



United States  
Department of  
Agriculture

Soil  
Conservation  
Service

In cooperation with  
the Iowa Agriculture and  
Home Economics  
Experiment Station; the  
Cooperative Extension  
Service, Iowa State  
University; and the  
Division of Soil  
Conservation, Iowa  
Department of Agriculture  
and Land Stewardship

# Soil Survey of Jackson County, Iowa





# How To Use This Soil Survey

## General Soil Map

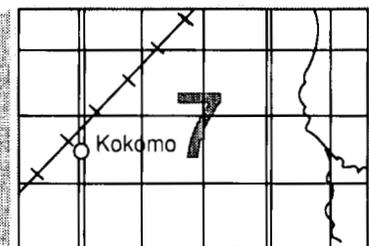
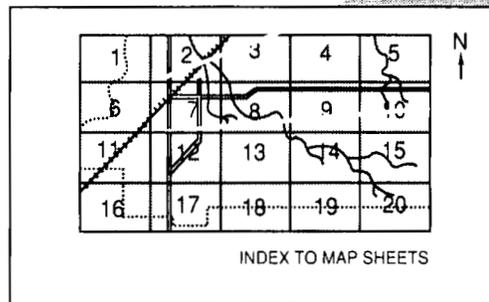
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

## Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

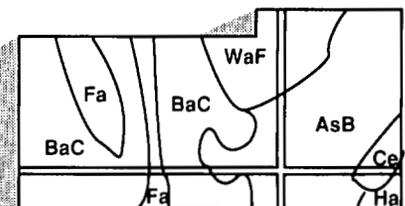


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1982 to 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Jackson County Soil and Water Conservation District. Funds appropriated by Jackson County were used to defray part of the cost of the survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

**Cover:** An area of the Rosetta-Derinda-Fayette association. Crop rotations of corn, oats, and hay in contour strips and well maintained grassed waterways help to control erosion in these gently rolling to hilly areas.

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# Preface

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This soil survey contains information that can be used in land-planning programs in Jackson County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



# Soil Survey of Jackson County, Iowa

By Mark R. LaVan, Soil Conservation Service

Fieldwork by Tom Brantmeier, Kevin R. Funni, Mark R. LaVan, Scott Switzer,  
and Jeff Talsky, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,  
in cooperation with  
the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension  
Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of  
Agriculture and Land Stewardship

JACKSON COUNTY is in the eastern part of Iowa (fig. 1). It has a total area of 412,032 acres, or 644 square miles. Maquoketa, the county seat, is in the south-central part of the county. It is about 170 miles northeast of Des Moines and 30 miles south of Dubuque.

This soil survey updates the survey of Jackson County published in 1941 (21). It provides additional information and larger maps, which show the soils in more detail.

## General Nature of the County

The following paragraphs give general information about the county. They describe climate, drainage and relief, history and development, agriculture, transportation facilities, and natural resources.

## Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Jackson County is cold in winter. It is quite hot in summer but has occasional cool spells. Precipitation during the winter frequently occurs as snowstorms. During the warm months, when warm, moist air moves in from the south, the precipitation occurs chiefly as

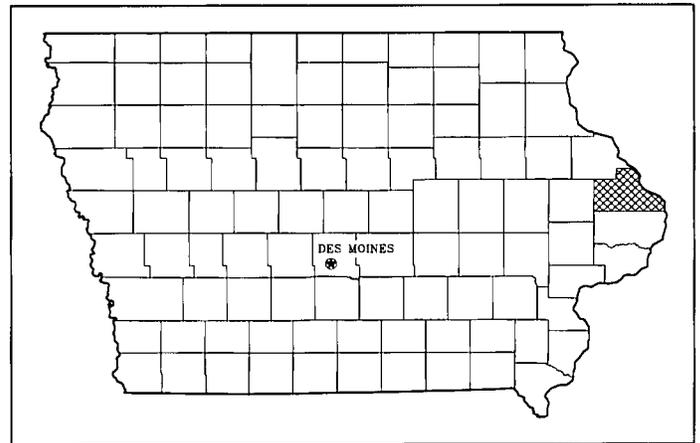


Figure 1.—Location of Jackson County in Iowa.

showers, which are often heavy. The total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Maquoketa, Iowa, in the period 1951 to 1986. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 22 degrees F

and the average daily minimum temperature is 13 degrees. The lowest temperature on record, which occurred at Maquoketa on January 20, 1985, is -27 degrees. In summer, the average temperature is 71 degrees and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 28, 1955, is 102 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 35 inches. Of this, about 23 inches, or more than 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 6.93 inches at Maquoketa on August 30, 1981. Thunderstorms occur on about 43 days each year.

