, moderately eroded	---	---	---	---	[3]	[3]	.8	1.6	32	64	28	48
WoB	Whalan silt loam, moderately deep, 2 to 6 percent slopes	45	60	19	28	30	50	2.2	3.4	88	136	---	---
WoB2	Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded	35	45	15	22	25	45	2.0	3.2	80	128	---	---
WoC	Whalan silt loam, moderately deep, 6 to 12 percent slopes	40	55	---	---	30	50	2.0	3.2	80	128	---	---
WoC2	Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded	30	40	---	---	20	40	1.8	3.0	72	120	---	---
WoD	Whalan silt loam, moderately deep, 12 to 18 percent slopes	35	50	---	---	25	40	1.8	3.0	72	120	48	80
WoD2	Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded	25	35	---	---	15	25	1.6	2.8	64	112	40	64

See footnotes at end of table.

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

Map symbol	Mapping unit	Corn		Soybeans		Oats		Rotation hay [1]		Rotation pasture		Permanent pasture	
		A	B	A	B	A	B	A	B	A	B	A	B
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
WoE	Whalan silt loam, moderately deep, 18 to 25 percent slopes	-----	-----	-----	-----	(3)	(3)	1.4	2.6	-----	-----	40	64
WoE2	Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded	-----	-----	-----	-----	(3)	(3)	1.3	2.5	-----	-----	36	60
WpC3	Whalan soils, 6 to 12 percent slopes, severely eroded	20	30	-----	-----	10	20	1.0	1.8	40	65	28	48
WpD3	Whalan soils, 12 to 18 percent slopes, severely eroded	-----	-----	-----	-----	(3)	(3)	.8	1.5	30	60	25	45
WsB3	Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded	35	45	12	18	25	35	1.8	2.8	72	120	-----	-----
WsC3	Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded	25	35	-----	-----	15	25	1.6	2.5	60	108	32	60
WsD3	Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded	20	30	-----	-----	10	20	1.0	1.8	40	65	28	48
WuA	Wykoff loam, 0 to 2 percent slopes	45	60	16	23	35	50	1.3	2.5	56	100	-----	-----
WuB	Wykoff loam, 2 to 6 percent slopes	40	55	14	21	30	45	1.3	2.5	56	100	-----	-----
WuB2	Wykoff loam, 2 to 6 percent slopes, moderately eroded	35	50	12	18	25	40	1.2	2.4	52	96	-----	-----
WuC	Wykoff loam, 6 to 12 percent slopes	35	50	-----	-----	25	40	1.2	2.4	50	94	-----	-----
WuC2	Wykoff loam, 6 to 12 percent slopes, moderately eroded	30	45	-----	-----	25	35	1.1	2.3	48	92	-----	-----
WuC3	Wykoff loam, 6 to 12 percent slopes, severely eroded	20	35	-----	-----	15	25	1.0	2.2	44	88	-----	-----
WuD2	Wykoff loam, 12 to 18 percent slopes, eroded	20	35	-----	-----	20	30	1.0	2.2	44	88	32	56
WuD3	Wykoff loam, 12 to 18 percent slopes, severely eroded	20	35	-----	-----	20	30	1.0	2.2	40	80	30	52
WyB	Wykoff soils, 2 to 6 percent slopes	25	30	10	15	25	35	1.0	2.0	44	80	-----	-----
WyB2	Wykoff soils, 2 to 6 percent slopes, moderately eroded	25	30	10	15	25	35	1.0	2.0	40	76	-----	-----
WyC2	Wykoff soils, 6 to 12 percent slopes, eroded	20	25	-----	-----	20	30	.9	1.9	40	76	28	52
WyC3	Wykoff soils, 6 to 12 percent slopes, severely eroded	15	20	-----	-----	10	20	.7	1.7	36	68	24	48
WzD2	Wykoff and Thurston soils, 12 to 18 percent slopes, eroded	-----	-----	-----	-----	(3)	(3)	-----	-----	-----	-----	24	48
WzD3	Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded	-----	-----	-----	-----	(3)	(3)	-----	-----	-----	-----	20	44

[1] These yields are to be expected if a mixture of alfalfa and bromegrass is grown. If a mixture of red clover and timothy is grown, yields will average 10 to 25 percent less than those given here.

[2] Cow-acre-days is the number of days in a year that 1 acre will furnish grazing for 1 mature cow or horse without injury to the pasture.

[3] Oats is grown on this soil only when it is necessary to renovate permanent pasture. Yields were not estimated, because oats may be pastured off, clipped, or harvested.

Engineering Properties of Soils

This soil survey report 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. Make preliminary estimates of runoff and erosion, for use in designing drainage structures and planning dams and other structures for conservation of soil and water.
3. Make preliminary evaluations 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 and rock for crushing.
5. Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in designing and maintaining the structures.
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 readily used by engineers.

8. Make a general estimate of the hazards or useful properties of various soils for highways and earth construction when definite laboratory data are not available.

The mapping and descriptive reports 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.

Only the data in table 3 are from actual laboratory tests. The estimates in tables 4 and 5 are based on a comparison of soils with those tested. At many construction sites, major variations in the soil may be present within the depth of the proposed excavations, and several soils may occur within a short distance. Specific laboratory data on mechanical analysis, liquid limit, and plasticity index should be determined for the soil at the site before any engineering work is planned in detail.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, sand, aggregate, and granular—have special meanings in soil science. Most of these terms, as well as other special terms that are used in the soil survey report, are defined in the glossary at the back of this report.

Some of the information useful for engineering can be obtained from the soil map. It will often be necessary, however, to refer to other parts of the report. By using the information in the soil map, the profile descriptions, and the tables in this section, the soils engineer can plan a detailed survey of the soil at the construction site.

Engineering Classification Systems

Two systems for classification of soils are in general use among engineers. Both will be used in this report. These classification systems are explained in the PCA Soil Primer (*5*).[2]

AASHO classification system

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system, all soil materials are classified in 7 principal groups, based on mechanical analysis and plasticity test data. The groups range from A–1 (gravelly soils of high bearing capacity, the best soils for subgrades) to A–7 (clay soils having low strength when wet, the poorest soils for subgrades).

Within each of the principal groups, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best materials to 20 for the poorest. The group index numbers for several of the soils of Dodge County are shown, in parentheses following the soil group symbol, in the next to last column in table 3. The estimated AASHO classification for all of the soils of the county is given in table 4.

[2] Italic numbers in parentheses refer to Literature Cited, page 108.

Unified classification system

Some engineers prefer to use the Unified soil classification system established by the Waterways Experiment Station, Corps of Engineers (*10*). This system is based on identification of soils according to their texture and plasticity and their performance as engineering construction materials. Table 3 shows the Unified classification of the samples tested, and table 4 gives the estimated Unified classification of all of the soils of Dodge County.

Soil Data Related to Engineering

Soil samples from three of the most important soil series of Dodge County were taken from nine locations selected by the Soil Conservation Service. These samples were tested by standard procedures in the laboratories of the Bureau of Public Roads, to help evaluate the soils for engineering purposes. These samples do not represent the entire range of soil characteristics in Dodge County, or even within the three soil series sampled, and not all layers of each profile were sampled. The test results, however, have been used as a general guide in estimating the physical properties of the soils of the county.

Mechanical analyses were made by a combination of the sieve and hydrometer methods. The liquid limit and plasticity index were determined. The results of these tests and the classification of each sample according to both the AASHO and the Unified systems are given in table 3.

Table 3 also gives data on the relationship between the moisture content and the compacted density of the soil, as determined by the methods described in AASHO Designation: T 99–57. If the soil material is compacted at successively higher moisture contents, assuming that the same amount of force is used in compacting the soil, 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 oven-dry weight in pounds per cubic foot of the soil at the optimum moisture content is the "maximum dry density." Data on the relationship of moisture to density are important in planning earthwork, because generally the soil is most stable if it is compacted to about its maximum dry density when it is at approximately the optimum moisture content.

Soil Engineering Interpretations

This section is intended as a reference guide and not as a manual for using soil materials in engineering.

In table 4, the soils of the county and their map symbols are listed, and certain characteristics that are significant to engineering use are described. Characteristics that are not important to engineering, such as color, are omitted, except in a few instances where they are needed to distinguish otherwise similar soils. The classification of each important layer is given according to the AASHO and the Unified classification systems.

Some features of a soil may be helpful in one kind of engineering work and a hindrance in another. For example, a highly permeable substratum would make a soil unsuitable as a site for a farm pond, but it might be favorable for artificial drainage.

TABLE 3.—*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	Moisture-density [2]: Optimum moisture
Floyd silty clay loam—						
Modal profile:			*Inches*		*Pounds per cubic foot*	*Percent*
NE¼SE¼ sec. 4, T. 106 N., R. 17 W	Iowan glacial till	S31772	0 to 15	A_{1p} and A_{12}	89	26
		S31773	33 to 52	C_1	125	11
		S31774	52+	C_2	126	10
Profile of coarse-textured subsoil phase:						
SE¼NW¼ sec. 5, T. 105 N., R. 17 W	Iowan glacial till	S31775	0 to 12	A_1	92	23
		S31776	25 to 34	B_{2n}	130	8
		S31777	40+	C	123	11
Profile associated with Kasson-Skyberg soils:						
NE¼NE¼ sec. 32, T. 108 N., R. 18 W	Iowan glacial till	S31778	0 to 15	A_1	89	28
		S31779	28 to 45	B_3	122	12
		S31780	45+	C	122	12
Kenyon silt loam—						
Modal profile:						
SW¼SE¼ sec. 3, T. 107 N., R. 17 W	Wind-deposited material over Iowan glacial till.	S31781	0 to 9	A_1	89	25
		S31782	42 to 54	C_1	121	12
		S31783	54+	C_2	122	12
Profile with coarser textured B and C horizons:						
SW¼NW¼ sec. 4, T. 106 N., R. 16 W	Wind-deposited material over Iowan glacial till.	S31784	0 to 12	A_1	98	21
		S31785	32 to 48	B_3	118	13
		S31786	48+	C	121	12
Profile with finer textured B and C horizons:						
NE¼NE¼ sec. 15, T. 106 N., R. 17 W	Wind-deposited material over Iowan glacial till.	S31787	0 to 12	A_1	96	22
		S31788	31 to 48	B_3	115	13
		S31789	48 to 60	C_1	122	12
Skyberg silt loam—						
Modal profile:						
NE¼NE¼ sec. 28, T. 108 N., R. 17 W	Wind-deposited material over Iowan glacial till.	S31790	26 to 38	B_{2g}	117	13
		S31791	38 to 50	B_3	116	14
		S31792	50+	C	107	18
Profile with coarser textured B horizon:						
NW¼NW¼ sec. 2, T. 106 N., R. 18 W	Wind-deposited material over Iowan glacial till.	S31793	27 to 38	B_{22g}	120	12
		S31794	40 to 51	B_{u2}	120	11
		S31795	53+	C	121	12
Profile with finer textured B and C horizons:						
SE¼SW¼ sec. 26, T. 106 N., R. 16 W	Wind-deposited material over Iowan glacial till.	S31796	26 to 34	B_{22g}	109	17
		S31797	34 to 46	B_{3g}	112	16
		S31798	46+	C_1	110	16

[1] Tests performed by Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

[2] Based on "The Moisture-density Relations of Soils Using 5.5-lb. Rammer and 12-in. Drop, AASHO Designation: T 99–57, Method A."

[3] Mechanical analyses according to the AASHO Designation: T 88-54. In many tests, results by this procedure differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of

soil samples taken from nine soil profiles

Mechanical analysis [3]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						AASHO	Unified
1½-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
--------	--------	--------	100	98	93	90	71	39	32	54	22	A-7-5(16)	MH or OH.
100	99	93	92	83	52	46	34	24	19	27	13	A-6(4)	CL.
--------	100	86	84	75	48	40	28	19	16	25	11	A-6(3)	SC.
--------	100	98	98	92	78	76	59	35	28	57	24	A-7-5(17)	MH or OH.
--------	100	90	88	72	25	23	17	12	10	19	4	A-2-4(0)	SM-SC.
100	95	81	80	74	53	50	38	26	21	32	17	A-6(6)	CL.
--------	--------	--------	100	99	94	91	68	40	34	56	23	A-7-5(16)	MH or OH.
100	99	93	92	85	58	53	43	31	25	32	17	A-6(7)	CL.
--------	100	91	89	81	58	52	41	28	23	31	17	A-6(7)	CL.
--------	100	99	99	96	87	85	63	37	29	52	19	A-7-5(14)	MH.
100	98	91	90	82	50	47	36	27	23	32	17	A-6(6)	SC.
100	98	87	85	76	54	49	38	27	22	31	17	A-6(6)	CL.
100	99	98	98	95	84	82	60	34	27	42	16	A-7-6(11)	ML-CL.
100	98	94	93	86	60	55	42	31	25	35	18	A-6(8)	CL.
100	99	86	84	76	54	50	38	27	22	29	14	A-6(5)	CL.
--------	100	99	99	95	83	81	61	38	31	42	16	A-7-6(11)	ML-CL.
100	99	92	90	84	63	60	46	31	26	39	22	A-6(10)	CL.
--------	100	93	91	82	57	53	42	29	24	30	15	A-6(6)	CL.
--------	100	92	91	84	59	56	46	29	25	32	16	A-6(7)	CL.
--------	100	98	98	94	76	74	53	30	26	34	19	A-6(12)	CL.
--------	--------	--------	100	99	93	91	71	43	37	43	24	A-7-6(14)	CL.
100	99	90	89	81	50	45	33	23	20	28	15	A-6(5)	SC.
100	99	90	83	42	9	8	7	7	6	[4]	[4]	A-1-b(0)	SW-SM.
--------	--------	100	98	89	62	57	45	29	22	29	15	A-6(7)	CL.
--------	--------	--------	100	97	78	75	53	35	32	38	21	A-6(12)	CL.
--------	--------	--------	100	98	86	83	56	35	30	35	18	A-6(11)	CL.
--------	--------	--------	100	95	75	72	52	35	31	36	19	A-6(12)	CL.

all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters 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] Nonplastic.

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
			Inches
Ad	Alluvial land.	These are mixed soils that developed in recent alluvium on flood plains. Drainage ranges from good to poor. The texture ranges from sand to clay. The soils are flooded nearly every spring and occasionally at other seasons. Old stream channels cut through these areas.	----------
BbA BbB2 BxA BxB2	Bixby loam, 0 to 2 percent slopes. Bixby loam, 2 to 6 percent slopes, eroded. Bixby loam, shallow, 0 to 2 percent slopes. Bixby loam, shallow, 2 to 6 percent slopes, eroded.	These are well-drained soils that developed on glacial outwash plains and stream terraces. The depth to the water table is more than 10 feet.	0 to 18---- 18 to 28--- 28+------
Ca	Canisteo silty clay loam.	This is a very poorly drained, calcareous soil that developed from alluvium over glacial till in depressions on uplands. The upper layer contains 5 to 8 percent organic matter. The water table is at or near the surface. Numerous large boulders lie in some drainageways.	0 to 18---- 18 to 33--- 33 to 39--- 39+------
Cb	Canisteo silty clay loam, coarse substratum.	This is a very poorly drained, calcareous, nearly level soil that developed in glacial outwash in depressions on terraces. The upper layer is highly organic; 5 to 8 percent consists of organic matter. At a depth of 8 to 10 feet or more, glacial till lies beneath the coarse outwash material. The water table is at or near the surface.	0 to 18---- 18 to 36--- 36+------
ChA ChB	Chaseburg silt loam, 0 to 2 percent slopes. Chaseburg silt loam, 2 to 6 percent slopes.	These are moderately well drained soils that developed in material recently washed from surrounding uplands and deposited in drainageways. The soil is mottled below a depth of 36 inches. The water table may be within 5 to 10 feet of the surface.	0 to 18---- 18 to 36--- 36+------
CsA CsB	Clyde silty clay loam, 0 to 2 percent slopes. Clyde silty clay loam, 2 to 6 percent slopes.	These are very poorly drained soils that developed from alluvium over glacial till in depressions on the uplands. The upper layer is 5 to 8 percent organic matter. The water table is at or near the surface. Numerous large boulders lie in some drainageways.	0 to 18---- 18 to 33--- 33 to 39--- 39+------
DaA DaB2 DaC2	Dakota sandy loam, 0 to 2 percent slopes. Dakota sandy loam, 2 to 6 percent slopes, moderately eroded. Dakota sandy loam, 6 to 12 percent slopes, moderately eroded.	These are well-drained soils that developed in alluvium over glacial outwash on terraces or outwash plains. In most places the water table is more than 10 feet deep.	0 to 12---- 12 to 24--- 24+------
DoA DoB DoB2 DoC2 DoC3 DoD2	Downs silt loam, 0 to 2 percent slopes. Downs silt loam, 2 to 6 percent slopes. Downs silt loam, 2 to 6 percent slopes, moderately eroded. Downs silt loam, 6 to 12 percent slopes, moderately eroded. Downs silt loam, 6 to 12 percent slopes, severely eroded. Downs silt loam, 12 to 25 percent slopes, moderately eroded.	These are well-drained soils developed in loess on the uplands. The water table is at a depth of more than 10 feet.	0 to 18---- 18 to 30--- 30+------
FaA FaB FaB2 FaC FaC2 FaD	Fayette silt loam, 0 to 2 percent slopes. Fayette silt loan, 2 to 6 percent slopes. Fayette silt loam, 2 to 6 percent slopes, moderately eroded. Fayette silt loam, 6 to 12 percent slopes. Fayette silt loam, 6 to 12 percent slopes, moderately eroded. Fayette silt loam, 12 to 18 percent slopes.	These are deep, well-drained soils that develop in loess on the uplands. In about one-fourth of the area, glacial till or limestone bedrock lies at a depth of 4 feet. Where the loess is deeper, it is calcareous at a depth of about 6 feet. The depth to the water table is more than 10 feet.	0 to 18---- 18 to 28--- 28+------

See footnote at end of table.

significant to engineering

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
No classification possible									
Loam	SC	A-4	90 to 100	40 to 45	110	15	0.8 to 2.5	0.2	6.0 to 6.5.
Clay loam, loam, or sandy loam.	SC to CL	A-4 to A-6	90 to 100	40 to 45	110	15	2.5 to 5.0	0.2 to 0.13.	5.5 to 6.0.
Sandy loam, loamy sand, or sand with fine gravel.	SM to GW	A-1, A-3, or A-2.	50	5 to 15	115 to 120	10 to 15	5.0 to 10.0+	0.015	6.5 to 7.5.
Silty clay loam	OL to CL	A-7-6	90 to 100	70 to 80	95	22	0.8 to 2.5	0.25	7.0 to 7.5.
Silty clay loam	CL	A-7-6	90 to 100	70 to 80	95 to 100	28	0.2 to 0.8	0.20	6.5 to 7.0.
Sand to gravelly loam.	SM to GW	A-2	50 to 75	30 to 45	110	15	2.5 to 5.0	0.07	6.5 to 7.0.
Clay loam	CL	A-6	80 to 90	50 to 60	110	18	0.8 to 2.5	0.17	7.5.
Silty clay loam	OL to CL	A-7-6	95 to 100	70 to 80	95	22	0.2 to 0.8	0.20	7.0 to 7.5.
Clay loam, sandy clay loam, or silty clay loam.	CL	A-6	95 to 100	60 to 80	110	18	0.2 to 0.8	0.18	6.5 to 7.0.
Stratified sand and gravel.	SW to GW	A-1 or A-3	50	5 to 10	125	8	10.0+	0.015	7.0 to 7.5.
Silt loam	ML to CL	A-4	100	80	105	18	0.8 to 2.5	0.18	6.0 to 6.5.
Silt loam to silty clay loam.	CL	A-4 to A-6	100	80	105	18	0.8 to 2.5	0.17	6.0 to 6.5.
Silt loam to silty clay loam.	CL	A-6	100	80	105	18	0.8 to 2.5	0.17	6.5 to 7.0.
Silty clay loam	MH or OH	A-7-5	90 to 100	70 to 80	90	25	0.8 to 2.5	0.25	6.5 to 7.0.
Silty clay loam	CL	A-7-6	90 to 100	70 to 80	90 to 95	28	0.2 to 0.8	0.20	6.5 to 7.0.
Sandy clay loam to sandy loam.	SM to CL	A-2 or A-4	50 to 75	30 to 45	115 to 125	10 to 15	2.5 to 5.0	0.07	6.5 to 7.0.
Clay loam	CL	A-6	80 to 90	50 to 60	115 to 125	10 to 15	0.8 to 2.5	0.17	7.5.
Sandy loam	SM	A-2	90 to 100	30 to 35	110	15	2.5 to 5.0	0.13	6.0 to 6.5.
Loam or sandy loam.	SC	A-4	90 to 100	30 to 45	110	15	2.5 to 5.0	0.17	5.5 to 6.0
Sand with fine gravel.	SW to GW	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	7.0 to 7.5.
Silt loam	ML to CL	A-4	100	95 to 99	100	18	0.8 to 2.5	0.20	5.5 to 6.0.
Silt loam to silty clay loam.	CL	A-7-6	100	95 to 99	105	18	0.8 to 2.5	0.18	5.5 to 6.0.
Silt loam to very fine sandy loam.	ML to CL	A-4 to A-6	100	95 to 99	107	18	0.8 to 2.5	0.17	5.5 to 7.5.
Silt loam	ML to CL	A-4	100	99	103	17	0.8 to 2.5	0.18	6.0 to 6.5.
Silty clay loam	CL	A-7-6	100	100	106	18	0.8 to 2.5	0.17	5.5 to 6.0.
Silt loam	ML to CL	A-4 to A-6	100	99	107	18	0.8 to 2.5	0.17	5.5 to 6.0.