The average seasonal snowfall is about 32 inches. The greatest snow depth at any one time during the period of record was 24 inches. On the average, 25 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms strike occasionally. They are usually local in extent and of short duration and result in sparse damage in narrow belts. Hail falls in scattered small areas at times during the warmer part of the year.

## Drainage and Relief

Approximately 75 percent of Jackson County is drained by the Maquoketa River and its tributaries. This river enters the county near the town of Canton and flows in a southeasterly direction until it reaches the town of Maquoketa. In an area directly north of this town, it is joined by the North Fork of the Maquoketa River. From this area, the Maquoketa River flows in an easterly direction until it reaches Spragueville. From Spragueville, it flows in a northeasterly direction and

eventually empties into the Mississippi River directly north of Green Island.

Some of the major tributaries of the Maquoketa River include Farmers Creek, Lytle Creek, Brush Creek, Deep Creek, and Prairie Creek. Most of the tributaries are characterized by sharp changes in direction. These changes result from the fractured dolomitic limestone bedrock controlling the directional flow of the tributaries.

Some of the streams in the eastern part of the county empty directly into the Mississippi River. The larger streams include the Tete des Morts River, Spruce Creek, Mill Creek, and Pleasant Creek.

Jackson County is mainly on well dissected uplands. The landscape in all areas, except for the stream terraces and bottom land along the Mississippi River, is gently rolling to very steep. Typical upland features are high relief, common limestone outcrops, narrow or moderately broad ridges, and fairly long side slopes. The landscape along the Mississippi and Maquoketa Rivers and their tributaries commonly is very steep and rugged. Limestone bedrock bluffs are common between the bottom land and the upland ridges.

Less rugged areas are in the southern part of the county, near Miles and south and west of Maquoketa. These areas are characterized by lower relief, fewer limestone outcrops, and undulating or gently rolling topography.

The major bottom land region is along the Mississippi River, near Green Island. This area is characterized by nearly level slopes, sloughs, old river channels, and backwater lakes.

The difference in elevation between the highest and lowest points in the county is about 570 feet. Surface relief in Prairie Spring Township alone is more than 500 feet (18). The highest elevation in the county, about 1,140 feet above sea level, is in section 6 of Prairie Spring Township. The lowest elevation, about 570 feet, is on a flood plain along the Mississippi River in the southeast corner of the county.

## History and Development

The area now called Jackson County was part of the Louisiana Purchase of 1803. While the area was part of the territory of Missouri, a treaty with the Sac and Fox Indians was signed in 1832. This was known as the Black Hawk Purchase, which opened the area for settlement (1). The first settler, James Armstrong, arrived in 1833. He lived about 1 mile south of Bellevue (21). Feeling isolated from the government across the Mississippi River, settlers worked to have a new territory formed. Through this effort, the Territory of Iowa was established in 1838. In 1846, Iowa became a state and Ansel Briggs, who was from Andrew, was

selected as the first governor.

Jackson County was established from part of Dubuque County in 1837 while under the jurisdiction of the territory of Wisconsin. It was named after Andrew Jackson.

During the early years, little towns were established throughout the county. Canton, which at one time was bigger than Dubuque, had a population of 1,200 in the 1840's. This included 160 coopers, 150 loggers, and 50 sawmill workers. A packing plant in the town handled 100 hogs per day. Like many other towns in Jackson County, the town decreased in population dramatically when the railroads passed it by (6). Only a handful of houses remain today.

Having almost an unlimited supply of limestone and timber, Alfred Hurst and O.W. Joiner each engaged in the lime industry in the 1870's. This activity put the town of Maquoketa on the map. The lime was considered the best available until the advent of Portland Cement and the discovery of gypsum in the early 1900's (2). Restored limestone kilns remain in Hurstville.

The population of Jackson County increased rapidly in the early years. In 1980, it was 22,503.

## Agriculture

Most of the acreage in Jackson County is used for agricultural production. Agriculture is the main economic enterprise in the county. Most of the local income is derived from the sale of hogs, beef cattle, and dairy products. Some corn is sold as a cash crop. The amount sold varies from year to year, depending mainly on the price of feeder cattle, the market for fattened cattle and for hogs, the cash price of corn, and the quantity of the corn crop.

Hogs, beef cattle, and dairy cows are the main kinds of livestock in the county. In 1986, about 156,000 hogs were marketed. In January 1987, the county had 34,000 cattle. This was the fifth largest number of cattle in Iowa (8). The total included 23,500 beef cattle and 10,500 dairy cows. About 14,000 grain-fed cattle and 1,000 sheep and lambs were marketed in 1986.

The principal crops in the county are corn, oats, and hay. In 1986, corn was grown on 107,000 acres, oats on 24,400 acres, and hay on 70,000 acres. The acreage of hay was the fifth highest in Iowa (8).