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
FaD2	Fayette silt loam, 12 to 18 percent slopes, moderately eroded.		
FaC3	Fayette silt loam, 6 to 12 percent slopes, severely eroded.		
FaD3	Fayette silt loam, 12 to 18 percent slopes, severely eroded.		
FsE2 FsF2 FsE3	Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded. Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded. Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded.	These are deep, well-drained soils that developed in loess on uplands. Fayette soils and Seaton soils are intermingled in these areas. In nearly all areas, glacial till or limestone bedrock is within 4 to 6 feet of the surface. The depth to the water table is more than 10 feet.	*Inches* 0 to 12 12 to 24 24+
FtB Fy	Floyd silty clay loam, 2 to 6 percent slopes. Floyd and Clyde silty clay loams.	The Floyd soils are deep and poorly drained. They developed in a silt cap over glacial till on uplands. The upper layer is highly organic; it is 5 to 8 percent organic matter. The substratum below a depth of 36 inches consists of till. The depth to the water table varies from 2 to 5 feet. A few stones and boulders are present on the surface and in the profile.	0 to 12 12 to 30 30 to 36 36+
HaA HaB	Hayfield silt loam, 0 to 2 percent slopes. Hayfield silt loam, 2 to 6 percent slopes.	These are moderately well drained soils that developed on glacial outwash plains. The loose sand between depths of 30 and 120 inches contains gravel and many thin bands of sandy loam. The substratum is commonly underlain by glacial till. The depth to the water table varies from 2 feet to 8 or 10 feet, according to the season.	0 to 12 12 to 30 30 to 120 120+
JuA JuB	Judson silt loam, 0 to 2 percent slopes. Judson silt loam, 2 to 6 percent slopes.	These are deep, moderately well drained soils that developed in material washed from surrounding uplands and deposited in waterways on uplands. Loess may lie beneath these soils at a depth of 3 feet or more. The water table may be within 3 to 5 feet of the surface, but it is generally lower.	0 to 24 24 to 48 48+
KaA KaB KaB2	Kasson silt loam, 0 to 2 percent slopes. Kasson silt loam, 2 to 6 percent slopes. Kasson silt loam, 2 to 6 percent slopes, moderately eroded.	These are deep, moderately well drained soils that developed in a thin silt cap over glacial till on uplands. The clay loam between depths of 18 and 30 inches contains pebbles and gravel. The depth to the water table varies from 2 or 3 feet to more than 10 feet.	0 to 18 18 to 30 30+
Kc	Kato silty clay loam.	This is a poorly drained or somewhat poorly drained, nearly level soil that developed in glacial outwash on terraces. The upper layer is highly organic; 5 to 8 percent is organic matter. The sand and gravel below a depth of 30 inches contain thin bands of sandy loam. The water table is within 2 feet of the surface in some seasons.	0 to 12 12 to 30 30+
KnA KnB KnB2	Kenyon silt loam, 0 to 2 percent slopes. Kenyon silt loam, 2 to 6 percent slopes. Kenyon silt loam, 2 to 6 percent slopes, moderately eroded.	These are deep, moderately well drained soils that developed in a thin silt cap over glacial till on uplands. Some gravel and stones are present in the lower part of the profile. The depth to the water table is 3 to 5 feet.	0 to 18 18 to 36 36+
Lo	Lawson and Orion silt loams.	These are mixed soils that developed in recent alluvium on flood plains. Drainage is somewhat poor. The soils are flooded every few years, and new material is deposited by each flood.	----------
Ma	Marshan silty clay loam.	This is a very poorly drained, nearly level soil that developed in glacial outwash in depressions on terraces. The upper layer is highly organic; 5 to 8 percent of it is organic matter. At a depth of 8 to 10 feet or more, glacial till lies beneath the coarse outwash material. The water table is at or near the surface.	0 to 18 18 to 36 36+

See footnote at end of table.

significant to engineering—Continued

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
Silt loam	ML to CL	A-4	100	99	103	17	0.8 to 2.5	0.18	6.0 to 6.5.
Silt loam or silty clay loam.	ML to CL	A-4 to A-6	100	99	106	18	0.8 to 2.5	0.17	5.5 to 6.0.
Silt loam or very fine sandy loam.	ML to CL	A-4	100	95 to 99	107	18	2.5 to 5.0	0.17	6.0 to 6.5.
Silty clay loam	MH or OH	A-7-5	100	80 to 94	89	26 to 28	0.2 to 0.8	0.25	6.0 to 6.5.
Silty clay loam or clay loam.	CL	A-6	90 to 95	50 to 60	112	17	0.2 to 0.8	0.20	6.0 to 6.5.
Sandy clay loam	SM to CL	A-2, A-4, or A-6.	80 to 90	25 to 60	130	8	0.8 to 2.5	0.17	6.0 to 6.5.
Clay loam	CL	A-6	80 to 90	50 to 60	122	12	0.8 to 2.5	0.17	6.0 to 6.5.
Silt loam	ML	A-4	95	60 to 70	98	21	0.8 to 2.5	0.2	6.0 to 6.5.
Loam or clay loam.	CL	A-7-6	80 to 90	55 to 65	105	15	0.8 to 2.5	0.18	5.1 to 5.5.
Sand with fine to medium gravel.	SM to GW	A-1 or A-3	50	10	125	8	5.0 to 10.0	0.07	6.0 to 7.5.
Clay loam	CL	A-6	80 to 90	50 to 60	122	12	0.8 to 2.5	0.17	7.5.
Silt loam	ML or CL	A-7-6	100	95	97	21	0.8 to 2.5	0.2	6.0 to 6.5.
Silt loam or silty clay loam.	CL	A-6	100	95	110	16	0.8 to 2.5	0.18	6.0 to 6.5.
Silt loam	CL	A-6	100	95	107	18	0.8 to 2.5	0.17	6.5 to 7.0.
Silt loam	CL	A-4 or A-6	90 to 100	50 to 70	108 to 111	15 to 17	0.8 to 2.5	0.18	6.0 to 6.5.
Clay loam	CL	A-4 or A-6	90	50 to 60	117 to 121	11 to 13	0.8 to 2.5	0.17	5.1 to 5.5.
Clay loam	CL	A-6	90 to 100	50 to 60	120 to 122	11 to 12	0.2 to 0.8	0.17	6.0 to 7.5.
Silty clay loam	MH or OH	A-7-5	100	80 to 94	89	26 to 28	0.8 to 2.5	0.25	6.0 to 6.5.
Silty clay loam to clay loam.	CL	A-6	90 to 95	50 to 60	122	12	0.2 to 0.8	0.20	6.0 to 6.5.
Coarse sand and fine gravel.	SW or GW; SP in some areas.	A-1 or A-3	60 to 75	5 to 10	120 to 125	8 to 10	5.0 to 10.0	0.015	6.0 to 7.5.
Silt loam	MH, ML, or CL.	A-7-5 or A-7-6.	98 to 100	73 to 87	97 to 98	21 to 22	0.8 to 2.5	0.20	6.0 to 6.5.
Silty clay loam to clay loam.	CL	A-6	94 to 100	60 to 65	110 to 115	13 to 16	0.2 to 0.8	0.18	5.5 to 6.0.
Clay loam	CL	A-6	86 to 99	50 to 68	116 to 122	12 to 15	0.8 to 2.5	0.17	6.0 to 7.5.
No classification possible									
Silty clay loam	OL to CL	A-7-6	95 to 100	70 to 80	95	22	0.2 to 0.8	0.20	6.0 to 6.5.
Clay loam, sandy clay loam, or silty clay loam.	CL	A-6	95 to 100	70 to 80	110	18	0.2 to 0.8	0.18	6.0 to 6.5.
Stratified sand and gravel.	GW; SP in some areas.	A-1 to A-3	50	5 to 10	125	8	10.0+	0.015	7.0 to 7.5.

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
			Inches
Mp Mx	Mixed alluvial land, poorly drained. Mixed alluvial land, moderately well drained.	These are mixed soils that developed in recent alluvium on flood plains. Drainage ranges from poor to moderately good. The texture ranges from sand to clay. The soils are flooded nearly every spring and occasionally at other seasons. Old stream channels cut through these areas.	----------
OsA OsB OsB2 OsC2	Ostrander silt loam, 0 to 2 percent slopes. Ostrander silt loam, 2 to 6 percent slopes. Ostrander silt loam, 2 to 6 percent slopes, moderately eroded. Ostrander silt loam, 6 to 12 percent slopes, moderately eroded.	These are deep, well-drained soils that developed in a thin silt cap over glacial till on uplands. The upper layer of the moderately eroded soils is 4 to 6 inches thinner than the one described. The depth to the water table is more than 10 feet. A few stones and boulders are present on the surface and in the profile.	0 to 15---- 15 to 35--- 35+------
PmA PtA PtB	Peat and Muck, coarse substrata, 0 to 2 percent slopes. Peat and Muck, medium textured substrata, 0 to 2 percent slopes. Peat and Muck, medium textured substrata, 2 to 6 percent slopes.	These organic soils vary in depth. Some are only 12 to 42 inches deep over mineral soil, and others are more than 42 inches deep. In some places the substratum is clay loam till, and in others it is sand.	0 to 12+--
RaA RaB RaB2 RaC RaC2 RcB3 RcC3	Racine silt loam, 0 to 2 percent slopes. Racine silt loam, 2 to 6 percent slopes. Racine silt loam, 2 to 6 percent slopes, moderately eroded. Racine silt loam, 6 to 12 percent slopes. Racine silt loam, 6 to 12 percent slopes, moderately eroded. Racine soils, 2 to 6 percent slopes, severely eroded. Racine soils, 6 to 12 percent slopes, severely eroded.	These are deep, well-drained soils that developed in a thin silt cap over glacial till on uplands. Below the silt loam, pieces of gravel and small stones are common, and pockets of sand and gravel are present in the till. The surface layer of the moderately eroded soils is 4 to 6 inches thinner, and that of the severely eroded soils is 6 to 10 inches thinner, than the layer described in the profile. The depth to the water table is normally more than 10 feet.	0 to 17---- 17 to 36--- 36+------
ReA ReB ReB2 ReC ReC2 ReD ReD2 ReE ReE2 ReF2 RfB3 RfC3 RfD3 RfE3	Renova silt loam, 0 to 2 percent slopes. Renova silt loam, 2 to 6 percent slopes. Renova silt loam, 2 to 6 percent slopes, moderately eroded. Renova silt loam, 6 to 12 percent slopes. Renova silt loam, 6 to 12 percent slopes, moderately eroded. Renova silt loam, 12 to 18 percent slopes. Renova silt loam, 12 to 18 percent slopes, moderately eroded. Renova silt loam, 18 to 25 percent slopes. Renova silt loam, 18 to 25 percent slopes, moderately eroded. Renova silt loam, 25 to 35 percent slopes, eroded. Renova soils, 2 to 6 percent slopes, severely eroded. Renova soils, 6 to 12 percent slopes, severely eroded. Renova soils, 12 to 18 percent slopes, severely eroded. Renova soils, 18 to 25 percent slopes, severely eroded.	These are deep, well-drained soils that developed in a thin silt cap over glacial till on uplands. Below a depth of 15 inches, small stones and pieces of gravel are common. Some pockets of sand and gravel are present in the till. The surface layer of the moderately eroded soils is 4 to 6 inches thinner, and that of the severely eroded soils is 6 to 10 inches thinner, than the layer described in the profile. The depth to the water table is normally more than 10 feet.	0 to 15---- 15 to 45--- 45+------
RoB2 RoD RoD2 RsC3 RsD3	Rockton silt loam, 2 to 6 percent slopes, moderately eroded. Rockton silt loam, 12 to 18 percent slopes. Rockton silt loam, 12 to 18 percent slopes, moderately eroded. Rockton soils, 6 to 12 percent slopes, severely eroded. Rockton soils, 12 to 18 percent slopes, severely eroded.	These soils developed in a thin silt cap over a thin layer of glacial till overlying limestone bedrock. The clay loam layer contains small stones and pieces of gravel. The limestone bedrock is shattered and somewhat disintegrated at the surface. The surface layer of the severely eroded soils is 6 inches thinner than that of the profile described. The depth of soil above the bedrock ranges from 12 to 24 inches. The water table is not above the bedrock.	0 to 12---- 12 to 21--- 21+------
RpA RpB RpC	Rockton silt loam, moderately deep, 0 to 2 percent slopes. Rockton silt loam, moderately deep, 2 to 6 percent slopes. Rockton silt loam, moderately deep, 6 to 12 percent slopes.	The bedrock is normally limestone, but in some places it is shale. The 3 inches above the bedrock contains fragments of the rock, the 11-inch layer above that contains small stones and pieces of gravel. The water table is within the bedrock.	0 to 16---- 16 to 27--- 27 to 30--- 30+------

See footnote at end of table.

significant to engineering—Continued

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
No classification possible									
Silt loam or loam	ML to CL	A-7-6	95 to 100	65 to 75	97 to 105	17 to 21	0.8 to 2.5	0.20	5.5 to 6.5.
Clay loam	CL	A-6	95 to 98	55 to 65	112	13	0.8 to 2.5	0.18	5.5 to 6.0.
Clay loam	CL	A-6	95 to 98	50 to 65	120	12	0.8 to 2.5	0.17	6.5 to 7.5.
Peat or muck	Pt						Variable	0.5	
Silt loam or loam	ML to CL	A-4	99 to 100	70 to 85	105	16	0.8 to 2.5	0.20	6.0 to 6.5.
Clay loam	CL	A-6	85 to 90	50 to 65	117	13	0.8 to 2.5	0.18	5.5 to 6.0.
Clay loam	SC to CL	A-6	80 to 90	50 to 65	116	15	0.8 to 2.5	0.17	6.0 to 7.5.
Silt loam	ML to CL	A-4	99 to 100	70 to 85	110 to 116	12 to 15	0.8 to 2.5	0.18	5.0 to 6.0.
Clay loam	CL	A-6	80 to 90	50 to 65	117 to 118	12 to 13	0.8 to 2.5	0.17	5.0 to 5.5.
Clay loam	SC to CL	A-6	85 to 90	50 to 65	111 to 119	12 to 15	0.8 to 2.5	0.17	6.5 to 7.5.
Silt loam	ML to CL	A-4 to A-6	95 to 100	65 to 70	97	21	0.8 to 2.5	0.20	5.5 to 6.5.
Clay loam to clay	CL to MH	A-6 or A-7	90 to 95	50 to 65	105	17	0.2 to 0.8	0.18	5.5 to 7.0.
Bedrock									
Silt loam	ML to CL	A-4 to A-6	95 to 100	65 to 75	97	21	0.8 to 2.5	0.20	5.5 to 6.5.
Clay loam	CL	A-6	90 to 95	50 to 65	105	17	0.8 to 2.5	0.18	5.5 to 6.0.
Clay loam to clay	CL to MH	A-7-5	90 to 95	50 to 65	112 to 120	12 to 18	0.2 to 0.8	0.18	6.5 to 7.0.
Bedrock									

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
			Inches
Ru	Rough broken and stony land.	These are shallow soils, 24 inches or less in depth over bedrock. Slopes are 18 percent or more. In most places the bedrock is limestone. The water table is not present above the bedrock.	----------
SaA	Sargeant silt loam, 0 to 2 percent slopes.	This is a deep, somewhat poorly drained soil that developed in a thin silt cap over glacial till on uplands. Small stones and pebbles are concentrated at the upper boundary of the clay loam layer and are also present in deeper material. A water table may be perched above the somewhat impermeable clay loam layer.	0 to 12---- 12 to 18--- 18 to 38--- 38+------
SeB SeB2 SeC SeC2 SeC3 SeD SeD2 SeD3	Seaton silt loam, 2 to 6 percent slopes. Seaton silt loam, 2 to 6 percent slopes, moderately eroded. Seaton silt loam, 6 to 12 percent slopes. Seaton silt loam, 6 to 12 percent slopes, moderately eroded. Seaton silt loam, 6 to 12 percent slopes, severely eroded. Seaton silt loam, 12 to 18 percent slopes. Seaton silt loam, 12 to 18 percent slopes, moderately eroded. Seaton silt loam, 12 to 18 percent slopes, severely eroded.	These are well-drained, deep soils that developed from loess on uplands. The silt loam between depths of 12 and 36 inches is slightly finer in texture than that in the layer above. In many places fine sand is present at a depth of 4 to 4½ feet. Glacial till of loam or clay loam generally lies below depths of 4 to 8 feet. The depth to the water table is more than 10 feet.	0 to 12---- 12 to 36--- 36 to 54--- 54+------
SkA SkB	Skyberg silt loam, 0 to 2 percent slopes. Skyberg silt loam, 2 to 6 percent slopes.	These are deep, somewhat poorly drained soils that developed in a thin silt cap over glacial till on uplands. The lower 6 inches of the surface layer is silty clay loam. Many small stones are at the upper boundary of the subsoil. The till is firm and slowly permeable. The water table varies, according to the season, from near the surface to depths of 3 or 4 feet.	0 to 18---- 18 to 38--- 38+------
TaA TaB TaB2	Tama silt loam, 0 to 2 percent slopes. Tama silt loam, 2 to 6 percent slopes. Tama silt loam, 2 to 6 percent slopes, moderately eroded.	These are deep, well-drained soils that developed in loess on uplands. The silty loess is 6 to 8 feet deep over loam or clay loam glacial till. The substratum is calcareous below a depth of 6 feet. The depth to the water table is normally more than 10 feet.	0 to 18---- 18 to 40--- 40+------
Te	Terrace escarpments.	These units consist of narrow, steeply sloping areas between different terrace levels, between terraces and bottom land, or on gravelly mounds and hills. The slopes are more than 12 percent. The depth to the water table is more than 10 feet.	0 to 60+--
ThB2 ThB3 ThC ThC2 ThC3 ThD3 TtA TtB	Thurston loam, 2 to 6 percent slopes, moderately eroded. Thurston loam, 2 to 6 percent slopes, severely eroded. Thurston loam, 6 to 12 percent slopes Thurston loam, 6 to 12 percent slopes, moderately eroded. Thurston loam, 6 to 12 percent slopes, severely eroded. Thurston loam, 12 to 18 percent slopes, severely eroded. Thurston and Dickinson loams, 0 to 2 percent slopes. Thurston and Dickinson loams, 2 to 6 percent slopes.	These are moderately deep, well-drained soils that developed in coarse-textured, loose glacial drift on uplands. The substratum of the Thurston soils is gravelly, and that of the Dickinson soils is sandy. The depth to the water table is normally more than 10 feet.	0 to 14---- 14 to 26--- 26 to 30--- 30+------
TsB3 TsC2	Thurston soils, 2 to 6 percent slopes, severely eroded. Thurston soils, 6 to 12 percent slopes, moderately eroded.	These are shallow, well-drained soils that developed in coarse-textured, loose glacial drift on uplands. The substratum of the Thurston soils is gravelly, and that of the Dickinson soils is sandy. The depth to the	0 to 16---- 16 to 20---

See footnote at end of table.

significant to engineering—Continued

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
Classification uncertain									
Silt loam	ML to CL	A-4 or A-6	99 to 100	70 to 84	108	17	0.8 to 2.5	0.17	5.5 to 6.5.
Silty clay loam	CL	A-4 or A-6	95 to 100	70 to 85	105	18	0.8 to 2.5	0.17	5.0 to 5.5.
Clay loam	SC to CL	A-2 to A-6	90 to 95	30 to 60	120	12	0 to 0.2	0.17	5.0 to 6.0.
Clay loam	CL	A-7-6	90 to 95	50 to 70	122	11	0.2 to 0.8	0.17	6.0 to 7.5.
Silt loam	ML to CL	A-4	100	95 to 100	105	16	0.8 to 2.5	0.20	5.5 to 6.5.
Silt loam	CL	A-6	100	95 to 100	105	16	0.8 to 2.5	0.18	5.5 to 6.0.
Silt loam to very fine sandy loam.	ML to CL	A-4	100	95 to 100	106	18	2.5 to 5.0	0.17	6.0 to 6.5.
Very fine sandy loam.	SM, ML, or CL.	A-2 to A-6	95 to 100	15 to 65	105 to 122	12 to 14	0.8 to 5.0	0.12 to 0.17.	6.5 to 7.5.
Silt loam	CL	A-4	100	70 to 80	108 to 111	15 to 17	0.8 to 2.5	0.17	5.5 to 6.5.
Clay loam	CL	A-6	90 to 100	50 to 75	109 to 120	12 to 17	0.2 to 0.8	0.17	5.0 to 5.5.
Clay loam	CL	A-6 or A-7-6.	95 to 100	60 to 90	107 to 121	12 to 18	0.8 to 2.5	0.17	5.5 to 7.5.
Silt loam	ML to CL	A-7-6	100	98 to 99	95	23	0.8 to 2.5	0.20	5.5 to 6.0.
Silt loam to silty clay loam.	CL	A-6	100	98 to 99	106	18	0.8 to 2.5	0.18	5.5 to 6.0.
Silt loam or very fine sandy loam.	ML to CL	A-4 or A-6	100	98 to 99	106	18	0.8 to 2.5	0.17	5.5 to 7.5.
Stratified gravel and sand.	GW or SW	A-1 or A-3	60 to 75	5 to 10	120 to 125	8 to 10	10.0+	0.015	6.0 to 7.5.
Loam to silt loam	SC	A-4	90 to 100	40 to 45	110	15	0.8 to 2.5	0.20	6.0 to 6.5.
Loam or clay loam.	SC to CL	A-4 to A-6	90 to 100	40 to 45	110	15	0.8 to 2.5	0.18	5.5 to 6.5.
Gravelly loam or sandy loam.	GM or SC	A-2 or A-4	50 to 75	20 to 40	125	8	2.5 to 5.0	0.12	5.5 to 6.5.
Gravelly or sandy glacial drift.	GW or SP	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	6.0 to 7.5.
Loam or sandy loam.	SC	A-4	90 to 100	40 to 45	110	15	2.5 to 5.0	0.20	5.5 to 6.5.
Sandy loam or gravelly loam.	GM or SC	A-2 or A-4	80 to 90	20 to 30	125	8	2.5 to 5.0	0.12	5.5 to 6.0.

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
			Inches
TsC3 TuA TuB TuB2	Thurston soils, 6 to 12 percent slopes, severely eroded. Thurston and Dickinson soils, 0 to 2 percent slopes. Thurston and Dickinson soils, 2 to 6 percent slopes. Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded.	water table is normally more than 10 feet.	20+------
Ud	Udolpho silt loam.	This is a moderately deep, somewhat poorly drained, nearly level soil that developed in glacial outwash. Firm glacial till lies beneath the outwash, at depths of 5 to 10 feet. The depth to the water table is between 2 and 10 feet, varying with the season.	0 to 18---- 18 to 27--- 27 to 120-- 120+-----
VaA VaB VaB2	Vlasaty silt loam, 0 to 2 percent slopes. Vlasaty silt loam, 2 to 6 percent slopes. Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded.	These are deep, moderately well drained soils that developed in a thin silt cap over glacial till on uplands. The silt cap ranges from 6 to 30 inches in depth. It overlies a pebble band at the top of the glacial till. The depth to the water table is normally more than 5 feet, but in some seasons it is no more than 2 feet.	0 to 11---- 11 to 35--- 35+------
WaA WaB WaB2 WdA WmC2	Waukegan silt loam, 0 to 2 percent slopes. Waukegan silt loam, 2 to 6 percent slopes. Waukegan silt loam, 2 to 6 percent slopes, moderately eroded. Waukegan silt loam, deep, 0 to 2 percent slopes. Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded.	These are deep to moderately deep, well-drained soils that developed from glacial outwash and alluvium on terraces. The deep Waukegan soil has 2 feet of silt loam or silty clay loam in the second layer. The sandy clay loam or clay loam layer contains fine gravel. The depth to the water table is normally more than 10 feet.	0 to 17---- 17 to 28--- 28 to 33--- 33+------
WkA	Waukegan silt loam, thick surface variant, 0 to 2 percent slopes.	This is a well-drained soil that developed from alluvium on high bottoms and low terraces. The depth to the water table is 5 to 10 feet or more. The soil is flooded about once in 25 years.	0 to 24---- 24 to 34--- 34 to 43--- 43+------
WnB WnB2 WnC WnC2 WnD WnD2 WpC3 WpD3	Whalan silt loam, 2 to 6 percent slopes. Whalan silt loam, 2 to 6 percent slopes, moderately eroded. Whalan silt loam, 6 to 12 percent slopes. Whalan silt loam, 6 to 12 percent slopes, moderately eroded. Whalan silt loam, 12 to 18 percent slopes. Whalan silt loam, 12 to 18 percent slopes, moderately eroded. Whalan soils, 6 to 12 percent slopes, severely eroded. Whalan soils, 12 to 18 percent slopes, severely eroded.	These are shallow, well-drained soils that developed in a thin silt cap over thin glacial till over limestone bedrock on uplands. The lower subsoil contains small stones, pieces of gravel, and fragments of limestone. A thin layer of stiff clay may lie next to the limestone. The water table is not generally within the soil above bedrock.	0 to 15---- 15 to 22--- 22+------
WoB WoB2 WoC WoC2 WoD WoD2	Whalan silt loam, moderately deep, 2 to 6 percent slopes. Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded. Whalan silt loam, moderately deep, 6 to 12 percent slopes. Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded. Whalan silt loam, moderately deep, 12 to 18 percent slopes. Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded.	These are moderately deep, well-drained soils that developed in a thin silt cap over glacial till over limestone bedrock on uplands. Pebbles and pieces of gravel are common at the top of the clay loam layer. Fragments of limestone are mixed into the layer above the bedrock. The depth to bedrock ranges from 24 to 42 inches. The water table is not generally within the soil above bedrock.	0 to 18---- 18 to 28--- 28 to 32--- 32+------

See footnote at end of table.

significant to engineering—Continued

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
Sand or stratified sand and gravel.	GW or SP	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	5.5 to 7.0.
Silt loam	ML	A-4	95 to 100	70 to 80	105	16	0.8 to 2.5	0.20	5.5 to 6.0.
Silty clay loam, clay loam, or sandy clay loam.	CL	A-6	90 to 100	60 to 80	120	12	0.8 to 2.5	0.18	5.0 to 5.5.
Sand or sand and gravel.	GW to SM	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	6.0 to 7.0.
Clay loam glacial till.	CL	A-6	80 to 90	50 to 60	122	12	0.8 to 2.5	0.17	7.5.
Silt loam	ML or CL	A-4 or A-6	90 to 100	50 to 70	108 to 111	15 to 17	0.8 to 2.5	0.18	5.5 to 6.5.
Clay loam	CL	A-4 or A-6	90	50 to 60	117 to 121	11 to 13	0.8 to 2.5	0.17	5.0 to 6.0.
Clay loam	CL	A-6	90 to 100	50 to 60	120 to 122	11 to 12	0.2 to 0.8	0.17	6.0 to 7.0.
Silt loam	ML	A-6	100	85	95	23	0.8 to 2.5	0.20	5.5 to 6.5.
Silt loam to silty clay loam.	CL	A-6 or A-7-6.	100	50 to 65	100	21	2.5 to 5.0	0.18	5.5 to 6.0.
Sandy clay loam or clay loam.	CL	A-6	80	60	117	13	2.5 to 5.0	0.17	5.5 to 6.0.
Stratified sand and gravel.	SM to GW	A-1 or A-3	50	5 to 10	125	8	10.0+	0.015	6.0 to 7.5.
Silt loam	ML	A-4 to A-6	95 to 100	50 to 60	95	23	0.8 to 2.5	0.20	6.0 to 6.5.
Silt loam to silty clay loam.	ML to CL	A-6	95 to 100	50 to 60	100	20	0.8 to 2.5	0.18	6.0 to 6.5.
Loam or sandy loam.	SM	A-2 or A-4	85 to 95	30 to 45	110	15	2.5 to 5.0	0.13	6.0 to 6.5.
Coarse sand or gravelly sand.	GW to SM	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	6.5 to 7.5.
Loam or silt loam.	ML to CL	A-4	98	70 to 80	110	15	0.8 to 2.5	0.18	5.5 to 6.5.
Clay loam	CL to CH	A-7-6	90 to 95	50 to 60	103	18	0.8 to 2.5	0.17	5.5 to 7.0.
Bedrock									
Silt loam	ML to CL	A-4	98	70 to 80	105	20	0.8 to 2.5	0.18	5.5 to 6.5.
Clay loam	CL	A-6	90 to 95	50 to 60	110	15	0.8 to 2.5	0.17	5.5 to 6.0.
Clay loam to clay	CL to MH	A-7-5	80 to 90	50 to 60	103	18	0.8 to 2.5	0.17	6.5 to 7.0.
Bedrock									

TABLE 4.—*Estimated physical properties*

Map symbol	Mapping unit	Site and general characteristics	Depth from surface
			Inches
WoE	Whalan silt loam, moderately deep, 18 to 25 percent slopes.		
WoE2	Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded.		
WsB3	Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded.		
WsC3	Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded.		
WsD3	Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded.		
WuA	Wykoff loam, 0 to 2 percent slopes.	These are moderately deep, well-drained soils that developed in coarse-textured, loose glacial drift on uplands. The depth to the water table is generally more than 10 feet.	0 to 18
WuB	Wykoff loam, 2 to 6 percent slopes.		18 to 30
WuB2	Wykoff loam, 2 to 6 percent slopes, moderately eroded.		
WuC	Wykoff loam, 6 to 12 percent slopes.		
WuC2	Wykoff loam, 6 to 12 percent slopes, moderately eroded.		30+
WuC3	Wykoff loam, 6 to 12 percent slopes, severely eroded.		
WuD2	Wykoff loam, 12 to 18 percent slopes, eroded.		
WuD3	Wykoff loam, 12 to 18 percent slopes, severely eroded.		
WyB	Wykoff soils, 2 to 6 percent slopes.	These are shallow, well-drained soils that developed in coarse-textured, loose glacial drift on uplands. The depth to the water table is generally more than 10 feet.	0 to 9
WyB2	Wykoff soils, 2 to 6 percent slopes, moderately eroded.		
WyC2	Wykoff soils, 6 to 12 percent slopes, eroded.		9 to 18
WyC3	Wykoff soils, 6 to 12 percent slopes, severely eroded.		
WzD2	Wykoff and Thurston soils, 12 to 18 percent slopes, eroded.		18+
WzD3	Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded.		

[1] These figures for the lower layers show the estimated range in inches per hour of water percolating through the soil. Classes of permeability are as follows: Slow, 0 to 0.2 inch per hour; moderately slow, 0.2 to 0.8 inch per hour; moderate, 0.8 inch to 2.5 inches per hour; moderately rapid, 2.5 to 5.0 inches per hour; rapid, 5.0 to 10.0 inches per hour; and very rapid, more than 10.0 inches per hour.

Frost action is a serious problem in soil engineering in this county. Frozen soil materials should not be used in constructing embankments, but it is not always practical to suspend earthwork construction during the winter months. If the material to be worked with is gravelly or sandy and does not contain more than a small percentage of silt or clay, earthwork may be permitted in winter, provided that the material is compacted according to the required standards for such construction and provided that no frozen material is included.

Soils that consist of a mixture of clay, silt, and coarser materials are not as susceptible to frost heaving and subsequent frost boils as soils that contain a high percentage of silts or very fine sands. A soil is susceptible to damaging frost action if about 10 percent or more of the soil material can pass a No. 200 sieve.

Uniformity of soil materials is important in grading design to prevent frost damage. Differences in expansion between one material and another cause damage from frost heaving. Some deposits of glacial till contain lenses or pockets of fine sand and silt that will cause differential frost heave. Highway subgrades laid over glacial till should contain a thick enough layer of material that is not susceptible to frost heaving.

Poorly drained and very poorly drained soils are extensive in depressions. In some of these areas the material is highly organic, and peat and muck have developed to a depth of 2 to 6 feet. Peat is not suitable for use in

significant to engineering—Continued

Estimated classification			Estimated percent passing—		Maximum dry density	Optimum moisture content	Permeability [1]	Available water	Reaction
USDA texture	Unified	AASHO	No. 4 sieve	No. 200 sieve					
			Percent	*Percent*	*Pounds per cubic foot*	*Percent*	*Inches per hour*	*Inches per inch*	*pH*
Silt loam or loam	ML to CL	A-4	90 to 100	40 to 45	110	15	0.8 to 2.5	0.18	5.0 to 6.0.
Loam, clay loam, or gravelly sandy clay loam.	SC to CL	A-6	80 to 90	40 to 55	115	12	0.8 to 2.5	0.17	5.0 to 5.5.
Gravelly sandy glacial drift.	GW to SM	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	5.5 to 7.5.
Loam or sandy loam.	SC to SM	A-2 or A-4	90 to 100	30 to 45	110	15	2.5 to 5.0	0.13	5.5 to 6.0.
Loam, sandy loam, or gravelly loam.	SC to SM	A-2 or A-4	80 to 90	30 to 45	110	15	2.5 to 5.0	0.13	5.0 to 5.5.
Gravelly sand	GW to SM	A-1 or A-3	50 to 75	5 to 10	120	10	10.0+	0.015	5.5 to 7.5.

foundations of roads or other engineering structures, because it has low strength. Roads should, if possible, be located to avoid areas of deep peat. Peat and other highly organic material should be removed from the section of roadway or foundation and replaced with a more suitable soil material.

In areas of peat or muck, the water table is normally high. Roads through these depressed areas should be built on embankments so that the pavement surface is at least 4 feet above the water table. A thorough field investigation is necessary to plan engineering structures in depressed areas.

Some soils that have a high water table may be made more suitable for borrow and for roadway excavation by the construction of drainage ditches before earthwork is started. Underdrains may be required where either a perched or normal water table might cause the soil to be unstable.

Parts of the bottom lands may be flooded each year. Roads on these bottom lands may need to be built on a continuous embankment above the high water level. Suitable materials for use in the embankment can be taken from most soils in the bottom lands, except from Mixed alluvial land, poorly drained.

Table 5 shows estimates of the suitability of the soils in each series for various engineering uses. Specific features of each soil series that might affect the selection, design, and application of various engineering practices have been considered. These features are evaluated from test data and from field performance.

TABLE 5.—*Estimated suitability of the soils for use in construction*

Soil series and map symbols	Suitability of soil material for—						
	Source of sand and gravel	Topsoil for cuts, fills, embankments, etc.[1]	Upper part of roadway [2]	Use in foundations [3]	Use in embankments [3]	Use in dikes [3]	Water impoundment
Alluvial land (Ad, Lo, Mp, Mx.)	Not suitable	Poor to good. Check each site.	Good to not suitable. Check each site.	Variable but generally fair to good. Check each site.	Variable but generally fair to good. Check each site.	Fair. Side slopes should be 4 or 6 to 1.	Not suitable
Bixby (BbA, BbB2, BxA, BxB2.)	Suitable for both sand and gravel.	Fair to good	Fair in upper 2½ feet; good below.	Good. Cutoffs and core trenches not practical. Piping hazard through fine sandy substratum.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Not suitable
Canisteo (Ca.)	Not suitable	Good	Not suitable in upper 3 to 4 feet; fair in underlying till if drained.	Poor to depth of 2½ to 3 feet; fair below. Discard material down to 2½ feet or to underlying till.	Poor above till; good in till if drained.	Poor	Good. Well suited to dugout ponds.
Canisteo, coarse substratum. (Cb.)	Suitable	Good	Not suitable in upper 3 to 4 feet; fair below if drained.	Poor above substratum; good below. Discard material to substratum. Piping hazard in substratum.	Poor above gravel; good in gravel.	Poor	Good. Well suited to dugout ponds.
Chaseburg (ChA, ChB.)	Not suitable	Fair to good	Generally not suitable.	Fair to poor	Fair	Fair. Side slopes should be 3 or 4 to 1.	Poor to fair. Reservoir bottom should be scarified and compacted.
Clyde (CsA, CsB.)	Not suitable	Good	Not suitable in upper 3 to 4 feet; fair in underlying till if drained.	Poor to depth of 2½ to 3 feet; fair below. Discard material down to 2½ feet or to underlying till.	Poor above the till; good in till if drained.	Poor	Good. Well suited to dugout ponds.
Dakota (DaA, DaB2, DaC2.)	Suitable for sand.	Good	Good	Fair to good. Piping hazard through sandy substratum.	Fair to good. Adequate strength and stability. Locate borrow outside of reservoir area.	Fair. Side slopes should be 4 or 6 to 1.	Poor. Reservoir bottoms require seal blankets.
Downs (DoA, DoB, DoB2, DoC2, DoC3, DoD2.)	Not suitable	Good	Not suitable	Fair to poor	Fair	Good	Poor to fair. Reservoir bottom should be scarified and compacted.

See footnotes at end of table.

and selected characteristics affecting engineering practices

Suitability of soil material for—Continued				Characteristics that affect engineering practices			Base needed for flexible pavement [3]
Drainage for agriculture	Sprinkler irrigation	Terracing	Septic tank disposal fields	Susceptibility to frost action [3]	Compaction characteristics [3 4]	Susceptibility to erosion of cuts and fills	
Not needed	Not suitable	Not suitable		Moderate to high.	Fair. Roll in thin layers.	Slight to moderate.	Thin to thick. Check each site.
Not needed	Suitable	Generally not suitable.	Suitable	Slight	Good. High density.	Severe	Thin.
Needed. Tile and open ditches suitable.	Not suitable	Not suitable		High	Poor in upper 3 feet, which is low in density and hard to work. Good in till.	Slight	Thick.
Needed. Tile and open ditches suitable.	Not suitable	Not suitable		High above substratum; slight in substratum if drained.	Poor in upper 3 feet, which is low in density and hard to work. Fair below.	Slight	Thin to moderate, depending on whether pavement is on material above or below depth of 3 feet.
Not needed	Suitable	Not suitable		Moderate to high.	Fair. Roll in thin layers.	Slight to moderate.	Moderate to thick.
Needed. Tile and open ditches suitable.	Not suitable	Not suitable		High	Poor in upper 3 feet, which is low in density and hard to work. Good in till.	Slight	Thick.
Not needed	Suitable	Not suitable	Suitable	Moderate in upper 2½ feet; slight below.	Good in surface soil and subsoil; fair in substratum.	Severe	Thin to moderate, depending on whether pavement is on material above or below depth of 2 feet.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		High	Fair. Roll in layers.	Moderate	Moderate to thick.

TABLE 5.—*Estimated suitability of the soils for use in construction*

Soil series and map symbols	Suitability of soil material for—						
	Source of sand and gravel	Topsoil for cuts, fills, embankments, etc.[1]	Upper part of roadway [2]	Use in foundations [3]	Use in embankments [3]	Use in dikes [3]	Water impoundment
Fayette (FaA, FaB, FaB2, FaC, FaC2, FaD, FaD2, FaC3, FaD3.)	Not suitable	Fair to good	Not suitable	Fair to poor	Fair	Good	Poor to fair. Reservoir bottom should be scarified and compacted.
Fayette and Seaton. (FsE2, FsF2, FsE3.)	Not suitable	Fair to good	Not suitable	Fair to poor	Fair	Fair	Poor. Reservoir bottom should be scarified and compacted.
Floyd (FtB, Fy.)	Not suitable	Good	Not suitable in upper 3 to 4 feet; fair to good in underlying till.	Poor in surface soil; fair in subsoil; good in till substratum.	Poor to fair above till; good in till.	Fair	Good
Hayfield (HaA, HaB.)	Suitable	Good	Fair in upper 2½ feet; good below.	Good below depths of 2½ feet. Substratum rapidly permeable. Cutoffs not practical.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Poor to fair. Reservoir bottom should be scarified and compacted.
Judson (JuA, JuB.)	Not suitable	Good	Not suitable	Fair to poor	Fair	Fair. Side slopes should be 3 or 4 to 1.	Poor. Reservoir bottom should be scarified and compacted.
Kasson (KaA, KaB, KaB2.)	Not suitable	Fair to good	Not suitable in upper 2 feet; fair to good below.	Poor in surface soil; fair in subsoil; good in substratum.	Poor to fair above till; good in till.	Fair to good.	Good. Reservoir bottom should be scarified and compacted.
Kato (Kc.)	Suitable; may have high water table.	Good	Fair in upper 2½ feet; good below.	Good; material below 2½ feet has good strength. Highly permeable. Cutoffs and core trenches not practical.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Poor to fair. Reservoir bottom should be scarified and compacted.
Kenyon (KnA, KnB, KnB2.)	Not suitable	Good	Not suitable in upper 3 to 4 feet; fair to good in underlying till.	Fair to good in subsoil and till.	Fair to good	Good	Good. Reservoir bottom should be scarified and compacted.
Marshan (Ma.)	Suitable; has high water table.	Good	Not suitable in upper 3 to 4 feet; fair below if drained.	Poor above substratum. Discard material down to underlying gravel.	Very poor above gravel; good in gravel if drained.	Poor	Good. Well suited to dugout ponds.
Ostrander (OsA, OsB, OsB2, OsC2.)	Not suitable	Good	Poor in surface soil and subsoil; fair in till.	Good. Needs core trench into till.	Good	Good	Fair to good. Reservoir bottom should be scarified and compacted.

See footnotes at end of table.

and selected characteristics affecting engineering practices—Continued

Suitability of soil material for—Continued				Characteristics that affect engineering practices			Base needed for flexible pavement [3]
Drainage for agriculture	Sprinkler irrigation	Terracing	Septic tank disposal fields	Susceptibility to frost action [3]	Compaction characteristics [3 4]	Susceptibility to erosion of cuts and fills	
Not needed	Suitable	Suitable on slopes of less than 12 percent.		High	Fair. Roll in layers.	Moderate	Moderate to thick.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		High	Fair. Roll in layers.	Moderate	Moderate to thick.
Needed. Tile drainage suitable.	Suitable. Needs adequate drainage before irrigation.	Not suitable		High	Poor in upper 3 feet; good in underlying till. Roll in layers.	Slight	Thick.
Not needed	Suitable	Suitable		Moderate in upper 2½ feet; slight below.	Fair in upper 2½ feet; good in substratum.	Slight	Moderate to thick over material in upper 2½ feet; thin below.
Not needed	Suitable	Not suitable		High	Fair. Roll in layers	Slight to moderate.	Moderate to thick.
Not needed	Suitable	Not suitable	May give trouble.	Moderate to high.	Fair in upper 2 to 3 feet; good in till.	Slight	Thick if placed on surface; moderate if placed on till.
Needed. Tile drainage suitable.	Suitable if drained.	Not suitable		Moderate in upper 2½ feet; slight below.	Good	Slight	Thick over material in upper 2½ feet; thin below.
Generally not needed.	Suitable	Suitable		High	Fair to good. Roll in layers.	Slight	Moderate to thick.
Needed. Tile and open ditches suitable.	Not suitable	Not suitable		High above substratum; slight in substratum if drained.	Poor in upper 3 feet, which is low in density and hard to work. Fair below.	Slight	Thick.
Not needed	Suitable	Suitable. Contains a few boulders.		Moderate to high.	Fair to good. Roll in layers.	Slight to moderate.	Moderate.

TABLE 5.—*Estimated suitability of the soils for use in construction*

Soil series and map symbols	Suitability of soil material for—						
	Source of sand and gravel	Topsoil for cuts, fills, embankments, etc.[1]	Upper part of roadway [2]	Use in foundations [3]	Use in embankments [3]	Use in dikes [3]	Water impoundment
Peat and Muck (PmA, PtA, PtB.)	Not suitable	Fair to good	Not suitable	Poor	Not suitable	Poor	Fair. Dugout ponds or level ditches can be used for wildlife management.
Racine (RaA, RaB, RaB2, RaC, RaC2, RcB3, RcC3.)	Not suitable	Good	Not suitable in upper 3 to 4 feet; fair to good in underlying till.	Good in subsoil and till.	Good	Good	Good. Reservoir bottom should be scarified and compacted.
Renova (ReA, ReB, ReB2, ReC, ReC2, ReD, ReD2, ReE, ReE2, ReF2, RfB3, RfC3, RfD3, RfE3.)	Not suitable	Fair to good	Not suitable in upper 3 to 4 feet; fair to good in underlying till.	Good in subsoil and till.	Good. High density and stability.	Good	Good. Reservoir bottom should be scarified and compacted.
Rockton (RoB2, RoD, RoD2, RpA, RpB, RpC, RsC3, RsD3.)	Not suitable	Fair to good	Not suitable	Fair to good. Excessive water loss through fractured limestone bedrock.	Fair for low dams. Quantity of material is limited because of shallow depth to bedrock. Locate borrow outside of reservoir area.	Fair	Poor, because of underlying bedrock.
Rough broken and stony land. (Ru.)	No classification possible						
Sargeant (SaA.)	Not suitable	Fair to good	Not suitable in upper 3 feet; fair in underlying till.	Poor in surface soil; fair in subsoil; good in till substratum.	Poor to fair above till; good in till.	Fair to good.	Good
Seaton (SeB, SeB2, SeC, SeC2, SeC3, SeD, SeD2, SeD3.)	Not suitable	Fair to good	Not suitable	Fair to poor	Poor to fair	Fair	Poor. Reservoir bottom should be scarified and compacted.
Skyberg (SkA, SkB.)	Not suitable	Fair to good	Not suitable in upper 3 feet; fair in underlying till.	Poor in surface soil; fair in subsoil; good in till substratum.	Poor to fair above till; good in till.	Fair to good.	Good
Tama (TaA, TaB, TaB2.)	Not suitable	Good	Not suitable	Fair to poor	Fair	Good	Poor to fair. Reservoir bottom should be scarified and compacted.

See footnotes at end of table.

and selected characteristics affecting engineering practices—Continued

Suitability of soil material for—Continued				Characteristics that affect engineering practices			Base needed for flexible pavement [3]
Drainage for agriculture	Sprinkler irrigation	Terracing	Septic tank disposal fields	Susceptibility to frost action [3]	Compaction characteristics [3 4]	Susceptibility to erosion of cuts and fills	
Needed. Open ditches with tile laterals suitable.	Suitable if drained.	Not suitable		High	Not suitable	Not suitable for fills.	Thick. Remove material down to mineral soil.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		Moderate to high.	Fair to good. Roll in layers.	Slight to moderate.	Moderate.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		Moderate to high.	Good. Roll in layers.	Slight to moderate.	Moderate.
Not needed	Not suitable	Not suitable; because of shallow depth to bedrock. Moderately deep soils may be suitable. Check each site.		Moderate. Bedrock limits capillary flow.	Fair; subsoil material above bedrock satisfactory.	Slight to moderate.	Thick.
Needed. Carefully evaluate the compact subsoil. Results of tile drainage vary.	Suitable if drained. Irrigation limited by compact subsoil.	Not suitable	May be a problem.	High	Poor to fair in upper 3 feet; good in underlying till.	Slight	Thick over material above till; moderate over till.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		High	Poor to fair. Roll in layers.	Moderate to severe.	Moderate to thick.
Needed. Carefully evaluate the compact subsoil. Results of tile drainage vary.	Suitable if drained. Irrigation limited by compact subsoil.	Not suitable	May be a problem.	High	Poor to fair in upper 3 feet; good in underlying till.	Slight	Thick over material above till; moderate over till.
Not needed	Suitable	Suitable on slopes of less than 12 percent.		High	Fair. Roll in layers.	Moderate to severe.	Moderate to thick.

TABLE 5.—*Estimated suitability of the soils for use in construction*

Soil series and map symbols	Suitability of soil material for—						
	Source of sand and gravel	Topsoil for cuts, fills, embankments, etc.[1]	Upper part of roadway [2]	Use in foundations [3]	Use in embankments [3]	Use in dikes [3]	Water impoundment
Terrace escarpments. (Te.)	Suitable; mostly sand or gravel or both, but may contain finer material. Check before using.	Not suitable	Good	Good; adequate strength. Highly permeable. Cutoffs and core trenches not practical.	Good. Adequate strength and stability. High compacted permeability.	Good	Not suitable.
Thurston and Dickinson loams. (ThB2, ThB3, ThC, ThC2, ThC3, ThD3, TtA, TtB.)	Thurston suitable for sand or gravel. Dickinson sand is poorly graded.	Fair to good	Good	Good. Substrata rapidly permeable. Cutoffs not practical.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Poor. Reservoirs and dams should have impervious blankets.
Thurston and Dickinson soils. (TsB3, TsC2, TsC3, TuA, TuB, TuB2.)	Thurston suitable for sand or gravel. Dickinson sand is poorly graded.	Not suitable	Good	Good. Substrata rapidly permeable. Cutoffs not practical.	Good. Adequate strength and stability.	Good	Not suitable. Dams need impervious blankets or center sections.
Udolpho (Ud.)	Suitable. May have high water table.	Fair to good	Fair in upper 2½ feet; good below.	Good. Material below 2½ feet has good strength. Highly permeable. Cutoffs and core trenches not practical. Possible piping hazard.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Fair. Reservoir bottom should be scarified and compacted.
Vlasaty (VaA, VaB, VaB2.)	Not suitable	Fair to good	Not suitable in upper 2 feet; fair to good in till.	Poor in surface soil; fair in subsoil; good in till substratum.	Poor to fair above till; good in till.	Fair to good.	Good. Reservoir bottom should be scarified and compacted.
Waukegan (WaA, WaB, WaB2, WdA, WkA, WmC2.)	Suitable	Good	Poor in upper 2½ feet; good below.	Good below 2½ feet. Highly permeable. Cutoffs and core trenches not practical. Possible piping hazard.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Poor to fair if gravel is not exposed. Reservoir bottom should be scarified and compacted.