The farms in Jackson County, like those throughout the Midwest, have been increasing in size and decreasing in number. In 1976, the average size was 236 acres and the number of farms was 1,660 (9). By 1986, the average size had increased to 285 acres and the number of farms had decreased to 1,330 (8).

## Transportation Facilities

U.S. Highway 61 runs north and south through the western part of Jackson County. State Highway 52 runs dominantly north and south along the eastern edge of the county. State Highway 64 runs east and west through the southern part of the county. State Highway 62 connects Maquoketa and Bellevue. Hard-surface county roads connect these highways to nearly all of the smaller communities in the county. Nearly all farmsteads are along farm-to-market roads surfaced with crushed limestone.

Bellevue and Sabula are along a major railway. Almost all of the railroad lines that formerly served other communities in the county have been abandoned. Motor freight lines serve every trading center in the county. Airline transportation is provided by a small municipal airport at Maquoketa and a private airport with a turf runway south of La Motte.

The Mississippi River is used for transporting the grain produced on farms throughout the northeastern part of Iowa. Grain terminals are located in Dubuque and Clinton.

## Natural Resources

Jackson County has a variety of natural resources other than agricultural land. Among these are limestone, sand, gravel, woodland, and water.

Limestone bedrock is near the surface or exposed in many areas throughout the county. It can be easily accessed for quarrying (fig. 2). Many small and a few large quarries are throughout the county. The limestone is crushed and used as road-building material, concrete aggregate, and a source of agricultural lime. Some limestone is cut into blocks or slabs and used for embankments or decorative purposes.

The county has several sand and gravel pits. The largest pit is on a stream terrace along the Mississippi River north of Bellevue. The sand and gravel are used mainly as road-surfacing material and concrete aggregate. Some of the gravel is used for landscaping purposes, and the very small gravel is used as roofing material for commercial or industrial buildings.

At one time, most of Jackson County was forested. Most of the less sloping areas have been cleared and are now used for agricultural purposes. The trees remaining in the county are important commercially. A large number of walnut and oak logs are cut throughout the year and are shipped out of the county. A considerable number of trees are cut for firewood, and some are sold commercially.

Jackson County has a number of permanent streams, including Brush Creek, Mill Creek, and Little



Figure 2.—A limestone quarry in an area of Rockton silt loam, 2 to 5 percent slopes, west of Miles.

Mill Creek. The flow of these streams is determined mainly by the number and size of the springs along them. Many of the streams are stocked with trout each year.

### How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil

profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind

of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given

soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

## Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the

landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient

information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

# General Soil Map Units

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The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

## Soil Descriptions

### 1. Fayette-Nordness-Rock Outcrop Association

*Rock outcrop and gently sloping to very steep, well drained soils formed in loess or in loess and a thin layer of clayey residuum over dolomitic limestone bedrock; on uplands*

This association consists of soils on narrow or moderately broad ridges and on side slopes and escarpments. Typically, dolomitic limestone bedrock escarpments rise abruptly above narrow, meandering valleys. The landscape between the valleys is undulating to very steep. A well developed network of drainageways characterizes this association. Slopes range from 2 to 60 percent.

This association makes up about 62 percent of the county. It is about 55 percent Fayette soils, 20 percent Nordness soils, 5 percent Rock outcrop, and 20 percent minor soils (fig. 3).

Fayette soils are on gently sloping to strongly sloping ridges and on the strongly sloping to very steep upper side slopes. Nordness soils are on moderately sloping and strongly sloping ridges and on the moderately sloping to very steep lower side slopes. The Rock

outcrop is on the moderately steep to very steep lower side slopes and escarpments.

Typically, the surface layer of the Fayette soils is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam mottled with strong brown and light brownish gray. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown and light brownish gray.

Typically, the surface layer of the Nordness soils is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is about 11 inches thick. The upper part is yellowish brown, friable silt loam and silty clay loam. The lower part is brown, firm silty clay loam. Limestone bedrock is at a depth of about 19 inches.

The Rock outcrop is exposed dolomitic limestone bedrock. It occurs as escarpments or bluffs.

Minor in this association are the Arenzville, Chaseburg, Dubuque, NewGlarus, and Rozetta soils. The moderately well drained Arenzville and well drained Chaseburg soils formed in stratified, silty alluvium in upland drainageways and on bottom land. Dubuque and NewGlarus soils formed in loess and clayey residuum over limestone bedrock, which is at a depth of 20 to 40 inches. They are on ridges and the upper side slopes. The moderately well drained Rozetta soils formed in loess on side slopes and concave slopes at the head of drainageways.