See footnotes at end of table.

and selected characteristics affecting engineering practices—Continued

Suitability of soil material for—Continued				Characteristics that affect engineering practices			Base needed for flexible pavement [3]
Drainage for agriculture	Sprinkler irrigation	Terracing	Septic tank disposal fields	Susceptibility to frost action [3]	Compaction characteristics [3 4]	Susceptibility to erosion of cuts and fills	
Not needed	Not suitable	Not suitable		Slight	Good. High density.	Slight to severe, depending on the texture of the material at the site.	Thin.
Not needed	Suitable for light frequent applications.	Suitable on slopes of less than 12 percent.	Suitable in substratum.	Moderate in upper 2 feet; slight below.	Good in substratum.	Slight to severe, depending on the texture of the material at the site.	Thin.
Not needed	Not suitable	Generally not suitable.	Suitable in substratum.	Slight	Good. High density.	Moderate to severe.	Thin.
Needed. Carefully evaluate the compact subsoil. Results of tile drainage vary.	Suitable if drained. Irrigation limited by compact subsoil.	Not suitable		Moderate in upper 2½ feet; slight below.	Good	Slight	Thick over material in upper 2½ feet; thin over material below.
Not needed	Suitable	Not suitable	May be a problem.	Moderate to high.	Fair in upper 2 to 3 feet; good in underlying till.	Slight	Thick over material of surface; moderate over till.
Not needed	Suitable	Suitable on slopes of less than 12 percent.	Suitable in substratum.	Moderate in upper 2½ feet; slight below.	Fair in upper 2½ feet; good in substratum.	Slight	Thick over material of upper 2½ feet; thin over material below.

TABLE 5.—*Estimated suitability of the soils for use in construction*

Soil series and map symbols	Suitability of soil material for—						
	Source of sand and gravel	Topsoil for cuts, fills, embankments, etc.[1]	Upper part of roadway [2]	Use in foundations [3]	Use in embankments [3]	Use in dikes [3]	Water impoundment
Whalan (WnB, WnB2, WnC, WnC2, WnD, WnD2, WoB, WoB2, WoC, WoC2, WoD, WoD2, WoE, WoE2, WpC3, WpD3, WsB3, WsC3, WsD3.)	Not suitable	Fair	Not suitable	Fair to good. Excessive water loss through fractured limestone bedrock.	Fair for low dams. Quantity of material is limited because of shallow depth to bedrock. Locate borrow outside of reservoir area.	Fair	Poor because of underlying bedrock.
Wykoff loam (WuA, WuB, WuB2, WuC, WuC2, WuC3, WuD2, WuD3.)	Suitable	Fair	Good	Good. Substratum rapidly permeable. Cutoffs not practical.	Good. Adequate strength and stability. Locate borrow outside of reservoir area.	Good	Poor. Reservoirs and dams should have impervious blankets.
Wykoff soils (WyB, WyB2, WyC2, WyC3, WzD2, WzD3.)	Suitable	Not suitable.	Good	Good. Substratum rapidly permeable. Cutoffs not practical.	Good. Adequate strength and stability.	Good	Not suitable for ponds. Dams need impervious blankets.

[1] Refers to the surface soil only.
[2] Refers to the entire soil material except where layers are specified.

Formation and Classification of the Soils of the County

The soils of Dodge County will be easier to understand if we first consider how they formed and then classify them into large groups that have certain characteristics in common.

Formation of Soils

Soil results when the forces of weathering and soil development act on the materials that have been deposited or accumulated by geologic agencies. The characteristics of the soil in any particular place are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and the drainage that results from it, and (5) the length of time the forces of development have acted on the material. These five factors of soil formation are interdependent, and each modifies the effects of the others.

Parent materials

The soils in Dodge County developed from a wide range of parent materials. The differences in these parent materials account for many of the differences between soil series. The major sources of parent materials in this county were glacial till, glacial outwash, deep loess, silty material of mixed origin, limestone, sandstone, shale, alluvium, colluvium, and organic material.

Glacial till.—Nearly all of the upland soils in the county contain glacial till in their profile. The soils of all the upland associations except association 2 (Fayette, Seaton) and association 10 (Tama, Downs) developed chiefly in glacial till.

Three glaciers, the Nebraskan, the Kansan, and the Iowan, are known to have covered all of Dodge County. The Nebraskan glaciation occurred about 2 million years ago, and the Kansan about 1 million years ago. The Iowan was the last major glaciation that covered this county. It happened probably about 24,000 years ago.

The Cary glacier of the Late Wisconsin stage may have extended into northwestern Dodge County a few miles from the Steele County line about 12,000 to 15,000 years ago. A discontinuous band of morainic hills extending from Claremont to the northwestern corner of the county may mark the eastern margin of the Cary glaciation. The soils between this moraine and the Steele County line have some of the pothole topography that is characteristic of soils dating from the Late Wisconsin stage. The average depth of leaching is less than in the soils developed from Iowan till.

The total thickness of all glacial tills in the county varies considerably. They are thinnest in the northeastern part of the county and thickest in the southwestern part. In the railway well at Hayfield, the glacial

and selected characteristics affecting engineering practices—Continued

Suitability of soil material for—Continued				Characteristics that affect engineering practices			Base needed for flexible pavement [3]
Drainage for agriculture	Sprinkler irrigation	Terracing	Septic tank disposal fields	Susceptibility to frost action [3]	Compaction characteristics [3] [4]	Susceptibility to erosion of cuts and fills	
Not needed	Not suitable	Not suitable; because of shallow depth to bedrock. Moderately deep soil may be suitable. Check each site.		High. Bedrock limits capillary flow.	Fair; subsoil material above bedrock satisfactory.	Slight to moderate.	Thick.
Not needed	Suitable	Suitable on slopes of less than 12 percent.	Suitable in substratum.	Moderate in upper 2 feet; slight below.	Good in substratum.	Slight	Thin.
Not needed	Not suitable	Generally not suitable.	Suitable in substratum.	Slight	Good. High density.	Moderate to severe.	Thin.

[3] Refers to the substratum, except where otherwise specified.
[4] When at or near the optimum moisture content.

till is 155 feet thick. In the Dodge Center railway well, it is 112 feet thick (*2*).

The Kansan and Nebraskan tills are buried under the Iowan till and are not readily observable anywhere in Dodge County. Some of the Kansan till was incorporated into the Iowan deposits.

The Iowan till shows considerable variation within short distances. The thickness varies from a few inches up to many feet but is most commonly 8 to 10 feet. Some of the till is firm, but most of it is only moderately firm. The general texture varies from clay loam to loam. Small areas of coarse-textured sand and gravel are common.

The depth of leaching in this material is as little as 3½ feet in some places and as much as 12 feet in others. The unleached Iowan till is calcareous. The unoxidized and unleached till generally has a bluish color and is locally called "blue clay".

In the eastern part of the county, principally in areas of Floyd and Clyde soils, the till contains large, coarse-grained, light-colored granite boulders that tend to collect in drainageways. Many of them have been broken up and buried. Some of the largest were 25 to 30 feet in diameter, but most of them were 1 to 5 feet in diameter (fig. 13). Smaller stones, mostly greenstone, granite, quartz, and chert, are common in the plow layer and throughout the profile where it is composed only of the glacial till.

In some parts of the county the Iowan till is at the surface; in others it is covered by a thin to moderately thick silt cap; and in still others it is buried under 3½ to 10 feet of loess. Soils in loess over till and soils in silt over till are intermingled in the same areas. The glacial till under the deep loess deposits is assumed to be of Iowan age, since it does not appear to differ from the Iowan till at the surface elsewhere.

Where a silt cap overlies the till, a concentration of pebbles, stones, and coarse-textured material is between the silt layer and the till. The thickness of this pebble band varies from a few inches to many inches. Little or no clay appears to have accumulated in the horizons below the pebble band in these "two-story" profiles. The till beneath the pebble band has a bulk density of 1.5 to 1.8, and the silty material above it contains less sand and has a bulk density of 1.15 to 1.4 (*11*).

Glacial outwash.—The glacial outwash in this county is principally in soil associations 1 (Alluvial land, Waukegan, Bixby), 4 (Kato, Marshan), and 11 (Waukegan, Hayfield). The largest outwash plains are between Blooming Prairie and Claremont.

In the major river valleys, both Cary outwash and Iowan outwash are present. Along the north branch of the Root River and the southern branches of the Zumbro River, the outwash is principally of Iowan age. Most of the outwash elsewhere probably came from the Cary glacier.

Figure 13.—**Granite boulder left by glacier of Iowan age; smaller stones in background. Field is used for permanent pasture.**

The blanket of medium textured loam to silt loam that generally covers the coarser textured gravel and sand is probably outwash also. Small amounts of clay and large stones are mixed in the outwash in some places, especially along the tributaries of the Zumbro River. In many places near the Cedar River, lenses of dark-colored, shaly material are interbedded in the coarser textured outwash.

If unleached, the outwash is calcareous. It is seldom leached to a depth of more than 4 feet.

Between Blooming Prairie and Claremont, the outwash is, on the average, less than 10 feet thick. Beneath it is very dense, gray and blue glacial till from Iowan or pre-Iowan glaciations. In the lowest areas of these outwash plains, this very dense, nearly impervious glacial till is responsible for a high water table and the development of gley horizons in the soils.

Deep loess.—Most of the deep loess is in the northeastern part of the county. The largest areas are in Milton Township. A small area lies along the south side of the South Branch of the Zumbro River in Canisteo Township.

This loess was deposited during the Iowan and Cary glaciations, or after them, in the Peorian interglacial stage (*4*). Most of it was blown from the mud flats created by meltwater from the receding glaciers. Some was blown from outwash plains and bottom lands onto scattered areas along the major streams. The material tended to accumulate in areas of rough topography and where vegetation was partly established.

From 60 to 70 percent of the loess is silt, and the rest is very fine sand or clay. Near the edges of the loess areas, near the major streams, and in scattered islands of loess, the material contains more very fine sand than clay. The original loess was calcareous. The coarser textured loess is leached to a depth of 4 to 4½ feet, but the finer textured loess is leached to a depth of 5½ to 6 feet.

The loess ranges in thickness from 3½ to 10 feet. A layer of glacial till of varying thickness separates it from the bedrock below.

Silty material of mixed origin.—The silt cap that overlies the glacial till and pebble band contains more clay and less sand than the materials below it. It is less dense than the glacial till. A few large or small stones are present in the silt, but generally it is free of stones. The silt cap is deeper on the intrazonal soils than on the zonal soils, possibly because of a difference in the rate of geologic erosion rather than a difference in original depth of deposits.

The material in this silt cap is similar to that in the deep loess deposits, except that it contains a few stones. The presence of these stones makes it seem unlikely that the silt was deposited by wind. It is possible that the glacial till was deposited and compressed beneath the Iowan glaciers, and that the pebble band and the silt cap were deposited by the glacier as it receded and were reworked by water and wind.

Limestone.—Limestone is an important part of the soil profile in the Rockton and Whalan series and in the Rough broken and stony land type. The profile above the limestone has developed principally in loess and glacial till and not from the limestone. The reddish clay horizon just above the bedrock is generally a mixture of glacial till and material weathered from the limestone.

All of the limestone exposed in Dodge County belongs to the Ordovician system. The major type is the Stewartville member of the Galena formation, which lies above the Decorah shale formation. Shakopee limestone is under the Rockton and Whalan soils in Milton Township. Maquoketa limestone is exposed in the rock quarry near Wasioja.

Sandstone.—Sandstone lies beneath some areas of Rough broken and stony land. Much of the coarse-textured alluvial material along the lower parts of the tributaries of the Zumbro River is sand weathered from this sandstone.

The only sandstone exposed in this county is of the St. Peter formation, which lies above the Shakopee limestone in the Ordovician system. In most places in this county, it is about 100 feet thick.

Shale.—Shale of the Decorah and Glenwood formations in the Ordovician system is part of the profile of a few of the Clyde, Rockton, and Whalan soils in Milton Township. In the southwestern part of the county, the Maquoketa shales lie beneath the glacial till, but they are not near enough to the surface to affect the soil profile.

Alluvium and colluvium.—The Lawson and Orion soils and the alluvial land types are made up principally of alluvium. The Judson and Chaseburg soils developed from a mixture of alluvial and colluvial materials in waterways and on alluvial fans.

The alluvium and colluvium vary in texture from silt to sand, depending on how near they are to glacial materials and sandstone escarpments. Most of them are silty. In reaction they are neutral to slightly calcareous.

Organic material.—Organic soils developed where the water table was high and where seepage kept the soil permanently wet. In the western part of the county, shallow peat soils formed in deep basins in the till plain and outwash plain. In the eastern part of the county, muck soils developed, principally on gentle slopes kept wet by seepage.

Many areas of the Clyde and Marshan soils had surface horizons of organic material less than 12 inches deep. After the soils were drained and cultivated for a few years, the organic material was incorporated into the mineral soil below.

The organic soils in Dodge County are generally slightly acid to mildly alkaline. Most of them are low in available phosphorus and potassium.

Climate

Climate is a major factor in determining what soils develop from the various parent materials. The rate and intensity of hydrolysis, hydration, carbonation, oxidation, and other important chemical reactions in the soil are influenced by the climate. Temperature, rainfall, relative humidity, and length of the frost-free period are important in determining the vegetation.

Details on the climate in Dodge County are given under the heading, Climate, in General Information About the County.

Vegetation

Dodge County is in the transition zone between a climate favorable for forest vegetation and a climate favorable for prairie grass vegetation. During the last 5,000 years the climate has been more favorable for prairie grasses, but before that it was more favorable for forests (*6*). Deciduous forests and prairie grasses have alternated as the principal cover in some areas.

In soils that have similar relief, drainage, parent material, and age, the surface soil is darker colored and deeper where the native vegetation has been grass than where it has been forest. In the forest soils, the movement of clay and nutrients into the subsoil is greater, and the subsoils are less permeable. Where forests and grasses have alternated, the soils have some characteristics of both forest soils and grassland soils.

Relief and drainage

Relief and drainage are important factors in the development of soils in Dodge County. Maximum development takes place in well-drained soils on gentle slopes. Little or no development occurs in depressed or level soils that have a permanent high water table. Soil development is very slow on steep slopes where runoff is rapid, infiltration of water is slow, and geologic erosion removes the surface soil as fast as it forms. Where the relief and drainage favor the growth of prairie grasses, the surface soil tends to be deeper and to contain more organic matter than where the growth of forest is favored.

Time

The effect of climate and vegetation on parent material that has favorable relief and drainage is somewhat proportional to the time that these forces have been working. If climate, vegetation, parent material, relief, and drainage are similar, the degree of profile development is greatest and the general fertility level is lowest in the oldest soils.

The oldest soils in Dodge County developed on glacial till. Most of the glacial till at the surface is from the Iowan glaciation of about 24,000 years ago (*6*, *11*). Beneath the Iowan till, and in a few places at the surface or mixed into the Iowan till, are older glacial tills of the Kansan and Nebraskan glaciations. The loess soils are similar in age to the glacial till soils.

Younger soil materials are those on the glacial outwash plains and terraces that date from the Cary glaciation about 12,000 to 15,000 years ago. The Cary glacier advanced to a point just west of Dodge County, and considerable material was washed into the western part of the county.

Still younger are the alluvial materials, which are altered by every flood; the organic soil materials; and the overwash that covers some upland soils after heavy rains.

Classification of Soils

The broadest categories of soil classification are the three *orders*—zonal, intrazonal, and azonal (*8*). Zonal soils are those that strongly reflect the influence of vegetation and climate. Azonal soils are those that are so young or so steep or are developing on such resistant material that very little progress in soil formation has been made. Intrazonal soils have distinct horizons, but their dominant characteristics are those that depend on the nature of the parent material or the drainage rather than on vegetation or climate.

Within the soil orders are the *great soil groups*. A great soil group is made up of soils that have generally similar profiles resulting from the similarity of several, but not all, of the soil-forming factors.

The soil *series* are divisions within the great soil groups. All of the soils in one series are similar in all profile characteristics except texture of the surface soil.

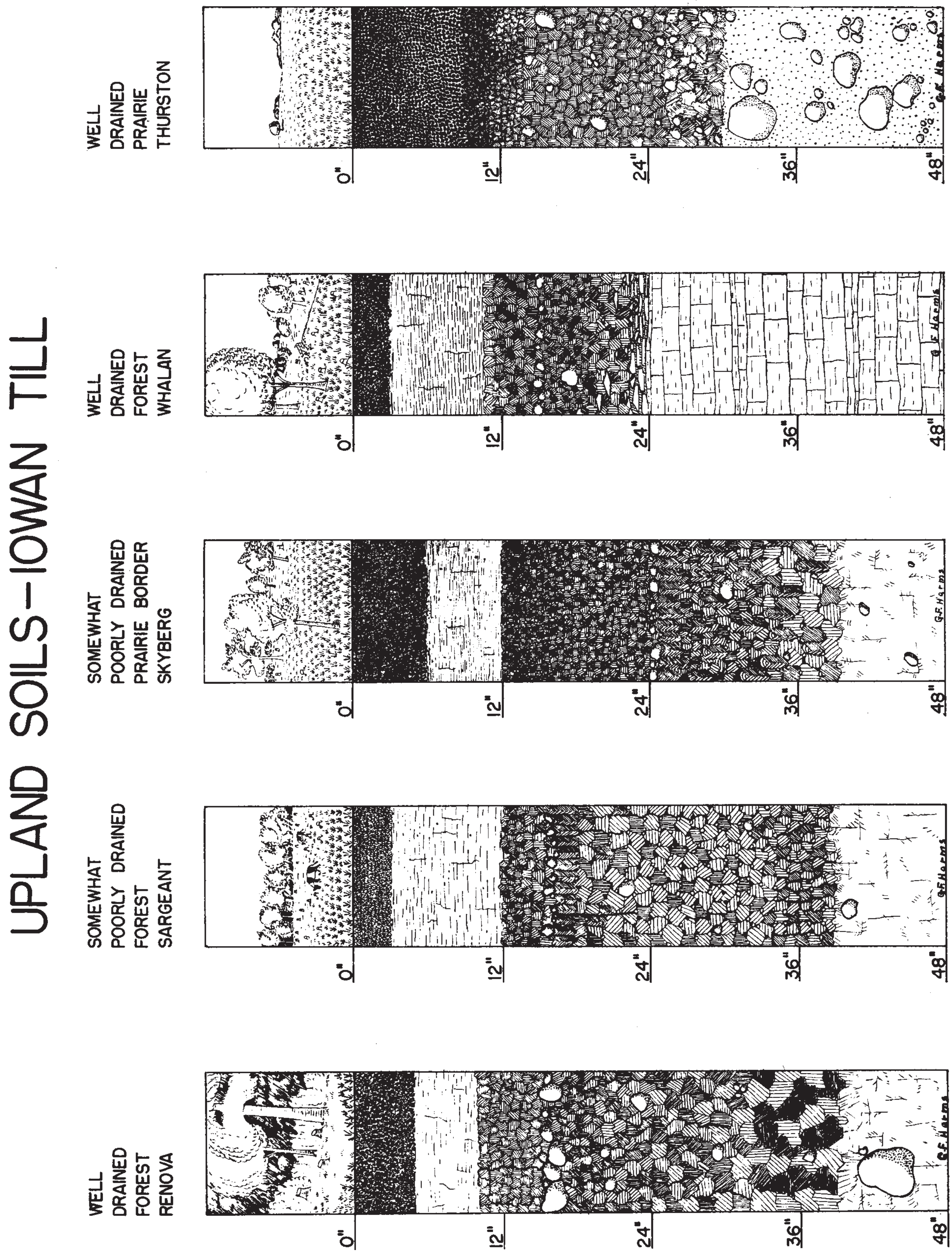
In the following pages, the great soil groups in the county and the principal intergrades are defined, and a typical profile is described for each of the more important groups. The classification of the soil series by orders and great soil groups is shown in table 6. For each series, the soil-forming factors of parent material, native vegetation, relief, and drainage are shown. The factors of time and climate are not shown on the table because they have not been as important in differentiating the soil series within the county.

Figures 14, 15, 16, and 17 will aid in understanding the position of the soils on the landscape, their parent material, and the nature of their profile.

Brunizems

The Brunizems are zonal soils that developed under tall grass in a relatively humid climate. They have a very dark brown to black A_1 horizon that grades through a brown and yellowish-brown subsoil to lighter colored parent material at depths of 2½ to 5 feet. Calcium carbonate accumulations are not normally present in any part of the profile.

The eight soil series in Dodge County that belong to the Brunizem great soil group are the Dakota, Dickinson, Kenyon, Ostrander, Rockton, Tama, Thurston, and Waukegan series. The Ostrander soils are typical well-drained Brunizems.


UPLAND SOILS-IOWAN TILL
WELL
DRAINED
FOREST
RENOVA
SOMEWHAT
POORLY DRAINED
FOREST
SARGEANT
SOMEWHAT
POORLY DRAINED
PRAIRIE BORDER
SKYBERG
WELL
DRAINED
FOREST
WHALAN
WELL
DRAINED
PRAIRIE
THURSTON
0"
12"
24"
36"
48"

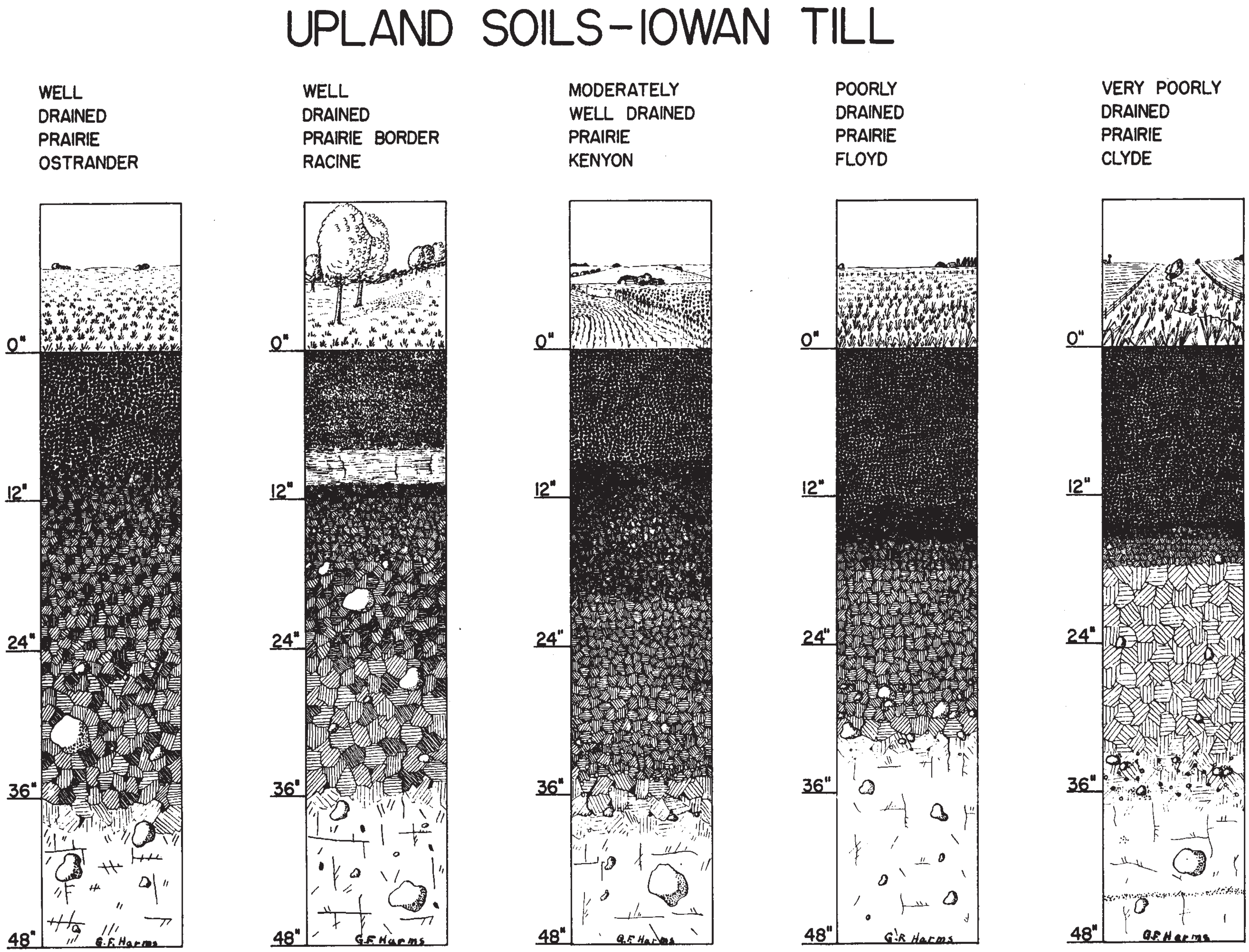


Figure 14.—Profiles of soils in Iowan till on the upland; see figure 17 for explanation of structures and textures.

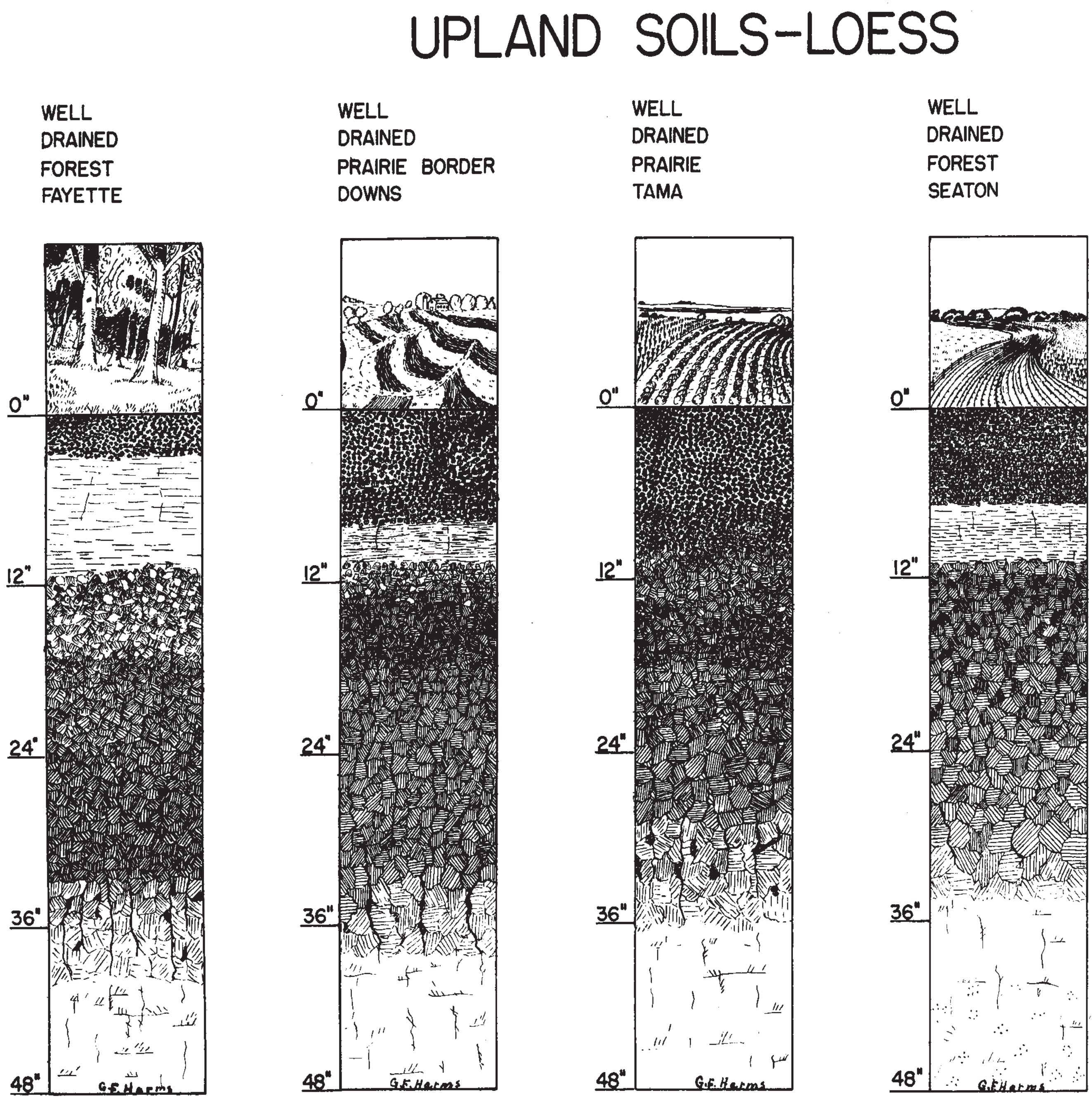


Figure 15.—Profiles of soils in loess on the upland; see figure 17 for explanation of structures and textures.

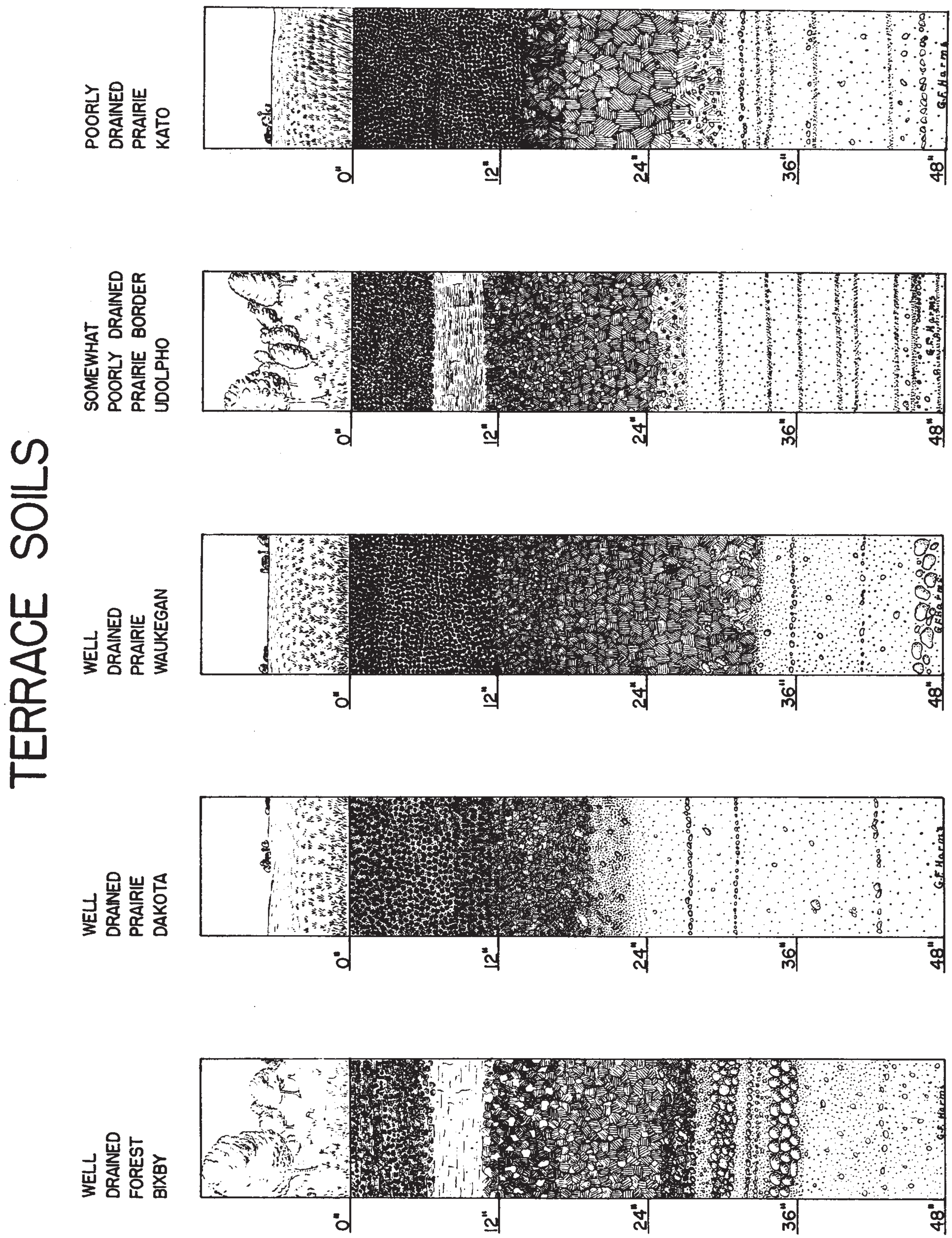


Figure 16.—Profiles of soils on the terraces; see figure 17 for explanation of structures and textures.

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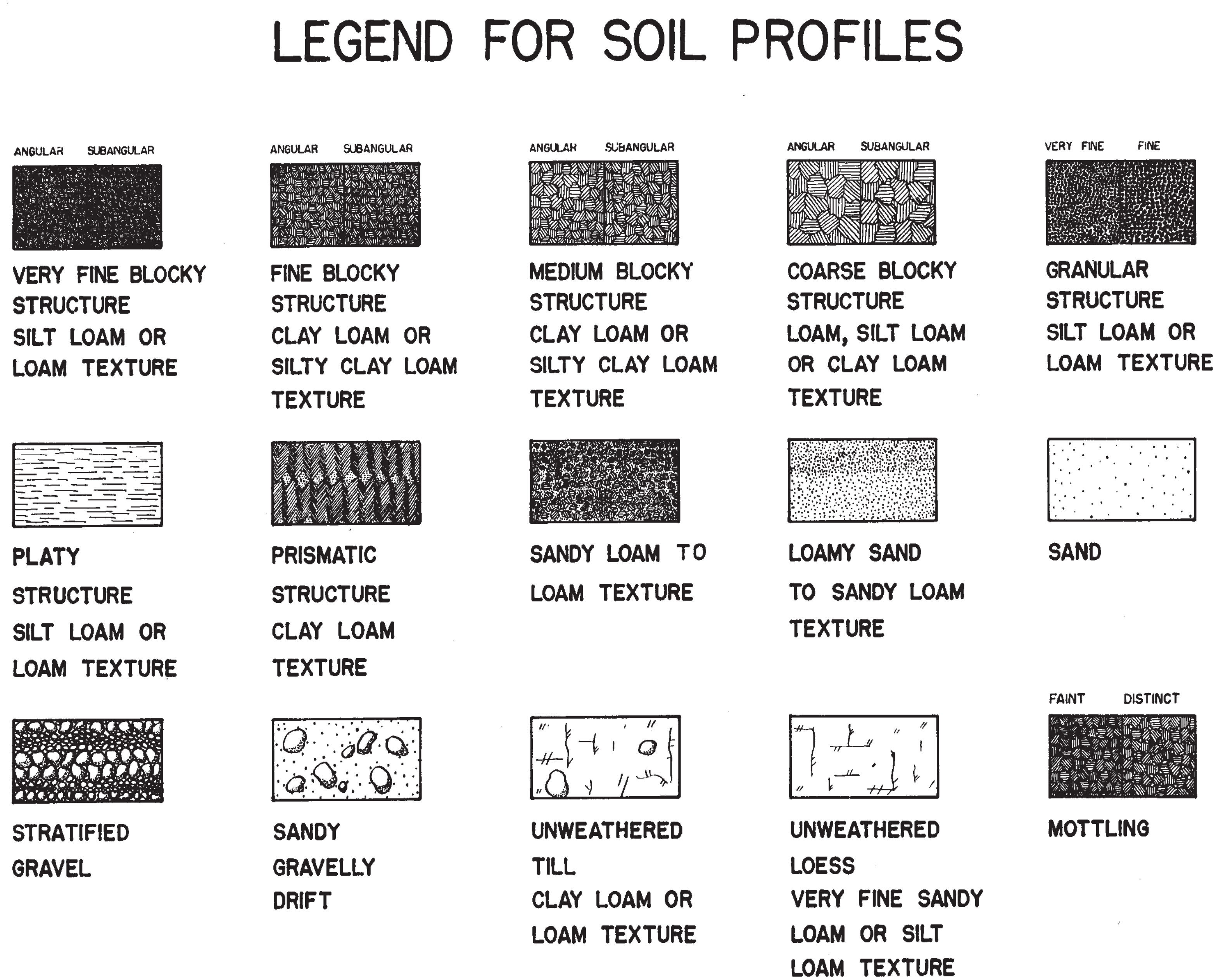

Figure 17.—Legend for soil profiles in figures 14, 15, and 16.

TABLE 6.—*Classification of the soil series by great soil groups and some factors that have contributed to their development*

ZONAL SOILS

Great soil group and series or land type	Parent material	Native vegetation	Topography: Position on landscape	Topography: Dominant slope	Topography: Range in slope	Natural drainage
Brunizems:						
Dakota	Iowan or Cary glacial outwash or alluvium.	Prairie grass	Outwash plains or stream terraces.	Level	Level with escarpments.	Somewhat excessive.
Dickinson	Iowan or pre-Iowan glacial till.	Transition between prairie grass and deciduous forest.	Uplands	Undulating	Nearly level to undulating.	Good to somewhat excessive.
Kenyon	Thin silt cap over Iowan or pre-Iowan glacial till.	Prairie grass	Uplands	Nearly level	Level to gently sloping.	Moderately good.
Ostrander	Thin silt cap over Iowan or pre-Iowan glacial till.	Prairie grass	Uplands	Gently sloping	Nearly level to moderately sloping.	Good.
Rockton	Thin silt cap over Iowan or pre-Iowan glacial till over Ordovician limestone.	Transition between prairie grass and deciduous forest.	Uplands	Moderately sloping.	Nearly level to strongly sloping.	Good.
Tama	Peorian or post-Peorian loess.	Prairie grass	Uplands	Gently sloping	Nearly level to gently sloping.	Good.
Thurston	Iowan or pre-Iowan glacial till.	Transition between prairie grass and deciduous forest.	Uplands	Undulating	Level to hilly	Good to somewhat excessive.
Waukegan	Iowan or Cary glacial outwash and alluvium.	Prairie grass	Outwash plains or stream terraces.	Level	Level with escarpments.	Good to somewhat excessive.
Gray-Brown Podzolic soils intergrading to Brunizems:						
Downs	Peorian or post-Peorian loess.	Transition between prairie grass and deciduous forest.	Uplands	Gently sloping	Nearly level to strongly sloping.	Good.
Hayfield	Iowan or Cary glacial outwash.	Transition between prairie grass and deciduous forest.	Outwash plains or stream terraces.	Level	Level to gently sloping.	Moderately good.
Kasson	Thin silt cap over Iowan or pre-Iowan glacial till.	Transition between prairie grass and deciduous forest.	Uplands	Nearly level	Level to gently sloping.	Moderately good.
Racine	Thin silt cap over Iowan or pre-Iowan glacial till.	Transition between prairie grass and deciduous forest.	Uplands	Gently sloping	Nearly level to strongly sloping.	Good.

TABLE 6.—*Classification of the soil series by great soil groups and some factors that have contributed to their development*—Continued

ZONAL SOILS—Continued

Great soil group and series or land type	Parent material	Native vegetation	Topography			Natural drainage
			Position on landscape	Dominant slope	Range in slope	
Gray-Brown Podzolic soils:						
Bixby	Iowan or Cary glacial outwash and alluvium.	Deciduous forest	Outwash plains or stream terraces.	Level	Level with escarpments.	Good to somewhat excessive.
Fayette	Peorian or post-Peorian loess.	Deciduous forest	Uplands	Gently sloping to moderately sloping.	Nearly level to steep.	Good.
Renova	Thin silt cap over Iowan or pre-Iowan glacial till.	Deciduous forest	Uplands	Gently sloping to moderately sloping.	Nearly level to steep.	Good.
Seaton	Peorian or post-Peorian loess.	Deciduous forest	Uplands	Gently sloping to moderately sloping.	Gently sloping to very steep.	Good.
Vlasaty	Thin silt cap over Iowan or pre-Iowan glacial till.	Deciduous forest	Uplands	Nearly level	Level to gently sloping.	Moderately good.
Whalan	Thin silt cap over Iowan or pre-Iowan glacial till over Ordovician limestone.	Deciduous forest	Uplands	Strongly sloping	Gently sloping to steep.	Good.
Wykoff	Iowan or pre-Iowan glacial till.	Deciduous forest	Uplands	Undulating to rolling.	Nearly level to hilly.	Somewhat excessive.
Gray-Brown Podzolic soils intergrading to Low-Humic Gley soils:						
Sargeant	Thin silt cap over Iowan or pre-Iowan glacial till.	Deciduous forest	Uplands	Level	Level to gently sloping.	Somewhat poor.
Skyberg	Thin silt cap over Iowan or pre-Iowan glacial till.	Transition between prairie grass and deciduous forest.	Uplands	Level	Level to gently sloping.	Somewhat poor.
Udolpho	Iowan or Cary glacial outwash.	Transition between prairie grass and deciduous forest.	Outwash plains or stream terraces.	Level	Level	Somewhat poor.

INTRAZONAL SOILS

Great soil group and series or land type	Parent material	Native vegetation	Position on landscape	Dominant slope	Range in slope	Natural drainage
Humic Gley soils:						
Canisteo	Moderately thick silt loam or silty clay loam over Iowan or pre-Iowan glacial till.	Water-tolerant grass.	Uplands	Level	Level	Poor to very poor.

TABLE 6.—*Classification of the soil series by great soil groups and some factors that have contributed to their development*—Continued

INTRAZONAL SOILS—Continued

Great soil group and series or land type	Parent material	Native vegetation	Topography			Natural drainage
			Position on landscape	Dominant slope	Range in slope	
Humic Gley soils—Con.						
Canisteo, coarse substratum.	Moderately thick silt loam or silty clay loam over Iowan or Cary glacial outwash.	Water-tolerant grass.	Outwash plains or stream terraces.	Level	Level	Poor to very poor.
Clyde	Moderately thick silt loam or silty clay loam over Iowan or pre-Iowan glacial till.	Swamp grass and sedges.	Uplands	Level	Level to gently sloping.	Very poor.
Marshan	Moderately thick silt loam or silty clay loam over Iowan or Cary glacial outwash.	Swamp grass and sedges.	Outwash plains or stream terraces.	Level	Level	Very poor.
Humic Gley soils intergrading to Brunizems:						
Floyd	Moderately thick silt cap over Iowan or pre-Iowan glacial till.	Water-tolerant grass.	Uplands	Nearly level	Level to gently sloping.	Somewhat poor to poor.
Kato	Iowan or Cary glacial outwash.	Water-tolerant grass.	Outwash plains or stream terraces.	Level	Level	Poor to somewhat poor.
Organic soils:						
Peat and Muck.	Organic residues over outwash or glacial till of all ages.	Swamp grass, sedges, and cattails.	Uplands, outwash plains, or stream terraces.	Level	Level to gently sloping.	Very poor.

AZONAL SOILS

Great soil group and series or land type	Parent material	Native vegetation	Position on landscape	Dominant slope	Range in slope	Natural drainage
Alluvial soils:						
Chaseburg	Recent alluvium and colluvium in waterways and on alluvial fans.	Deciduous forest	Uplands	Nearly level	Level to gently sloping.	Moderately good.
Lawson	Recent alluvium	Grass and forest	Bottom lands	Level	Level	Somewhat poor.
Alluvial land	Recent alluvium	Flood-tolerant grass and forest.	Bottom lands	Level	Level, with sloughs and escarpments.	Good to very poor.
Orion	Recent alluvium	Grass and forest	Bottom lands	Level	Level	Somewhat poor.

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TABLE 6.—*Classification of the soil series by great soil groups and some factors that have contributed to their development*—Continued

AZONAL SOILS—Continued

Great soil group and series or land type	Parent material	Native vegetation	Topography			Natural drainage
			Position on landscape	Dominant slope	Range in slope	
Alluvial soils intergrading to Brunizems:						
Judson	Recent alluvium and colluvium in waterways and on alluvial fans.	Grass	Uplands	Nearly level	Level to gently sloping.	Moderately good.
Regosols:						
Terrace escarpments.	Coarse-textured glacial till and outwash of mixed ages.	Mixed, drought-resistant grass and forest.	Uplands	Steep	Gently sloping to very steep.	Excessive.
Lithosols:						
Rough broken and stony land.	Very thin glacial till or loess over bedrock of limestone, sandstone, or shale.	Mixed, drought-resistant grass and forest.	Uplands	Very steep	Steep to very steep.	Excessive.

Profile of Ostrander silt loam in a cultivated field (720 feet south of NE. corner of the NE¼SE¼ sec. 2, T. 107 N., R. 17 W.):

A_1 0 to 9 inches, black to very dark brown (10YR 2/1 to 10YR 2/2, moist) silt loam; cloddy; slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; slightly acid; 8 to 12 inches thick; clear, wavy boundary.

AB 9 to 15 inches, very dark brown (10YR 2/2, moist) mixed with dark brown to brown (10YR 4/3, moist) loam to clay loam; weak to moderate, very fine to fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; medium acid; 5 to 7 inches thick; clear, wavy boundary.

B_{21} 15 to 25 inches, yellowish-brown (10YR 5/4 to 10YR 5/6, moist) clay loam; moderate, fine to medium, subangular blocky structure; continuous clay films on blocks; slightly hard to hard when dry, friable to firm when moist, sticky and slightly plastic when wet; medium acid; contains a few pebbles; 8 to 12 inches thick; clear, wavy boundary.

B_{22} 25 to 35 inches, yellowish-brown (10YR 5/4 to 10YR 5/6, moist) and brown (10YR 5/3, moist) clay loam; moderate to strong, fine, angular blocky structure; continuous clay films on blocks; hard when dry, very firm when moist, sticky and plastic when wet; slightly acid; contains a few pebbles; 8 to 12 inches thick; clear, wavy boundary.

C_1 35 to 44 inches, yellowish-brown to light olive-brown (2.5Y 5/4, moist) clay loam; massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; neutral; contains a few stones; 8 to 20 inches thick; clear, wavy boundary.

C_2 44 to 60 inches +, yellowish-brown (10YR 5/6, moist) clay loam; massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; mildly calcareous; contains a few stones.

The Ostrander soils developed in a thin silt cap over Iowan and pre-Iowan glacial till. The six other well-drained Brunizems differ as follows: The Tama soils developed from loess. The Waukegan developed from moderately deep silty materials over coarse-textured glacial outwash of Iowan or Cary age. The Dakota developed from shallow loam to sandy loam materials over coarse-textured glacial outwash of Iowan or Cary age. The Dickinson developed in medium textured to moderately coarse textured materials over coarse sandy Iowan and pre-Iowan glacial till. The Thurston soils are similar to the Dickinson, except that the sandy till contains much more gravel. The Rockton soils developed from a thin silt cap over Iowan and pre-Iowan glacial till that is less than 42 inches deep over Ordovician limestone.

In Dodge County only one Brunizem—the Kenyon—is moderately well drained. The following profile is typical. The series, like the Ostrander, developed in a thin silt cap over Iowan or pre-Iowan glacial till.

Profile of Kenyon silt loam in a cultivated field (300 feet north of the SW. corner of the SW¼NE¼ sec. 3, T. 107 N., R. 17 W.):

A_1 0 to 9 inches, black (10YR 2/1, moist) silt loam; cloddy; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; neutral; 9 to 12 inches thick; gradual, smooth boundary.

A_3 9 to 15 inches, black to very dark brown (10YR 2/1 to 10YR 2/2, moist) silt loam; moderate, very fine to fine, subangular blocky structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; slightly acid; 5 to 7 inches thick; clear, smooth boundary.