Most of the gently sloping to moderately steep areas in this association are used for crop production. The steep and very steep areas and the soils that are shallow over limestone bedrock are used for permanent pasture, woodland, or wildlife habitat. The areas on bottom land are used for crop production, permanent pasture, or woodland, depending on their width and accessibility.

The gently sloping to strongly sloping areas of the Fayette soils are well suited or moderately well suited to

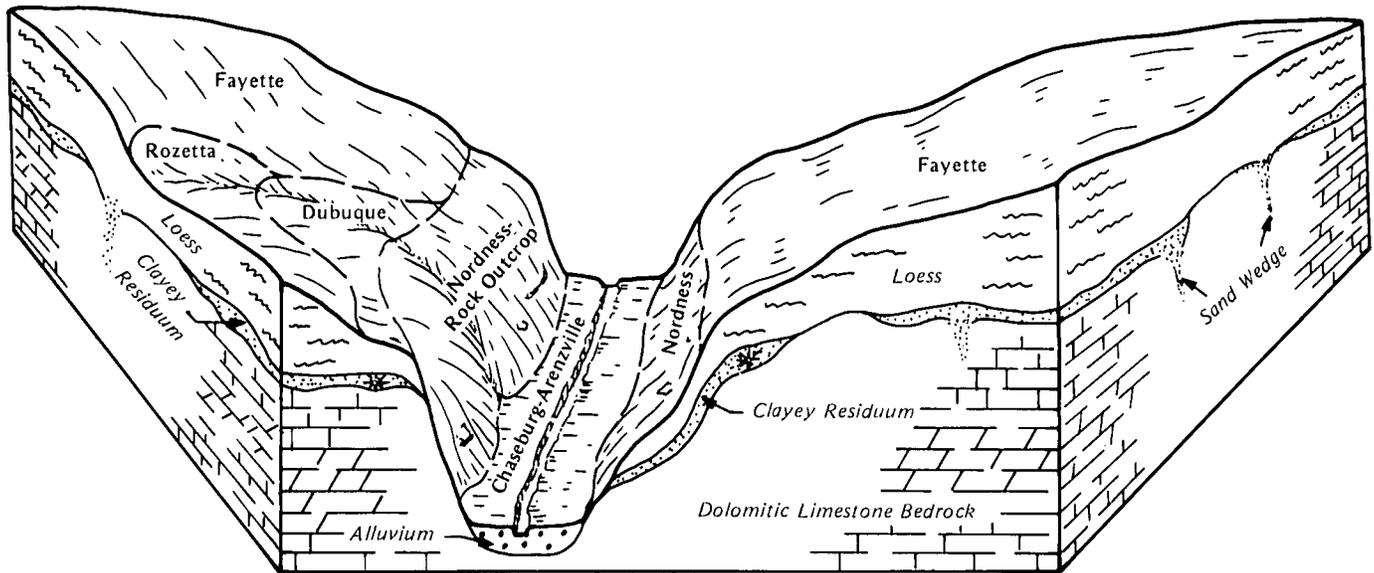


Figure 3.—Typical pattern of soils and parent material in the Fayette-Nordness-Rock outcrop association.

corn occasionally grown in rotation with small grain and hay. The steeper areas of the Fayette soils, the Nordness soils, and the Rock outcrop are poorly suited or unsuited to crop production. The main management needs are measures that control water erosion, prevent the formation of gullies, and maintain tilth and fertility. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. A combination of terraces, crop rotations that include grasses and legumes, and contour stripcropping helps to prevent excessive soil loss on most of the Fayette soils. In some areas terrace systems or well maintained grassed waterways help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility.

## 2. Downs-Fayette Association

*Gently sloping to very steep, well drained soils formed in loess; on uplands*

This association consists of soils on moderately broad ridges and side slopes. The landscape is undulating to very steep. Slopes range from 2 to 40 percent.

This association makes up about 17 percent of the county. It is about 45 percent Downs soils, 30 percent Fayette soils, and 25 percent minor soils (fig. 4).

Downs soils are on gently sloping and moderately sloping ridges and on strongly sloping to steep side slopes. Fayette soils are on gently sloping to strongly

sloping ridges and on moderately steep to very steep side slopes.

Typically, the surface layer of the Downs soils is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 53 inches thick. It is friable. The upper part is brown silt loam, the next part is dark yellowish brown and yellowish brown silty clay loam, and the lower part is yellowish brown silty clay loam and silt loam mottled with strong brown and light brownish gray.

Typically, the surface layer of the Fayette soils is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam mottled with strong brown and light brownish gray. The substratum to a depth of about 60 inches also is yellowish brown silt loam mottled with strong brown and light brownish gray.