B_1 15 to 20 inches, very dark grayish-brown to dark-brown (10YR 3/2 to 10YR 4/3, moist) silt loam to silty clay loam; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; slightly acid; 4 to 8 inches thick; clear, smooth boundary.

B_2 20 to 28 inches, brown (10YR 5/3, moist), dark yellowish-brown (10YR 4/4, moist), and yellowish-brown (10YR 5/6, moist) clay loam; common, fine, faint mottles; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; medium acid; contains many pebbles in the upper part of the horizon; 6 to 12 inches thick; clear, smooth boundary.

B_3 28 to 42 inches, yellowish-brown (10YR 5/6, moist), dark grayish-brown (2.5Y 6/2, moist), and light brownish-gray (2.5Y 4/2, moist) clay loam; common, fine, distinct mottles; moderate, medium, subangular blocky structure; patchy clay films on blocks; hard when dry, firm when moist, sticky and plastic when wet; medium acid; 12 to 18 inches thick; gradual, smooth boundary.

C_1 42 to 54 inches, yellowish-brown (10YR 5/6, moist) and grayish-brown (2.5Y 5/2, moist) clay loam; common, medium, distinct mottles; weak, medium, subangular blocky structure to massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; neutral; 10 to 20 inches thick; clear, smooth boundary.

C_2 54 to 60 inches +, yellowish-brown (10YR 5/6, moist) and grayish-brown (2.5Y 5/2, moist) clay loam; common, medium, distinct mottles; massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; mildly calcareous.

Gray-Brown Podzolic soils intergrading to Brunizems

These are zonal soils of the Gray-Brown Podzolic group, but they have some characteristics of Brunizems. Tall prairie grass and deciduous forest have alternated as the principal cover during the development of these soils. These soils have a thinner, somewhat lighter colored A_1 horizon than the Brunizems. The grayish-brown, leached A_2 horizon is weaker and thinner than in typical Gray-Brown Podzolic soils, or it may be absent. The structure in the subsoil is not so strongly developed as in a typical Gray-Brown Podzolic soil.

The Downs, Hayfield, Kasson, and Racine series are in this group. The moderately well drained Kasson soils are typical.

Profile of Kasson silt loam in a cultivated field (360 feet west of the driveway in the NE¼NE¼ sec. 27, T. 108 N., R. 18 W.):

A_p 0 to 6 inches, very dark gray (10YR 3/1, moist) silt loam; cloddy; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; slightly acid; 6 to 8 inches thick; abrupt, smooth boundary.

A_2 6 to 13 inches, dark grayish-brown (10YR 4/2, moist) silt loam; moderate, very fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly acid; 4 to 8 inches thick; gradual, smooth boundary.

B_1 13 to 19 inches, dark-brown (10YR 4/3, moist) and dark yellowish-brown (10YR 4/4, moist) silty clay loam to clay loam; few, fine, faint mottles; moderate, fine to medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; strongly acid; 5 to 7 inches thick; clear, smooth boundary.

B_{21} 19 to 25 inches, dark yellowish-brown (10YR 4/4, moist) to yellowish-brown (10YR 5/4, moist) clay loam; few, fine, faint mottles; weak, medium, prismatic structure that breaks into weak, medium, subangular blocky structure; continuous clay films on blocks; hard when dry, firm when moist, sticky and plastic when wet; numerous pebbles in upper part of horizon; strongly acid; 4 to 8 inches thick; gradual, wavy boundary.

B_{22} 25 to 44 inches, dark yellowish-brown (10YR 4/4, moist) to yellowish-brown (10YR 5/4, moist) clay loam; common, fine, faint mottles; many light brownish-gray (10YR 6/2, moist) coatings on the vertical faces; weak to moderate, medium to coarse, prismatic structure that breaks into moderate, medium, subangular blocky structure; continuous clay films on the blocks; hard when dry, firm when moist, sticky and plastic when wet; strongly acid; 12 to 20 inches thick; clear, wavy boundary.

C_1 44 to 60 inches +, yellowish-brown (10YR 5/6, moist) and grayish-brown (2.5Y 5/2, moist) clay loam; a few light brownish-gray (10YR 6/2, moist) coatings of sand on the vertical faces of cracks extending deep into the parent material; common, medium, distinct mottles; massive (structureless); patchy clay films; hard when dry, firm when moist, sticky and plastic when wet; slightly acid.

The Kasson soils developed in a thin silt cap over Iowan or pre-Iowan glacial till. The Racine soils developed in the same kind of parent material, but they are well drained and somewhat more friable. The Downs soils are also well drained, but they developed in deep Peorian and post-Peorian loess. The moderately well drained Hayfield soils developed in medium-textured materials over coarse-textured Iowan or Cary glacial outwash on level outwash plains or stream terraces.

Gray-Brown Podzolic soils

Gray-Brown Podzolic soils are zonal soils that developed under deciduous forest in a temperate, moist climate. They have a thin, dark-colored A_1 horizon, a grayish-brown, leached A_2 horizon, and an illuviated, brown to yellowish-brown subsoil.

Seven soil series in Dodge County belong to the Gray-Brown Podzolic great soil group—the Bixby, Fayette, Renova, Seaton, Vlasaty, Whalan, and Wykoff series. The Renova soils are typical well-drained Gray-Brown Podzolic soils.

Profile of Renova silt loam in a deep, fresh road cut in a virgin area (south side of U.S. Highway No. 14 in the SE¼NE¼ sec. 29, T. 107 N., R. 17 W.):

A_1 0 to 5 inches, very dark grayish-brown (10YR 3/2, moist) silt loam; weak to moderate, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; neutral; 4 to 7 inches thick; abrupt, wavy boundary.

A_2 5 to 10 inches, dark grayish-brown (10YR 4/2, moist) to dark-gray (10YR 4/1, moist) silt loam; weak, very thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; strongly acid; 2 to 7 inches thick; clear, wavy boundary.

A_3 10 to 15 inches, dark grayish-brown (10YR 4/2, moist) silt loam; weak to moderate, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly acid; 4 to 6 inches thick; clear, smooth boundary.

B_{21} 15 to 24 inches, brown (10YR 4/3, moist) to yellowish-brown (10YR 5/4, moist) clay loam; moderate, fine to medium, angular blocky structure; continuous clay films on blocks; hard to very hard when dry, friable when moist, slightly plastic and sticky when wet; strongly acid; 8 to 16 inches thick; clear, smooth boundary.

B_{22} 24 to 39 inches, brown (10YR 4/3 to 10YR 5/3, moist) clay loam; strong, medium to coarse, angular blocky structure; coatings of very dark grayish-brown (10YR 3/2, moist) silica flour on structure blocks; very hard when dry, very firm when moist, plastic and sticky when wet; strongly acid; 12 to 20 inches thick; clear, smooth boundary.

B_{23} 39 to 48 inches, dark yellowish-brown (10YR 4/4, moist) clay loam; strong, coarse, angular blocky structure; coatings of very dark grayish-brown (10YR 3/2 to 10YR 3/3, moist) silica flour on structure blocks; very hard when dry, very firm when moist, slightly plastic and sticky when wet; medium acid; 6 to 12 inches thick.

C 48 to 60 inches, yellowish-brown (10YR 5/6, moist) to brownish-yellow (10YR 6/6, moist) clay loam; moderate, medium, angular blocky structure; coatings of brown (10YR 5/3, moist) silica flour on structure blocks; hard when dry, firm when moist, slightly plastic and sticky when wet; neutral; mildly calcareous in spots.

The well-drained Renova soils developed in a thin silt cap over Iowan or pre-Iowan glacial till. The Vlasaty soils developed from the same kind of parent materials, but they are less sloping and only moderately well drained. The Bixby soils are well drained to somewhat excessively drained. They developed on medium textured to moderately coarse textured material over coarse textured Iowan or Cary glacial outwash and alluvium. The somewhat excessively drained Wykoff soils are similar to the Bixby soils, except that they developed in Iowan or pre-Iowan glacial till on nearly level to hilly glacial till plains and kames. The Fayette and Seaton soils developed in Peorian and post-Peorian loess. The Seaton soils are on slightly steeper slopes, they contain more coarse silt, and they are not so deeply leached as the Fayette soils. The shallower leaching indicates that the post-Peorian loess dominates in the Seaton soils more than in the Fayette soils.

Gray-Brown Podzolic soils intergrading to Low-Humic Gley soils

These soils are in the zonal Gray-Brown Podzolic group, but they grade toward the intrazonal Low-Humic Gley group. The Sargeant, Skyberg, and Udolpho series are in this group. The poorly drained Sargeant soil is a good example. It developed under deciduous forest in somewhat poorly drained sites. Although it has strong characteristics of the Gray-Brown Podzolic great soil group, it is related to the Low-Humic Gley group in that there is strong evidence of gleying beginning in the upper part of the B horizon. Distinct mottles are common, beginning at a depth of about 12 inches and extending to a depth of about 4 feet or more. In most places, fine, faint mottles are common in the A_2 horizon.

Profile of Sargeant silt loam (600 feet west and 50 feet south of the NE. corner of the NE¼NE¼ sec. 1, T. 106 N., R. 18 W.):

A_1 0 to 7 inches, dark-gray (10YR 4/1, moist) to gray (10YR 5/1, moist) silt loam; cloddy; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly acid; 3 to 7 inches thick; abrupt, smooth boundary.

A_2 7 to 12 inches, light brownish-gray (10YR 6/2, moist), pale-brown (10YR 6/3, moist), and brown (10YR 5/3, moist) silt loam; common, fine, faint mottles; weak, very thin to thin, platy structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly acid; 4 to 8 inches thick; clear, smooth boundary.

B_{1g} 12 to 19 inches, dark grayish-brown (2.5Y 4/2) and yellowish-brown (10YR 5/6) silt loam to silty clay loam; common, fine, distinct mottles; moderate to strong, fine to medium, subangular blocky structure; coatings of light brownish-gray (10YR 6/2, moist) silica flour on structure blocks; patchy clay films on blocks; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; strongly acid; 6 to 10 inches thick; clear, smooth boundary.

B_{2g} 19 to 33 inches, grayish-brown (2.5Y 5/2, moist), yellowish-brown (10YR 5/6, moist), and dark yellowish-brown (10YR 4/4, moist) clay loam; many, medium, distinct mottles; weak, coarse, prismatic structure that breaks into strong, medium to coarse, angular blocky structure; continuous clay films on blocks; hard when dry, firm when moist, sticky and plastic when wet; contains a concentration of pebbles in the upper part of the horizon; strongly acid; 8 to 16 inches thick; gradual, smooth boundary.

B_{3g} 33 to 45 inches, yellowish-brown (10YR 5/6 and 10YR 5/4, moist) and grayish-brown (2.5Y 5/2, moist) clay loam; organic coatings of very dark gray (10YR 3/1, moist) clay along old root channels; many, medium, distinct mottles; moderate, medium, subangular blocky structure; continuous clay films on blocks; hard when dry, firm when moist, sticky and plastic when wet; slightly acid; 10 to 20 inches thick; clear, smooth boundary.

C 45 inches +, yellowish-brown (10YR 5/6 and 10YR 5/4, moist) and grayish-brown (2.5Y 5/2, moist) clay loam; massive (structureless); hard when dry, firm when moist, sticky and slightly plastic when wet; mildly calcareous.

The Skyberg and Udolpho series developed in somewhat poorly drained sites. The native vegetation was alternately tall prairie grass and deciduous forest. The subsoils show evidence of slight to moderate gleying. The grayish-brown, leached A_2 horizons are weaker and thinner than in the typical Gray-Brown Podzolic soils, and the structure in the subsoil is less weakly developed. These soils also have thinner, somewhat lighter colored A_1 horizons than the Brunizems.

Both the Skyberg and the Sargeant soils developed in a thin silt cap over Iowan or pre-Iowan glacial till, but they differ because of the difference in vegetation. The poorly drained Udolpho soils developed under the same kind of vegetation as the Skyberg soils, but their parent material consisted of medium-textured material over coarse-textured Iowan or Cary glacial outwash.

Profile of Skyberg silt loam in the school yard, 40 feet northwest of the school (NE¼NE¼ sec. 28, T. 108 N., R. 17 W.):

A_1 0 to 6 inches, very dark gray (10YR 3/1, moist) silt loam; weak, fine, subangular blocky structure to weak, thin, platy structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; moderately acid; 5 to 8 inches thick; abrupt, smooth boundary.

A_2 6 to 13 inches, dark grayish-brown (10YR 4/2, moist) silt loam to silty clay loam; few, fine, faint mottles; weak, thin, platy structure to weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly acid; 2 to 7 inches thick; clear, smooth boundary.

B_{1g} 13 to 26 inches, dark grayish-brown (10YR 4/2 to 2.5Y 4/2, moist), dark yellowish-brown (10YR 4/4, moist), and yellowish-brown (10YR 5/8, moist) silty clay loam to silt loam; common, fine, distinct mottles; moderate, very fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; strongly acid; 8 to 14 inches thick; clear, smooth boundary.

B_{2g} 26 to 38 inches, grayish-brown (2.5Y 5/2 to 10YR 5/2 moist), dark-brown (10YR 4/3, moist), dark yellowish-brown (10YR 4/4, moist), and light olive-brown (2.5Y 5/4, moist) clay loam; many, fine, distinct mottles; moderate, medium, prismatic structure that breaks into strong, medium, subangular blocky structure; continuous clay films on blocks; heavy coatings of sand on the vertical faces; hard when dry, firm when moist, sticky and plastic when wet; strongly acid; many pebbles in the upper part of horizon; 8 to 16 inches thick; clear, smooth boundary.

B_{3g} 38 to 50 inches, grayish-brown (2.5Y 5/2, moist), light olive-brown (2.5Y 5/4, moist), dark yellowish-brown

(10YR 4/4, moist), and yellowish-brown (10YR 5/4, moist) clay loam; many, fine, distinct mottles; weak, coarse, prismatic structure that breaks into weak, fine, subangular blocky structure; continuous clay films on blocks; many light brownish-gray (10YR 6/2) coatings of sand on the vertical faces; very hard when dry, firm when moist, sticky and plastic when wet; moderately acid; 10 to 16 inches thick; clear, smooth boundary.

C 50 to 72 inches, grayish-brown (2.5Y 5/2, moist), light olive-brown (2.5Y 5/4, moist), dark yellowish-brown (10YR 4/4, moist), and yellowish-brown (10YR 5/4, moist) clay loam; common, fine, distinct mottles; massive (structureless); a few light brownish-gray (10YR 6/2, moist) coatings of sand on the vertical faces of cracks extending deep into the parent material; hard when dry, firm when moist, sticky and plastic when wet; slightly acid.

Humic Gley soils

The Humic Gley great soil group consists of intrazonal soils that developed under swamp grasses and sedges. They are poorly drained to very poorly drained. The profile is made up of mineral soil, but the A_1 horizon is thick and dark colored and the B horizon is gleyed. Some of the Humic Gley soils in this county have concentrations of calcium carbonate in the A_1 horizon. This calcium carbonate makes the A_1 horizon somewhat grayer in color when dry.

The Clyde, Marshan, and Canisteo soils belong to the Humic Gley great soil group.

Profile of Clyde silty clay loam in a pasture on the south side of an open ditch bank (100 feet in from the road bridge in the NW¼SW¼ sec. 33, T. 108 N., R. 18 W.):

A_1 0 to 10 inches, black (5Y N2/ , moist) silty clay loam to silt loam; cloddy to weak, very fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; neutral; 10 to 15 inches thick; clear, irregular boundary.

A_{3g} 10 to 16 inches, dark-gray (5Y N4/ , moist) silty clay loam to silt loam; few, fine, faint mottles; weak, very fine, subangular blocky structure to massive (structureless); hard when dry, friable when moist, sticky and slightly plastic when wet; neutral; 3 to 8 inches thick; gradual, irregular boundary.

C_{1g} 16 to 24 inches, light olive-gray (5Y 6/2, moist) to olive-gray (5Y 5/2, moist) silt loam to silty clay loam; few, fine, faint mottles; weak, medium, platy structure to massive (structureless); hard when dry, very friable when moist, very sticky and slightly plastic when wet; neutral; 8 to 10 inches thick; abrupt, wavy boundary.

C_{2g} 24 to 28 inches, light olive-gray (5Y 6/2, moist) to olive-gray (5Y 5/2, moist), olive (5Y 5/3, moist), and yellowish-brown (10YR 5/6, moist) silty clay loam to clay loam; common, fine, distinct mottles; weak, medium, platy structure to massive (structureless); hard when dry, friable when moist, sticky and slightly plastic when wet; mildly calcareous; 2 to 5 inches thick; abrupt, wavy boundary.

C_{3u} 28 to 32 inches, grayish-brown (2.5Y 5/2, moist) to light brownish-gray (2.5Y 6/2, moist) sand; single grain (structureless); loose when dry or moist, nonsticky and nonplastic when wet; mildly calcareous; 2 to 6 inches thick; clear, wavy boundary.

C_{4u} 32 to 37 inches, variegated light olive-brown (2.5Y 5/4, moist) loamy sand that contains pebbles; single grain (structureless); loose when dry, very friable when moist, slightly sticky and nonplastic when wet; mildly calcareous; 3 to 5 inches thick; abrupt, wavy boundary.

D 37 inches +, yellowish-brown (10YR 5/6, moist) and light olive-gray (5Y 6/2, moist) clay loam to sandy clay loam; common, prominent mottles; massive (structureless); hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous.

The Clyde soils developed from moderately thick silt loam or silty clay loam over Iowan or pre-Iowan glacial till. Soils from similar parent materials over the glacial till substratum, but containing calcium carbonate in the A_1 horizon, are in the Canisteo series. The Marshan soils developed from the same kind of moderately thick silt loam or silty clay loam, but they are underlain by the coarser textured Iowan or Cary glacial outwash. The calcareous soils that developed from these materials are Canisteo soils also, but "coarse substratum" is specified in the name. The calcareous Canisteo soils generally lie slightly higher than the Clyde and Marshan soils.

Profile of Canisteo silty clay loam in a tile trench (190 feet west and 75 feet north of the road ditch crossing in the SE¼SE¼ sec. 29, T. 108 N., R. 18 W.):

A_1 0 to 13 inches, black (2.5Y N2/ , moist) silty clay loam to silt loam; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; 12 to 15 inches thick; clear, wavy boundary.

A_{3g} 13 to 18 inches, mixed very dark gray (5Y 3/1, moist), dark-gray (5Y 4/1, moist), dark grayish-brown (2.5Y 4/2, moist), and grayish-brown (2.5Y 5/2, moist) silty clay loam and silt loam; few, fine, distinct mottles; weak, thin, platy structure to massive (structureless); slightly hard when dry, friable when moist, sticky and slightly plastic when wet; mildly calcareous; 3 to 8 inches thick; clear, wavy boundary.

C_{1g} 18 to 26 inches, light brownish-gray (2.5Y 6/2, moist) to light olive-gray (5Y 6/2, moist) silt loam; few, fine, distinct mottles; weak, medium, platy structure to massive (structureless); slightly hard when dry, friable when moist, sticky and slightly plastic when wet; mildly calcareous; 6 to 10 inches thick; abrupt, smooth boundary.

C_{2g} 26 to 30 inches, light brownish-gray (2.5Y 6/2, moist), light yellowish-brown (10YR 6/4, moist), and yellowish-brown (10YR 5/6, moist) sandy clay loam; common, medium, prominent mottles; weak, coarse, subangular blocky structure to massive (structureless); slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; mildly calcareous; 3 to 6 inches thick; abrupt, wavy boundary.

C_{3u} 30 to 36 inches, yellowish-brown (10YR 5/6, moist) and light yellowish-brown (10YR 6/4, moist) medium to fine sand that contains fine to medium gravel; single grain (structureless); loose when dry or moist, nonsticky and nonplastic when wet; neutral; 3 to 8 inches thick; abrupt, wavy boundary.

D 36 to 60 inches +, yellowish-brown (10YR 5/6, moist) and light brownish-gray (2.5Y 6/2, moist) to grayish-brown (2.5Y 5/2, moist) silty clay to silty clay loam; many, medium, prominent mottles; massive (structureless); hard when dry, firm when moist, very sticky and plastic when wet; moderately calcareous.

Humic Gley soils intergrading to Brunizems

These are intrazonal soils that grade toward zonal soils. They developed in poorly drained to somewhat poorly drained sites where the vegetation consists principally of water-tolerant tall prairie grass. These soils have a darker, thicker A_1 horizon than the Brunizems, and they have a thin, moderately gleyed horizon in the subsoil. There are very thin, patchy clay films on the surface of the structural blocks in a few places. These clay films, the less intensive gleying, and the somewhat better natural drainage differentiate these soils from the typical Humic Gley soils.

The Floyd and Kato soils belong to this group.

Profile of Floyd silty clay loam in a tile trench (280 feet northwest of a point 110 feet west and 140 feet north of a road ditch crossing in the NE¼SE¼ sec. 4, T. 106 N., R. 17 W.):

A_{1p} 0 to 7 inches, black (2.5Y N2/ , moist) silty clay loam; cloddy; slightly hard when dry, very friable when moist, sticky and slightly plastic when wet; neutral; 6 to 7 inches thick; abrupt, smooth boundary.

A_{12} 7 to 15 inches, black (2.5Y N2/ , moist) silty clay loam; weak, fine, granular structure; slightly hard when dry, very friable when moist, sticky and slightly plastic when wet; neutral; 5 to 10 inches thick; clear, smooth boundary.

A_3 15 to 18 inches, very dark gray (5Y 3/1, moist) and olive-gray (5Y 4/2, moist) silty clay loam; a few, fine, faint mottles; weak, fine, subangular blocky structure to weak, fine, granular structure; slightly hard when dry, very friable when moist, sticky and slightly plastic when wet; neutral; 3 to 6 inches thick; clear, smooth boundary.

B_{21G} 18 to 27 inches, dark olive-gray (5Y 3/2, moist) to olive-gray (5Y 5/2, moist) silty clay loam to silt loam; brownish-yellow (10YR 6/6, moist) flecks and common, fine, faint mottles; weak, medium, subangular blocky structure to massive (structureless); slightly hard when dry, very friable when moist, sticky when wet; neutral; 6 to 15 inches thick; abrupt, wavy boundary.

B_{22G} 27 to 30 inches, grayish-brown (2.5Y 5/2, moist), yellowish-brown (10YR 5/4, moist), and light yellowish-brown (10YR 6/4, moist) clay loam to sandy clay loam; common, fine, distinct mottles; weak, medium, subangular blocky structure to massive (structureless); slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; contains many pieces of gravel and small stones; neutral; 2 to 6 inches thick; abrupt, wavy boundary.

B_{3g} 30 to 33 inches, yellowish-brown (10YR 5/4, moist) to light yellowish-brown (10YR 6/4, moist) and grayish-brown (2.5Y 5/2, moist) sandy clay loam; fine, faint mottles; very weak, coarse, angular blocky structure to massive (structureless); slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; contains a few pieces of gravel and small stones; slightly acid; 2 to 6 inches thick; clear, wavy boundary.

C_{1g} 33 to 52 inches, light yellowish-brown (10YR 6/4, moist) to brownish-yellow (10YR 6/6, moist) and grayish-brown (2.5Y 5/2, moist) clay loam to sandy clay loam; common, medium, distinct mottles; massive (structureless); hard when dry, friable when moist, sticky and plastic when wet; slightly acid; 16 to 27 inches thick; clear, wavy boundary.

C_{2g} 52 inches +, light yellowish-brown (10YR 6/4, moist), brownish-yellow (10YR 6/6, moist), and grayish-brown (2.5Y 5/2, moist) clay loam; common, medium, distinct mottles; massive (structureless); hard when dry, friable when moist, sticky and plastic when wet; mildly alkaline, effervesces slightly with acid.

The Floyd soils developed in a moderately thick silt cap over Iowan and pre-Iowan glacial till. The Kato soils developed from medium-textured materials over coarse-textured Iowan or Cary glacial outwash.

Organic soils

These are intrazonal soils that consist of 12 or more inches of peat or muck over mineral materials. They developed from organic residues over outwash or glacial till. In this county the residues consist of partly decayed sedges and grasses. The natural drainage is very poor.

Three kinds of peat and muck have been mapped in Dodge County. Under one, the substratum is coarse textured, and under the others, it is medium textured.

Alluvial soils

The Alluvial great soil group consists of azonal soils that developed from recent alluvium and colluvium on flood plains, on alluvial fans, and in waterways. The drainage ranges from good to poor, but most of the soils are moderately well drained.

These are all very young soils, in which no profile development has taken place. The profile is frequently changed by fresh deposits of sediment.

The Chaseburg, Lawson, and Orion series belong to the Alluvial great soil group. Three different kinds of alluvial land were mapped in Dodge County, but they were not classified into series.

Profile of Alluvial land (in a field west of the new Highway 57 bridge and 200 feet south of the old river channel in the NE¼SE¼ sec. 18, T. 108 N., R. 16 W.):

A_{11} 0 to 12 inches, black (10YR 2/1, moist) silt loam; moderate, fine, granular structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; neutral; 12 to 16 inches thick; gradual, wavy boundary.

A_{12} 12 to 28 inches, black (10YR 2/1, moist) silt loam; weak, very fine to fine, subangular blocky structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; neutral; 12 to 15 inches thick; gradual, wavy boundary.

A_{13} 28 to 44 inches, very dark brown (10YR 2/2, moist) silt loam to silty clay loam; weak to moderate, fine, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; mildly calcareous; 12 to 16 inches thick; clear, wavy boundary.

A_{14} 44 to 60 inches +, very dark brown (10YR 2/2, moist) to very dark grayish-brown (10YR 3/2, moist) silt loam to very fine sandy loam; massive (structureless); soft when dry, very friable when moist, slightly sticky and nonplastic when wet; moderately calcareous.

The Chaseburg soils are Alluvial soils that developed on alluvial fans and in waterways. They are steeper than Alluvial land, and the alluvium is shallower. They are lighter in color because the alluvial parent material came from Gray-Brown Podzolic soils instead of from Brunizems.

The Lawson and Orion soils are developing in recent alluvium deposited by floodwaters. Both are somewhat poorly drained, but the Lawson materials are dark colored and the Orion materials are light colored. The Alluvial soils that were mapped as land types vary considerably in texture, drainage, and hazard of flooding.

Alluvial soils intergrading to Brunizems

This group consists of azonal Alluvial soils that grade toward the zonal Brunizems. They are developing under grass on alluvial fans and in waterways. The parent material is recent alluvium and colluvium.

The Judson soils are the only soils in this group in Dodge County. They have some resemblance to the Brunizems, in that the development of their horizons is slightly stronger than is typical of Alluvial soils. In this county, the Judson soils are not so well developed as the typical Judson soils in other areas.

Lithosols

Lithosols are azonal soils that consist of a thin layer of soil material over bedrock. These soils have only an

A and a D horizon. Little or no profile development has occurred.

Rough broken and stony land is the only mapping unit in Dodge County that contains soils of the Lithosol great soil group.

Regosols

Regosols are azonal soils that consist of deep deposits of sand or gravel in which little or no profile development has occurred. The A horizon is thin. The B horizon has never developed, or it is only very faintly developed. The rest of the profile is a C horizon.

The only Regosols in Dodge County are mapped as Terrace escarpments.

Study of Loess-Derived Soils

Table 7 presents the results of laboratory analysis of several loess-derived soils in Dodge County. With one exception, the samples analyzed were taken from the B_2 horizon, because it is in that horizon that the soils differ.

The correlation of loess-derived Gray-Brown Podzolic soils is still under study. New standards for differentiating among them were proposed in Illinois Agricultural Experiment Station Bulletin No. 587 (*9*). If these standards were used, most of the loess-derived Gray-Brown Podzolic soils in Dodge County would be correlated in the Seaton series.

TABLE 7.—*Laboratory data for selected loess-derived soils*

Sample number and location of profile sampled	Soil type	Horizon	Reaction (1:1)	Organic carbon	USDA size class and diameter of particles, in millimeters						
					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)
			pH	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
No. 4251 (NW¼ sec. 23, T. 108 N., R. 16 W.).	Fayette silt loam	C	7.8	0.18	0.1	0.1	0.1	0.9	18.2	67.2	13.4
No. 4252 (NW¼ sec. 8, T. 108 N., R. 16 W.).	Fayette silt loam	B_{22}	5.4	.30	-------	-------	-------	.3	9.8	63.8	26.1
No. 4253 (NE¼ sec. 3, T. 108 N., R. 16 W.).	Fayette silt loam	B_{22}	5.1	.32	-------	.1	.4	1.0	8.9	63.8	25.8
No. 4254 (NW¼ sec. 23, T. 108 N., R. 16 W.).	Fayette silt loam	B_{22}	6.3	.30	-------	-------	.1	.3	10.6	62.7	26.3
No. 4255 (NE¼ sec. 27, T. 108 N., R. 16 W.).	Downs silt loam	B_{22}	5.7	.47	-------	-------	-------	.3	11.3	65.1	23.3
No. 4256 (SE¼ sec. 20, T. 108 N., R. 16 W.).	Fayette silt loam	B_{22}	6.3	.42	-------	-------	.2	.6	10.4	67.4	21.4
No. 4257 (SE¼ sec. 1, T. 108 N., R. 17 W.).	Fayette silt loam	B_{22}	5.2	.38	-------	-------	-------	.3	7.4	67.3	25.0
No. 4258 (NE¼ sec. 25, T. 107 N., R. 16 W.).	Tama silt loam	B_{22}	5.6	.65	-------	.1	0	.2	4.4	69.6	25.7
No. 4259 (NW¼ sec. 24, T. 106 N., R. 16 W.).	Seaton silt loam	B_{22}	5.6	.41	-------	.2	.4	1.4	16.1	59.6	22.3
No. 4260 (NW¼ sec. 23, T. 107 N., R. 16 W.).	Fayette silt loam	B_{22}	6.7	.34	-------	-------	-------	.4	13.2	60.9	25.5

General Information About the County

Dodge County includes some of the highest land in the southeastern part of Minnesota. The elevation in the southern part of the county is 1,300 to 1,350 feet above sea level. In the northern part, the elevation is generally between 1,200 and 1,300 feet. The North Middle Branch of the Zumbro River is just a few feet less than 1,000 feet above sea level at the point where it leaves the county.

Three rivers drain the county. The Cedar River drains about 65 square miles in the southwestern part of the county. About 7 square miles southeast of Hayfield along the Mower County line is drained by the North Branch of the Root River. The rest of the county is drained by the North Branch, North Middle Branch, South Middle Branch, and South Branch of the Zumbro River.

Climate

Dodge County has a midcontinental type of climate characterized by seasonal variation in temperature, little precipitation in winter, and generally abundant rainfall in summer. The climatic data in table 8 was compiled from records of the nearest United States Weather Bureau station, which is at Rochester in Olmsted County.

TABLE 8.—*Temperature and precipitation at Rochester Municipal Airport, Olmsted County, Minnesota*

[Elevation, 1,017 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1910)	Wettest year (1938)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	19. 4	63	−31	0. 93	0. 45	0. 65	9. 2
January	12. 4	58	−40	. 98	1. 65	. 66	8. 5
February	16. 4	60	−34	. 82	. 05	1. 00	7. 8
Winter	16. 1	63	−40	2. 73	2. 15	2. 31	25. 5
March	29. 3	77	−29	1. 54	(3)	2. 05	10. 4
April	44. 7	87	9	2. 40	. 77	3. 59	1. 7
May	56. 8	106	24	3. 75	2. 35	6. 42	. 1
Spring	43. 6	106	−29	7. 69	3. 12	12. 06	12. 2
June	66. 1	105	31	4. 58	(3)	5. 91	0
July	71. 9	108	42	3. 42	. 84	9. 65	0
August	69. 3	100	33	3. 55	2. 94	2. 66	0
Summer	69. 1	108	31	11. 55	3. 78	18. 22	0
September	60. 4	98	22	3. 04	1. 98	7. 95	(3)
October	48. 8	87	10	1. 90	. 42	. 56	. 1
November	32. 5	75	−17	1. 53	. 20	2. 58	4. 6
Fall	47. 2	98	−17	6. 47	2. 60	11. 09	4. 7
Year	44. 0	108	−40	28. 44	11. 65	43. 68	42. 4

[1] Average temperature based on a 43-year record, through 1959; highest and lowest temperature on a 19-year record, through 1950.
[2] Average precipitation based on a 43-year record, through 1959; wettest and driest years based on a 43-year record, in the period 1909–1959; snowfall based on a 19-year record, through 1950.
[3] Trace.

Rainfall is generally ample to supply moisture for crops for the full growing season. June has been the wettest and the driest month of the year: June 1914 had 11.95 inches of rain, and June 1910 had only a trace of precipitation.

A summary of the wet and dry years from 1909 to 1954 shows the following:

Eleven percent were dry years, having precipitation 6 inches or more below average.
Eighteen percent were moderately dry years, having precipitation 2 to 4 inches below average.
Thirty-four percent were average years, having precipitation no more than 2 inches above or below average.
Twenty-one percent were moderately wet years, having precipitation 2 to 4 inches above average.
Sixteen percent were wet years, having precipitation 6 inches or more above average.

Thunderstorms are the main source of rain in the growing season. On the average there are 23 thunderstorms in the summer months. While severe storms or tornadoes do occur infrequently, they cover relatively small areas. Ice storms also occur infrequently.

The succession of high- and low-pressure areas across this region from west to east results in daily variations in temperature that are stimulating and invigorating. Generally there are no long periods of extreme heat or extreme cold.

Because of the favorable growing season of 137 days and the ample rainfall and sunshine, all general farm crops, including corn, small grains, soybeans, alfalfa, and grass can be grown. The average date of the last killing frost in spring is May 15, and the average date of the first in fall is September 29.

Native Vegetation

A little more than 10 percent of Dodge County was covered by hardwood forest at the time of settlement. The forests were mostly in the northeastern corner, near the North Middle Branch, and in a belt through the central part, along the South Middle Branch of the Zumbro River. A third of the county probably had prairie and forest cover alternately, as climatic conditions changed through the centuries since the ice ages. Patches of trees and shrubs were still present in these areas when the county was settled. At present, less than 3 percent of the county is woodland, and most of this is pastured.

The major native prairie grasses of Dodge County were redtop (*Agrostis alba*), big bluestem (*Andropogon gerardi*), little bluestem (*A. scoparius*), reedgrass (*Calamagrostis canadensis*), panicgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutana*), prairie cordgrass (*Spartina pectinata*), side-oats grama (*Bouteloua curtipendula*), needlegrass (*Stipa* spp.), and switchgrass (*Panicum* spp.). Cattails (*Typha latifolia*), leadplant (*Amorpha canescens*), and vetches (*Vicia spp.*) were common. Sedges (*Carex* spp.) of many varieties grew in marshes and swamps.

The native shrubs included northern prickly-ash (*Xanthoxylum americanum*), smooth sumac (*Rhus glabra*), poison-ivy (*R. toxicodendron*), wild plum (*Prunus americana*), pin cherry (*P. pensylvanica*), chokecherry (*P. virginiana*), wild black cherry (*P. serotina*), wild rose (*Rosa blanda*), wild red raspberry (*Rubus strigosus*), wild black raspberry (*R. occidentalis*), black thorn (*Crataegus tomentosa*), chokeberry (*Pyrus arbutifolia*), red-osier dogwood (*Cornus stolonifera*), gray dogwood (*C. paniculata*), wolfberry (*Symphoricarpos occidentalis*), sheepberry (*Viburnum lentago*), hazelnut (*Corylus americana*), and speckled alder (*Alnus incana*).

The principal native trees are basswood (*Tilia americana*), sugar maple (*Acer saccharum*) silver maple (*A. saccharinum*), boxelder (*A. negundo*), white ash (*Fraxinus americana*), green ash (*F. pensylvanica*), hickory (*Carya glabra*) bur oak (*Quercus macrocarpa*), white oak (*Q. alba*), quaking aspen (*Populus tremuloides*), cottonwood (*P. deltoides*), common juniper (*Juniperus communis*), redcedar (*J. virginiana*), and willows (*Salix* spp.)

Geology

The Pleistocene geology of Dodge County is discussed under the heading, Parent materials, in the section, Formation and Classification of the Soils of the County. The pre-Pleistocene geology is also very important, as it directly affects the availability of water for all uses. In addition, the pre-Pleistocene topography had some influence on present topography, especially in the eastern and northeastern parts of the county (*3*).

Beneath the glacial drift of the Iowan, Kansan, and Nebraskan glaciations are alternating beds of limestone, sandstone, and shale (*7*). Limestone is the dominant type of bedrock. The beds are generally tilted downward toward the southwest. In a line northeastward across the county, each underlying formation comes closer to the surface and crops out in many places.

In the southwestern corner of the county, the rock formations, from top to bottom, can be expected to be as follows:

System	*Formation*	*Character*
Ordovician	Maquoketa	Shale, limestone.
	Galena (Stewartville member).	Limestone, dolomite.
	Decorah	Shale, limestone.
	Platteville	Limestone, dolomite.
	Glenwood	Shale.
	St. Peter	Sandstone.
	Shakopee	Limestone, dolomite.
	New Richmond	Sandstone.
	Oneota	Dolomite, limestone.
Cambrian	Jordan	Sandstone.
	St. Lawrence	Limestone.
	Franconia	Glauconitic sandstone and limestone.
	Dresbach	Sandstone.
Precambrian	Sioux	Quartzite.

The easterly exposure of the Maquoketa formation is near Wasioja. The surface rock formation in the area not covered by the Maquoketa formation is the Stewartville member of the Galena formation. These formations are dominantly limestone and dolomite.

In the low uplands along the North Middle Branch of the Zumbro River, the surface formation is Shakopee limestone. New Richmond sandstone forms the floor of this valley, and there are a few exposures of Decorah and Glenwood shale. All the other formations between the Galena and the New Richmond are exposed in spots on the steep escarpment along the tributaries of the Zumbro River.

In a well section at Dodge Center, which is at the center of the county, the glacial drift over the bedrock was 112 feet thick (*2*). The combined thickness of the Galena, Decorah, and Platteville formations was 378 feet. St. Peter sandstone, a very important source of water, was at a depth of 490 feet. In the well section at Hayfield, St. Peter sandstone had not been reached at a depth of 545 feet. In the eastern part of the county, the depth to this formation is seldom more than 200 feet. Other well sections in the county show that the average thickness of St. Peter sandstone is 100 feet. New Richmond sandstone is usually about 20 feet thick and lies 35 feet below the base of St. Peter sandstone. Jordan sandstone is about 120 feet thick and lies about 250 feet below the base of St. Peter sandstone. Dresbach sandstone is about 80 feet thick and lies about 600 feet below the base of St. Peter sandstone. All of these sandstones are excellent sources of water. All of the water is moderately hard (*2*). It is usually not necessary at the present time to go deeper than the St. Peter sandstone to get water, except near river bluffs where the formation outcrops.

In places, adequate supplies of water for ordinary use can be obtained from the glacial drift itself, or from the limestone where it is underlain by impervious beds of shale.

Agriculture

Agriculture has always been the chief industry of Dodge County. As early as 1859, commercial quantities of wheat, corn, oats, barley, and potatoes were being grown. Wheat became a foremost crop early in the county's history. Production of wheat reached its peak in 1880. Soon after, it began to decline, and dairying and diversified farming gained in importance.

In 1954, the acreages of the major crops were as follows: Corn, 65,144 acres; oats, 44,905 acres; soybeans, 35,750 acres; hay, 33,628 acres, about half of which was alfalfa.

The livestock population of the county in 1954 was as follows: Cattle and calves, 45,463; horses and mules, 1,111; hogs and pigs, 47,249; sheep and lambs, 7,493; turkeys (raised in 1954), 107,023.

Modern tractors have nearly eliminated horses as a source of workpower. Combines, cornpickers, and balers are common equipment.

The average-size farm in Dodge County in 1954 was 157.9 acres. About 25 percent of the farms are tenant operated.

Practically all farms in the county have electricity. In 1954, 83 percent of the farms had telephones, 71 percent had piped running water, 59 percent had television, and 42 percent had home freezers.

Transportation and Markets

Dodge County is served by three railroads. The Chicago and North Western Railway crosses the county from east to west and serves Kasson, Dodge Center, and Claremont. Traversing the county from north to south is the

Chicago Great Western Railway, which serves West Concord, Dodge Center, and Hayfield. The Chicago, Milwaukee, St. Paul, and Pacific crosses the extreme southwestern corner of the county.

The county has a good system of roads. U.S. Highway No. 14 is paved, and Minnesota State Highways 30, 56, and 57 are blacktopped. Good gravelled roads maintained by the county or the township serve nearly every farm.

Marketing facilities are good. Milk is usually marketed as whole milk, and there is daily pickup service by truck. A number of creameries and cheese factories are located in the county, and large dairy processing plants are located at Rochester and Austin. Livestock is taken by truck to be marketed at Austin, Albert Lea, or South St. Paul. Grain elevators are located in nearly every town that has railway facilities.

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Glossary

Acid. Of a soil, having a pH of less than 6.6. See *pH* and *Reaction*.

Aggregate, soil. Many fine soil particles held in a single mass or cluster, such as a *clod, crumb, block*, or *prism*.

Alkaline. Of a soil, having a pH of more than 7.3. See *pH* and *Reaction*.

Alluvial soils. A great soil group of the azonal order. Alluvial soils are developing in recently deposited alluvium that has been modified little or not at all by soil-forming processes. The soils have little profile development.

Alluvium. Sand, mud, and other sediments deposited on land by streams.

Azonal soils. Soils that have little or no profile development. Most of them are young. In the United States, Alluvial soils, Lithosols, and Regosols are included in the azonal group. See *Order*.

Bedrock. The solid rock underlying soils and other earthy surface formations.

Broad-base terrace. A low embankment with slopes gentle enough to be farmed, constructed across sloping soils approximately on the contour. Broad-base terraces are used on pervious soils to reduce runoff and soil erosion.

Brunizems. A zonal group of soils that have a dark-colored surface horizon that grades through brown soil material to lighter colored parent material at depths of 2 to 5 feet. Brunizems form under tall grasses in a temperate, humid climate.

Bulk density. The mass or weight of oven-dry soil per unit bulk volume, including air space. (Formerly called "apparent density" or "volume weight.")

Calcareous. Of a soil, containing calcium carbonate, or alkaline in reaction because of the presence of calcium carbonate. A calcareous soil contains enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

Category. In soil classification, any one of the subdivisions of the system of classification in which soils are arranged on the basis of their characteristics. Beginning with the lowest category, the type, soils are classified on the basis of progressively fewer characteristics into progressively more inclusive categories—the series, the family, the great soil group, the suborder, and the order.

Catena. A group of soils, within a specific soil zone, formed from similar parent materials but having unlike soil characteristics because of differences in relief or drainage.

Chert. A structureless form of silica, closely related to flint, that breaks into angular fragments. Soils developed from impure limestones containing fragments of chert and having abundant quantities of these fragments in the soil mass are called cherty soils.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay loam. Soil material that is 27 to 40 percent clay and 20 to 45 percent sand.

Clod. A mass of soil produced by plowing or digging; usually slakes easily with repeated wetting and drying; in contrast to a ped, which is a natural soil aggregate.

Colluvium. Mixed deposits of soil material and rock fragments near the base of rather steep slopes. The deposits have accumulated through soil creep, slides, and local wash.

Complex, soil. An intricate mixture of different kinds of soils mapped as one unit because the individual areas are too small to be shown separately on the soil map.

Consistence. The combination of properties of soil material that determine its resistance to crushing and its ability to be molded or changed in shape. Consistence depends mainly on the forces of attraction between soil particles. It is described by such words as *loose, friable, firm, soft, plastic*, and *sticky*.

Deep soil. Generally, a soil more than 40 inches deep to rock or other strongly contrasting material. Also, a soil with a deep, black surface layer; a soil more than about 40 inches deep to the parent material or to other unconsolidated rock material not modified by soil-forming processes; or a soil in which the total depth of unconsolidated material, whether true soil or not, is 40 inches or more.

Drainage (a practice). The removal of excess surface water or excess water from within the soil by means of surface or subsurface drains.

Drainage, soil. The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. As a condition of the soil, drainage refers to the frequency and duration of periods when the soil is free of saturation. For example, in well drained soils, the water is removed readily but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods and the roots of ordinary crop plants cannot get enough oxygen; and in excessively drained soils, the water is removed so completely that most crop plants are damaged by lack of water.

Drift. Material of any sort deposited by geological processes in one place after having been removed from another. *Glacial drift* consists of earth, sand, gravel, and boulders deposited by glaciers and by the streams and lakes associated with glaciers. It includes *glacial till*, which is not stratified, and *glacial outwash*, which is stratified.

Duff. The matted, partly decomposed organic surface layer of forested soils.

Eluviation. The movement of material from one place to another within the soil in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial. With an excess of rainfall over evaporation, eluviation may take place either downward or laterally, according to the direction of water movement.

Erodible. Susceptible to erosion.

Erosion. The wearing away of the land surface by detachment and transport of soil and rock materials through the action of moving water, wind, or other geological agents.

Erosive. Of wind or water, having sufficient velocity to cause erosion. Not to be confused with *erodible*, which describes a quality of soil.

Fine-textured soil. Roughly, soil that is 35 percent or more clay.

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

Flood plain. The nearly flat land along streams that overflow during floods.

Glacial soil material. Parent material that has been moved and redeposited by glacial activity. See *Parent material.*

Gley soil. A soil horizon in which waterlogging and lack of oxygen have caused the material to be a neutral gray in color. The term "gleyed" is applied, as in "moderately gleyed soil," to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Graded terrace. A terrace constructed at a slight angle to the contour. See *Level terrace.*

Granular structure. Soil structure in which the individual grains are grouped into spherical aggregates with indistinct sides. Highly porous granules are commonly called crumbs. A well-granulated soil has the best structure for most ordinary crop plants.

Gray-Brown Podzolic soils. A zonal group of soils having a thin organic covering and a thin organic-mineral layer over a grayish-brown leached layer that rests upon a brown B horizon richer in clay than the horizon above. These soils form under deciduous forest in a moist, temperate climate.

Great soil group. Any one of several broad groups of soils having fundamental characteristics in common.

Heavy soil. A term formerly used to describe a clayey or fine-textured soil; originally used because of the heavy draught on the horses when plowing.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil-forming processes.

Humic Gley soils. An intrazonal group of soils having a dark-brown or black surface layer that grades, at depths of 6 to 30 inches, to a grayish layer. Humic Gley soils develop under grasses and sedges, mostly in a humid or subhumid climate.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended mineral and organic matter originating from horizons above. Since at least part of the fine clay in the B horizon (or subsoil) of many soils has moved from the A horizon above, the B horizon is called an illuvial horizon.

Intrazonal soil. Any one of the great groups of soils having more or less well-developed soil characteristics that reflect a dominating influence of some local factor of relief or of parent material over the normal influences of the climate and vegetation. Such groups of soils may be geographically associated with two or more of the zonal groups of soils having characteristics dominated by the influence of climate and vegetation.

Leaching. The removal of materials in solution by the passage of water through soil.

Level terrace. A broad surface channel or embankment constructed across a slope on the contour, as contrasted to a graded terrace, which is built at a slight angle to the contour. Can be used only on soils that are permeable enough so that all of the storm water will soak into the soil and none will break over the terrace to cause gullies.