Minor in this association are the Arenzville, Chaseburg, Lindley, Newvienna, Nordness, and Tama soils. Arenzville and Chaseburg soils formed in stratified, silty alluvium in upland drainageways. Lindley soils formed in glacial till, are moderately slowly permeable, and are on the lower side slopes. Newvienna soils formed in loess, are moderately well drained, and are on ridges, side slopes, and concave

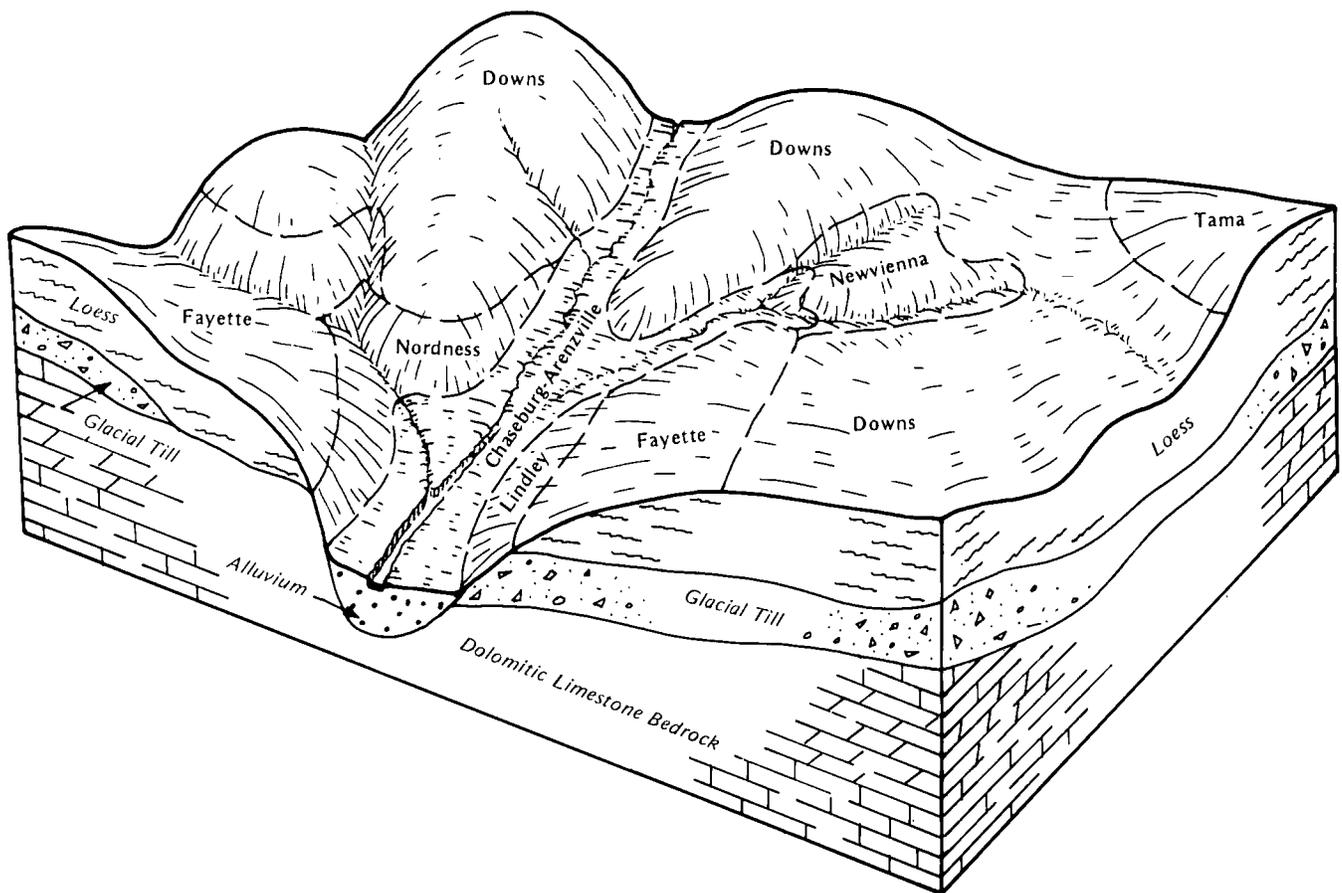


Figure 4.—Typical pattern of soils and parent material in the Downs-Fayette association.

slopes at the head of drainageways. Nordness soils are well drained and formed in loess and clayey residuum over limestone bedrock, which is at a depth of 8 to 20 inches. They are on the lower side slopes. Tama soils formed in loess, are well drained, and are on ridges and side slopes.

Most of the gently sloping to moderately steep areas in this association are used for crop production. Generally, grain in rotation with hay is grown to be fed to beef cattle, dairy cows, or hogs. A few areas are used for pasture. Most of the steep and very steep areas are used for permanent pasture, woodland, or wildlife habitat. The areas in upland drainageways and on bottom land are used for row crops, permanent pasture, or woodland, depending on their accessibility and width.