Light soil. A term formerly used to describe sandy or coarse-textured soils. See *Heavy soil.*

Liquid limit. The moisture content at which the soil material passes from a plastic to a liquid state. See *Plastic limit.*

Lithosols. A group of soils that have little or no evidence of soil development and consist mainly of a partly weathered mass of rock fragments or of nearly barren rock.

Loam. The textural class name for soil having a moderate amount of sand, silt, and clay. Loam soils are 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. (In old literature, especially English literature, the term "loam" applied to mellow soils rich in organic matter, regardless of the texture. As used in the United States, the term refers only to the relative amounts of sand, silt, and clay; loam soils may or may not be mellow.)

Loess. Geological deposit of relatively uniform, fine material, mostly silt, presumably transported by wind.

Low-Humic Gley soils. An intrazonal group of imperfectly to poorly drained soils that have very thin surface horizons, moderately high in organic matter, over mottled gray and brown, gleylike mineral horizons with a low degree of textural differentiation.

Maximum density. The highest density obtained in the compaction test. See *Optimum moisture content.*

Moderately deep soil. A soil that has 24 to 42 inches of moderately coarse or finer textured material over bedrock, sand, or gravel.

Mineral soil. Soil composed chiefly of mineral (inorganic) matter, in contrast to an organic soil, which is composed chiefly of organic matter.

Modal profile. A single profile that represents the most usual condition of each property of all soils in a given category.

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

Muck. Highly decomposed organic soil material developed from peat. Generally, muck has a higher mineral or ash content than peat and is decomposed to such a degree that the original plant parts cannot be identified.

Mulch tillage. Tillage of the soil and treatment of crop residues in such ways as to leave plant materials within or on the soil to form a mulch.

Neutral. Of a soil, having a pH between 6.6 and 7.3. Exact neutrality is pH 7.0.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in elaboration of its food and tissue.

Optimum moisture content. The moisture content at which a soil material yields the highest density in the standard or modified test for optimum moisture and maximum density.

Order. The highest category in soil classification. The three orders are *zonal soils, intrazonal soils,* and *azonal soils.*

Organic soil. Soil that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers.

Parent material. The unconsolidated mass of rock material (or peat) from which the soil profile develops.

Peat. Unconsolidated soil material consisting largely of undecomposed or only slightly decomposed organic matter accumulated under conditions of excessive moisture.

Ped. An individual natural soil aggregate, such as a *crumb, prism,* or *block,* in contrast to a *clod,* which is a mass of soil brought about by digging or other disturbance.

Permeability, soil. The quality of a soil that enables water or air to move through it. It can be measured quantitatively in terms of rate of flow of water through a unit cross section in unit time under specified temperature and hydraulic conditions. Values for saturated soils usually are called *hydraulic conductivity.* The permeability of a soil may be limited by the presence of one nearly impermeable horizon, even though the others are permeable.

pH. A numerical designation of relatively weak acidity and alkalinity, as in soils and other biological systems. Technically, pH is the common logarithm of the reciprocal of the hydrogen-ion concentration of a solution. A pH of 7.0 indicates precise neutrality, higher values indicate increasing alkalinity, and lower values indicate increasing acidity.

Phase, soil. A subdivision of a soil type based on variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of such variations are differences in slope, stoniness, and degree of erosion.

Plastic limit. The moisture content at which a soil material passes from a solid to a plastic state.

Plow planting. Planting a crop at the time the soil is plowed, or soon after, without additional tillage operations to prepare a seedbed.

Productivity, soil. The present capability of a kind of soil for producing a specified plant or sequence of plants under a defined set of management practices.

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

Reaction, soil. The degree of acidity or alkalinity of a soil mass, expressed in either pH value or in words, as follows:

	pH		*pH*
Extremely acid	below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline.	9.1 and higher.
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3 [1]		

[1] Precise neutrality is 7.0.

Regosols. An azonal group of soils that are developing from deep, unconsolidated or soft, rocky deposits and that do not have definite genetic horizons.

Relief. Elevations or inequalities of the land surface, considered collectively.

Residual material. Unconsolidated and partly weathered parent material presumed to have developed from the same kind of rock as that on which it lies. The term "residual" is sometimes incorrectly applied to soils, but it can be applied correctly only to the material from which soils are formed.

Sand. As a soil separate, mineral particles ranging in diameter from 0.05 millimeter to 2.0 millimeters. Usually sand grains consist chiefly of quartz, but they may be of any mineral composition. As a textural class, sand is soil material that is 85 percent or more sand and not more than 10 percent clay.

Sandy clay. Soil material that is 35 percent or more clay and 45 percent or more sand.

Sandy clay loam. Soil material that is 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Sandy loam. Soil material that is 50 percent sand and less than 20 percent clay.

Series, soil. A group of soils that have the same profile characteristics, the same general range in color, structure, consistence, and sequence of horizons, the same general conditions of relief and drainage, and usually a common or similar origin and mode of formation.

Shallow soil. A soil that has 12 to 24 inches of moderately coarse or medium textured material over bedrock, sand, or gravel.

Silt. As a soil separate, mineral particles that range in diameter from 0.002 millimeter to 0.05 millimeter. As a textural class, silt is 80 percent or more silt and less than 12 percent clay. Also a term for sediments deposited by water and consisting of individual grains that are approximately the size of silt; sometimes applied loosely to sediments containing considerable sand and clay.

Silt loam. Soil material that is 50 percent or more silt and 12 to 27 percent clay; or 50 to 80 percent silt and less than 12 percent clay.

Silty clay. Soil material that is 40 percent or more clay and 40 percent or more silt.

Silty clay loam. Soil material that is 27 to 40 percent clay and less than 20 percent sand.

Single-grain soil. A structureless soil in which each particle exists separately, as in dune sand.

Slope. The incline of the surface of a soil, usually expressed as a percentage, which equals the number of feet of fall per 100 feet of horizontal distance.

Soil. The natural body on the surface of the earth; characterized by conformable layers resulting from modification of parent material by physical, chemical, and biological forces over a period of time. The natural medium for the growth of land plants.

Soil association. A group of defined and named soils associated in a characteristic geographic pattern.

Soil characteristic. A feature of a soil that can be seen and measured in the field or in the laboratory. Examples are slope, stoniness, texture, structure, color, and chemical composition.

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

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

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

Subsoil. The B horizon of a soil that has a distinct profile. In a soil with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days, when "soil" meant only the plowed soil and that under it was the "subsoil."

Substratum. Any layer beneath the solum. It may refer either to the parent material or to other layers below the B horizon or the subsoil.

Subsurface soil. The part of the soil between the surface soil and the subsoil.

Surface soil. That part of the soil from the actual surface to the first change in color, texture, or structure; usually the plow layer or its equivalent in uncultivated soil; normally about 5 to 8 inches in thickness, but may be as thick as 18 inches.

Terrace. An embankment or ridge constructed across slopes, on the contour or at a slight angle to the contour. The terrace intercepts and slows surplus runoff so it will infiltrate the soil and so that any excess will flow slowly and harmlessly to a prepared outlet.

Terrace, geological. A nearly flat or undulating plain, commonly rather narrow and usually with a steep front, bordering a river, a lake, or the sea. Although many old terraces have become more or less hilly through dissection by streams, they are still regarded as terraces.

Texture, soil. The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, it refers to the proportion of sand, silt, and clay.

Till, glacial. An unstratified deposit of earth, sand, gravel, and boulders transported by glaciers.

Tilth, soil. The physical condition of a soil in respect to its fitness for the growth of a specified plant or sequence of plants. Ideal soil tilth is not the same for each kind of crop, nor is it uniform for the same kind of crop growing on contrasting kinds of soil.

Topography. The shape of the ground surface, such as hills, mountains, or plains.

Topsoil. A general term used in at least four different senses: (1) A presumed fertile soil or soil material, usually rich in organic matter, used to topdress roadbanks, lawns, and gardens; (2) the plow layer of a soil, thus, the surface soil; (3) the original or present dark-colored upper soil, which ranges in thickness from a mere fraction of an inch to 2 or 3 feet depending on the kind of soil; and (4) the original or present A horizon. Applied to soils in the field, the term has no precise meaning unless defined as to depth or productivity in relation to a specific kind of soil.

Type, soil. A subdivision of the soil series, based on the texture of the surface soil.

Variant, soil. A soil that has properties sufficiently different from those of other known soils to justify a new series name, but whose geographic area is so limited that creation of a new series is not believed to be justified.

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

Zonal soils. A general group of soils that have well-developed characteristics that reflect the influence of the active factors of soil formation: climate and living organisms, chiefly vegetation.

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit	Page
Ad	Alluvial land	8	IIw-4	50
BbA	Bixby loam, 0 to 2 percent slopes	9	IIs-1	50
BbB2	Bixby loam, 2 to 6 percent slopes, eroded	9	IIe-3	47
BxA	Bixby loam, shallow, 0 to 2 percent slopes	9	IIIs-1	55
BxB2	Bixby loam, shallow, 2 to 6 percent slopes, eroded	9	IIIs-3	55
Ca	Canisteo silty clay loam	10	IIIw-4	53
Cb	Canisteo silty clay loam, coarse substratum	10	IIIw-5	54
ChA	Chaseburg silt loam, 0 to 2 percent slopes	11	IIw-4	50
ChB	Chaseburg silt loam, 2 to 6 percent slopes	11	IIw-5	50
CsA	Clyde silty clay loam, 0 to 2 percent slopes	12	IIIw-4	53
CsB	Clyde silty clay loam, 2 to 6 percent slopes	12	VIw-2	58
DaA	Dakota sandy loam, 0 to 2 percent slopes	12	IIIs-1	55
DaB2	Dakota sandy loam, 2 to 6 percent slopes, moderately eroded	13	IIIs-2	55
DaC2	Dakota sandy loam, 6 to 12 percent slopes, moderately eroded	13	IVs-1	56
DoA	Downs silt loam, 0 to 2 percent slopes	13	I-1	46
DoB	Downs silt loam, 2 to 6 percent slopes	13	IIe-1	46
DoB2	Downs silt loam, 2 to 6 percent slopes, moderately eroded	14	IIe-1	46
DoC2	Downs silt loam, 6 to 12 percent slopes, moderately eroded	14	IIIe-1	51
DoC3	Downs silt loam, 6 to 12 percent slopes, severely eroded	14	IIIe-1	51
DoD2	Downs silt loam, 12 to 25 percent slopes, moderately eroded	14	IVe-1	56
FaA	Fayette silt loam, 0 to 2 percent slopes	14	I-2	46
FaB	Fayette silt loam, 2 to 6 percent slopes	14	IIe-2	47
FaB2	Fayette silt loam, 2 to 6 percent slopes, moderately eroded	15	IIe-2	47
FaC	Fayette silt loam, 6 to 12 percent slopes	15	IIIe-1	51
FaC2	Fayette silt loam, 6 to 12 percent slopes, moderately eroded	15	IIIe-1	51
FaD	Fayette silt loam, 12 to 18 percent slopes	15	IVe-1	56
FaD2	Fayette silt loam, 12 to 18 percent slopes, moderately eroded	15	IVe-1	56
FaC3	Fayette silt loam, 6 to 12 percent slopes, severely eroded	15	IIIe-1	51
FaD3	Fayette silt loam, 12 to 18 percent slopes, severely eroded	15	IVe-1	56
FsE2	Fayette and Seaton silt loams, 18 to 25 percent slopes, eroded	16	VIe-1	57
FsF2	Fayette and Seaton silt loams, 25 to 35 percent slopes, moderately eroded	16	VIIe-1	58
FsE3	Fayette and Seaton silt loams, 18 to 25 percent slopes, severely eroded	16	VIe-1	57
FtB	Floyd silty clay loam, 2 to 6 percent slopes	16	IIw-2	49
Fy	Floyd and Clyde silty clay loams	17	IIw-1	48
HaA	Hayfield silt loam, 0 to 2 percent slopes	17	IIs-1	50
HaB	Hayfield silt loam, 2 to 6 percent slopes	17	IIe-3	47
JuA	Judson silt loam, 0 to 2 percent slopes	18	IIw-4	50
JuB	Judson silt loam, 2 to 6 percent slopes	18	IIw-5	50
KaA	Kasson silt loam, 0 to 2 percent slopes	18	IIs-1	50
KaB	Kasson silt loam, 2 to 6 percent slopes	19	IIe-2	47
KaB2	Kasson silt loam, 2 to 6 percent slopes, moderately eroded	19	IIe-2	47
Kc	Kato silty clay loam	19	IIw-3	49
KnA	Kenyon silt loam, 0 to 2 percent slopes	19	I-1	46
KnB	Kenyon silt loam, 2 to 6 percent slopes	20	IIe-1	46
KnB2	Kenyon silt loam, 2 to 6 percent slopes, moderately eroded	20	IIe-1	46
Lo	Lawson and Orion silt loams	20	IIw-4	50
Ma	Marshan silty clay loam	21	IIIw-5	54
Mp	Mixed alluvial land, poorly drained	8	VIw-1	57
Mx	Mixed alluvial land, moderately well drained	8	VIw-1	57
OsA	Ostrander silt loam, 0 to 2 percent slopes	22	I-1	46
OsB	Ostrander silt loam, 2 to 6 percent slopes	22	IIe-1	46
OsB2	Ostrander silt loam, 2 to 6 percent slopes, moderately eroded	22	IIe-1	46
OsC2	Ostrander silt loam, 6 to 12 percent slopes, moderately eroded	22	IIIe-1	51
PmA	Peat and Muck, coarse substrata, 0 to 2 percent slopes	22	IIIw-7	55
PtA	Peat and Muck, medium textured substrata, 0 to 2 percent slopes	23	IIIw-6	54
PtB	Peat and Muck, medium textured substrata, 2 to 6 percent slopes	23	VIw-2	58
RaA	Racine silt loam, 0 to 2 percent slopes	23	I-1	46
RaB	Racine silt loam, 2 to 6 percent slopes	23	IIe-1	46
RaB2	Racine silt loam, 2 to 6 percent slopes, moderately eroded	24	IIe-1	46
RaC	Racine silt loam, 6 to 12 percent slopes	24	IIIe-1	51
RaC2	Racine silt loam, 6 to 12 percent slopes, moderately eroded	24	IIIe-1	51
RcB3	Racine soils, 2 to 6 percent slopes, severely eroded	24	IIe-2	47
RcC3	Racine soils, 6 to 12 percent slopes, severely eroded	25	IIIe-1	51
ReA	Renova silt loam, 0 to 2 percent slopes	25	I-2	46
ReB	Renova silt loam, 2 to 6 percent slopes	25	IIe-2	47
ReB2	Renova silt loam, 2 to 6 percent slopes, moderately eroded	25	IIe-2	47
ReC	Renova silt loam, 6 to 12 percent slopes	26	IIIe-1	51
ReC2	Renova silt loam, 6 to 12 percent slopes, moderately eroded	26	IIIe-1	51
ReD	Renova silt loam, 12 to 18 percent slopes	26	IVe-1	56
ReD2	Renova silt loam, 12 to 18 percent slopes, moderately eroded	26	IVe-1	56
ReE	Renova silt loam, 18 to 25 percent slopes	26	VIe-1	57
ReE2	Renova silt loam, 18 to 25 percent slopes, moderately eroded	26	VIe-1	57
ReF2	Renova silt loam, 25 to 35 percent slopes, eroded	26	VIIe-1	58
RfB3	Renova soils, 2 to 6 percent slopes, severely eroded	26	IIe-2	47

GUIDE TO MAPPING UNITS—Continued

Map symbol	*Mapping unit*	*Page*	*Capability unit*	*Page*
RfC3	Renova soils, 6 to 12 percent slopes, severely eroded	26	IIIe–1	51
RfD3	Renova soils, 12 to 18 percent slopes, severely eroded	26	IVe–1	56
RfE3	Renova soils, 18 to 25 percent slopes, severely eroded	27	VIe–1	57
RoB2	Rockton silt loam, 2 to 6 percent slopes, moderately eroded	27	IIIs–2	55
RoD	Rockton silt loam, 12 to 18 percent slopes	27	VIs–1	58
RoD2	Rockton silt loam, 12 to 18 percent slopes, moderately eroded	28	VIs–1	58
RpA	Rockton silt loam, moderately deep, 0 to 2 percent slopes	28	IIs–1	50
RpB	Rockton silt loam, moderately deep, 2 to 6 percent slopes	28	IIe–3	47
RpC	Rockton silt loam, moderately deep, 6 to 12 percent slopes	28	IIIe–2	51
RsC3	Rockton soils, 6 to 12 percent slopes, severely eroded	28	IVs–1	56
RsD3	Rockton soils, 12 to 18 percent slopes, severely eroded	28	VIs–1	58
Ru	Rough broken and stony land	29	VIIe–1	58
SaA	Sargeant silt loam, 0 to 2 percent slopes	29	IIIw–1	52
SeB	Seaton silt loam, 2 to 6 percent slopes	30	IIe–2	47
SeB2	Seaton silt loam, 2 to 6 percent slopes, moderately eroded	30	IIe–2	47
SeC	Seaton silt loam, 6 to 12 percent slopes	30	IIIe–1	51
SeC2	Seaton silt loam, 6 to 12 percent slopes, moderately eroded	30	IIIe–1	51
SeC3	Seaton silt loam, 6 to 12 percent slopes, severely eroded	30	IIIe–1	51
SeD	Seaton silt loam, 12 to 18 percent slopes	30	IVe–1	56
SeD2	Seaton silt loam, 12 to 18 percent slopes, moderately eroded	31	IVe–1	56
SeD3	Seaton silt loam, 12 to 18 percent slopes, severely eroded	31	IVe–1	56
SkA	Skyberg silt loam, 0 to 2 percent slopes	31	IIIw–1	52
SkB	Skyberg silt loam, 2 to 6 percent slopes	32	IIIw–3	53
TaA	Tama silt loam, 0 to 2 percent slopes	32	I–1	46
TaB	Tama silt loam, 2 to 6 percent slopes	32	IIe–1	46
TaB2	Tama silt loam, 2 to 6 percent slopes, moderately eroded	32	IIe–1	46
Te	Terrace escarpments	32	VIIe–1	58
ThB2	Thurston loam, 2 to 6 percent slopes, moderately eroded	33	IIe–3	47
ThB3	Thurston loam, 2 to 6 percent slopes, severely eroded	33	IIe–3	47
ThC	Thurston loam, 6 to 12 percent slopes	33	IIIe–3	52
ThC2	Thurston loam, 6 to 12 percent slopes, moderately eroded	33	IIIe–3	52
ThC3	Thurston loam, 6 to 12 percent slopes, severely eroded	33	IIIe–3	52
ThD3	Thurston loam, 12 to 18 percent slopes, severely eroded	34	VIs–1	58
TsB3	Thurston soils, 2 to 6 percent slopes, severely eroded	34	IIIs–3	55
TsC2	Thurston soils, 6 to 12 percent slopes, moderately eroded	34	IVs–1	56
TsC3	Thurston soils, 6 to 12 percent slopes, severely eroded	34	IVs–1	56
TtA	Thurston and Dickinson loams, 0 to 2 percent slopes	34	IIs–1	50
TtB	Thurston and Dickinson loams, 2 to 6 percent slopes	35	IIe–3	47
TuA	Thurston and Dickinson soils, 0 to 2 percent slopes	35	IIIs–1	55
TuB	Thurston and Dickinson soils, 2 to 6 percent slopes	35	IIIs–2	55
TuB2	Thurston and Dickinson soils, 2 to 6 percent slopes, moderately eroded	35	IIIs–2	55
Ud	Udolpho silt loam	35	IIIw–2	53
VaA	Vlasaty silt loam, 0 to 2 percent slopes	36	IIs–1	50
VaB	Vlasaty silt loam, 2 to 6 percent slopes	36	IIe–2	47
VaB2	Vlasaty silt loam, 2 to 6 percent slopes, moderately eroded	36	IIe–2	47
WaA	Waukegan silt loam, 0 to 2 percent slopes	37	IIs–1	50
WaB	Waukegan silt loam, 2 to 6 percent slopes	37	IIe–3	47
WaB2	Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	37	IIe–3	47
WdA	Waukegan silt loam, deep, 0 to 2 percent slopes	37	I–1	46
WkA	Waukegan silt loam, thick surface variant, 0 to 2 percent slopes	38	I–1	46
WmC2	Waukegan-Bixby silt loams, 6 to 12 percent slopes, moderately eroded	38	IIIe–3	52
WnB	Whalan silt loam, 2 to 6 percent slopes	38	IIIs–3	55
WnB2	Whalan silt loam, 2 to 6 percent slopes, moderately eroded	39	IIIs–3	55
WnC	Whalan silt loam, 6 to 12 percent slopes	39	IVs–1	56
WnC2	Whalan silt loam, 6 to 12 percent slopes, moderately eroded	39	IVs–1	56
WnD	Whalan silt loam, 12 to 18 percent slopes	39	VIs–1	58
WnD2	Whalan silt loam, 12 to 18 percent slopes, moderately eroded	39	VIs–1	58
WoB	Whalan silt loam, moderately deep, 2 to 6 percent slopes	39	IIe–3	47
WoB2	Whalan silt loam, moderately deep, 2 to 6 percent slopes, moderately eroded	40	IIe–3	47
WoC	Whalan silt loam, moderately deep, 6 to 12 percent slopes	40	IIIe–2	51
WoC2	Whalan silt loam, moderately deep, 6 to 12 percent slopes, moderately eroded	40	IIIe–2	51
WoD	Whalan silt loam, moderately deep, 12 to 18 percent slopes	40	IVe–1	56
WoD2	Whalan silt loam, moderately deep, 12 to 18 percent slopes, moderately eroded	40	IVe–1	56
WoE	Whalan silt loam, moderately deep, 18 to 25 percent slopes	40	VIe–1	57
WoE2	Whalan silt loam, moderately deep, 18 to 25 percent slopes, moderately eroded	41	VIe–1	57
WpC3	Whalan soils, 6 to 12 percent slopes, severely eroded	41	IVs–1	56
WpD3	Whalan soils, 12 to 18 percent slopes, severely eroded	41	VIs–1	58
WsB3	Whalan soils, moderately deep, 2 to 6 percent slopes, severely eroded	41	IIe–3	47
WsC3	Whalan soils, moderately deep, 6 to 12 percent slopes, severely eroded	41	IIIe–2	51
WsD3	Whalan soils, moderately deep, 12 to 18 percent slopes, severely eroded	41	IVe–1	56
WuA	Wykoff loam, 0 to 2 percent slopes	42	IIs–1	50
WuB	Wykoff loam, 2 to 6 percent slopes	42	IIe–3	47
WuB2	Wykoff loam, 2 to 6 percent slopes, moderately eroded	42	IIe–3	47
WuC	Wykoff loam, 6 to 12 percent slopes	42	IIIe–3	52

GUIDE TO MAPPING UNITS—Continued

Map symbol	*Mapping unit*	*Page*	*Capability unit*	*Page*
WuC2	Wykoff loam, 6 to 12 percent slopes, moderately eroded	42	IIIe-3	52
WuC3	Wykoff loam, 6 to 12 percent slopes, severely eroded	42	IIIe-3	52
WuD2	Wykoff loam, 12 to 18 percent slopes, eroded	42	IVe-1	56
WuD3	Wykoff loam, 12 to 18 percent slopes, severely eroded	43	IVe-1	56
WyB	Wykoff soils, 2 to 6 percent slopes	43	IIIs-3	55
WyB2	Wykoff soils, 2 to 6 percent slopes, moderately eroded	43	IIIs-3	55
WyC2	Wykoff soils, 6 to 12 percent slopes, eroded	43	IVs-1	56
WyC3	Wykoff soils, 6 to 12 percent slopes, severely eroded	43	IVs-1	56
WzD2	Wykoff and Thurston soils, 12 to 18 percent slopes, eroded	43	VIs-1	58
WzD3	Wykoff and Thurston soils, 12 to 18 percent slopes, severely eroded	44	VIs-1	58

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