The gently and moderately sloping soils are well suited to corn, soybeans, small grain, and hay. The strongly sloping soils are moderately well suited to corn occasionally grown in rotation with small grain and hay. The main management needs are measures that control

water erosion, prevent the formation of gullies, and maintain tilth and fertility. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. Terrace systems or well maintained grassed waterways help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility.

### 3. Orwood-Emeline-Racine Association

*Gently sloping to steep, well drained and somewhat excessively drained soils formed in loamy and silty eolian material, loamy material over limestone bedrock, and loamy sediment and the underlying glacial till; on uplands*

This association consists of soils on moderately broad ridges and side slopes. The landscape is undulating to very steep. Slopes range from 2 to 25 percent.

This association makes up about 2 percent of the county. It is about 40 percent Orwood soils, 25 percent Emeline soils, 18 percent Racine soils, and 17 percent minor soils.

Orwood soils are well drained and are on moderately sloping ridges and strongly sloping to steep side slopes. Emeline soils are somewhat excessively drained and are on gently sloping and moderately sloping ridges and on strongly sloping to steep side slopes. Racine soils are well drained and are on gently sloping ridges and moderately sloping side slopes.

Typically, the surface layer of the Orwood soils is very dark grayish brown and dark brown loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is dark yellowish brown loam, the next part is yellowish brown silt loam, and the lower part is yellowish brown silt loam mottled with light brownish gray and strong brown.

Typically, the surface layer of the Emeline soils is black loam about 9 inches thick. Limestone bedrock is at a depth of about 9 inches.

Typically, the surface layer of the Racine soils is very dark grayish brown loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 53 inches thick. The upper part is brown and yellowish brown, friable loam; the next part is yellowish brown, friable loam mottled with light brownish gray and strong brown; and the lower part is yellowish brown, firm loam mottled with light brownish gray and strong brown.

Minor in this association are the Downs, Floyd, Nordness, Sparta, and Winneshiek soils. Downs soils formed in more than 5 feet of loess on ridges and side slopes. Floyd soils formed in silty or loamy sediment on foot slopes and in upland drainageways. Nordness soils formed in 8 to 20 inches of loess and are underlain by limestone bedrock. They are on the lower side slopes. Sparta soils formed in sandy material and are excessively drained. They are on ridges and side slopes. Winneshiek soils formed in loamy sediment and in a thin layer of residuum and are underlain by limestone bedrock at a depth of 20 to 40 inches. They are on ridges and side slopes.

Most of the gently sloping to strongly sloping areas in this association are used for crop production. The moderately steep and steep soils and the soils that are shallow over limestone bedrock are used for pasture, woodland, or wildlife habitat.

The gently sloping and moderately sloping soils are well suited or moderately well suited to corn, soybeans,

small grain, and hay. The strongly sloping soils are moderately well suited to corn occasionally grown in rotation with small grain and hay. The moderately steep and steep soils and the soils that are shallow over limestone bedrock are not suitable for crop production. The main management needs are measures that control water erosion and maintain fertility and tilth. Droughtiness may be a problem on most of the soils in years of below normal rainfall. A system of conservation tillage that leaves most of the crop residue on the surface helps to conserve moisture and prevent excessive soil loss. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to control erosion. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility.

#### 4. Rozetta-Derinda-Fayette Association

*Moderately sloping to very steep, moderately well drained and well drained soils formed in loess or in loess and the underlying residuum of shale; on uplands*

This association consists of soils on side slopes, head slopes, and narrow ridges. It is dissected by many concave drainageways. The landscape is gently rolling to very steep. Slopes range from 5 to 40 percent.

This association makes up about 2 percent of the county. It is about 60 percent Rozetta soils, 12 percent Derinda soils, 10 percent Fayette soils, and 18 percent minor soils (fig. 5).

Rozetta soils are moderately well drained and are on moderately steep and steep side slopes and on strongly sloping ridges. Derinda soils are moderately well drained and are on moderately steep and steep side slopes and head slopes. Fayette soils are well drained and are on moderately steep and steep side slopes and on moderately sloping and strongly sloping ridges.

Typically, the surface layer of the Rozetta soils is brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 41 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and has strong brown and light brownish gray mottles. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with light brownish gray and strong brown.

Typically, the surface layer of the Derinda soils is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material into the surface layer. The subsoil is about 19 inches thick. It is yellowish brown. The upper part is

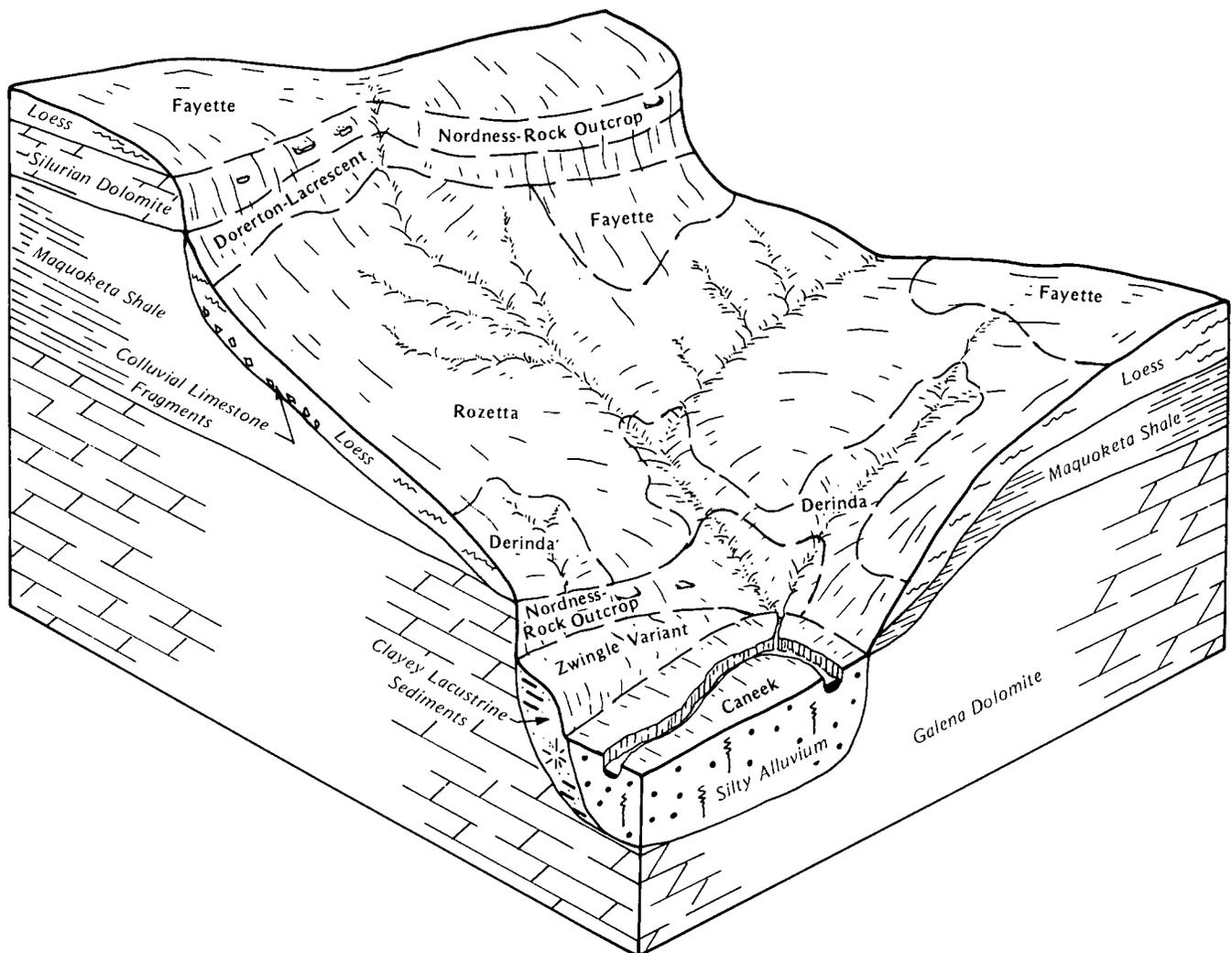


Figure 5.—Typical pattern of soils and parent material in the Rozetta-Derinda-Fayette association.

friable silty clay loam, and the lower part is firm silty clay mottled with light yellowish brown and strong brown. Pale olive, clayey shale mottled with olive yellow is at a depth of about 27 inches.

Typically, the surface layer of the Fayette soils is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam mottled with strong brown and light brownish gray. The substratum to a depth of about 60 inches also is yellowish brown silt loam mottled with strong brown and light brownish gray.

Minor in this association are the Caneek, Dorerton, Lacrescent, Nordness, and Zwingle Variant soils and Rock outcrop. Caneek soils are poorly drained and formed in silty alluvium over an older buried soil. They are on bottom land along the tributaries of major streams. Dorerton and Lacrescent soils formed in a mixture of loess, colluvium, and dolomitic limestone fragments. They are upslope from the major soils. Nordness soils and the Rock outcrop are on the lower side slopes below the major soils. Nordness soils formed in loess and clayey residuum over limestone bedrock, which is at a depth of 8 to 20 inches. Zwingle Variant soils are poorly drained and formed in clayey lacustrine sediment on stream terraces.

Most of the moderately sloping to moderately steep soils in this association are used for row crops or small

grain or for grasses and legumes for hay. Most of the steep soils are used for grasses and legumes for hay. Some areas are used as permanent pasture, and a few areas are used as woodland. Most of the very steep areas are used as woodland or wildlife habitat. The areas in drainageways and on bottom land are used for crop production, hay, permanent pasture, or wildlife habitat, depending on their width and accessibility and the extent of stream channel meanders.

The moderately sloping to moderately steep soils are moderately well suited to corn occasionally grown in rotation with small grain and legumes. They are well suited to grasses and legumes for hay and pasture. The main management needs are measures that control water erosion, prevent the formation of gullies, and maintain tilth and fertility. In wet years a drainage system is needed to remove excess water and permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to conserve soil moisture and prevent excessive soil loss. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to control erosion. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility.

##### **5. Chaseburg-Caneek-Orion Association**

*Nearly level, well drained to poorly drained soils formed in silty alluvial sediment; on bottom land along the major streams*

This association consists of soils on long, moderately wide or wide bottom land. Slopes range from 0 to 2 percent.

This association makes up about 11 percent of the county. It is about 30 percent Chaseburg soils, 20 percent Caneek soils, 10 percent Orion soils, and 40 percent minor soils.

Chaseburg soils are well drained. Caneek soils are poorly drained. Orion soils are somewhat poorly drained. The three soils are in similar positions on the landscape.

Typically, the surface layer of the Chaseburg soils is dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified dark grayish brown, brown, very dark grayish brown, and pale brown silt loam.

Typically, the surface layer of the Caneek soils is brown silt loam about 4 inches thick. The substratum is about 24 inches of stratified dark grayish brown, grayish brown, and brown silt loam mottled with strong brown, dark gray, and yellowish brown. Below this to a depth of about 60 inches is an older buried surface layer of black or very dark gray silt loam.

Typically, the surface layer of the Orion soils is dark grayish brown and brown silt loam about 4 inches thick. The substratum is about 30 inches of stratified brown, dark grayish brown, grayish brown, very dark grayish brown, and brown silt loam mottled with brown, yellowish brown, and dark reddish brown. Below this to a depth of about 60 inches is an older buried surface layer of black silt loam.

Minor in this association are the Arenzville, Dorchester, Festina, Lawson, and Zwingle Variant soils. Arenzville, Dorchester, and Lawson soils are in positions on the landscape similar to those of the major soils. Arenzville soils have a buried soil at a depth of 20 to 40 inches and are moderately well drained. Dorchester soils formed in calcareous alluvial sediment. Lawson soils formed in silty alluvium under a native vegetation of prairie grasses. Festina and Zwingle Variant soils are on stream terraces adjacent to the major soils. Festina soils formed in silty alluvium. Zwingle Variant soils formed in clayey lacustrine sediment.

Most of this association is used for corn or soybeans. Some areas are used for permanent pasture, depending on their accessibility and the extent of stream channel meanders. If drained and protected from flooding, the association is well suited to crop production. Flooding occurs in the spring and may delay fieldwork. The deposition of sediment may damage crops in some years. The main management concerns are flooding and wetness. Terraces or diversions on the adjacent uplands can protect this association from overflow. A properly installed drainage system works well if an adequate outlet is available.

##### **6. Chelsea-Fayette-Lamont Association**

*Gently sloping to very steep, well drained and excessively drained soils formed in sandy and loamy eolian deposits and loess; on uplands*

This association consists of soils in dunelike areas on narrow ridges and short side slopes and soils on narrow or moderately broad ridges and on side slopes. The landscape is undulating to very steep. Slopes range from 2 to 40 percent.

This association makes up about 3 percent of the county. It is about 30 percent Chelsea soils, 25 percent Fayette soils, 15 percent Lamont soils, and 30 percent minor soils.

Chelsea soils are excessively drained and are on gently sloping to strongly sloping ridges and on strongly sloping to very steep side slopes. Fayette soils are well drained and are on gently sloping to strongly sloping ridges and on strongly sloping to very steep side slopes. Lamont soils are well drained and are on

moderately sloping or strongly sloping ridges and on strongly sloping to very steep side slopes.

Typically, the surface layer of the Chelsea soils is very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 22 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Typically, the surface layer of the Fayette soils is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam, the next part is yellowish brown silty clay loam, and the lower part is yellowish brown silt loam mottled with strong brown and light brownish gray. The substratum to a depth of about 60 inches also is yellowish brown silt loam mottled with strong brown and light brownish gray.

Typically, the surface layer of the Lamont soils is dark grayish brown sandy loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand.

Minor in this association are the Nordness, Sparta, Terril, and Winneshiek soils. Nordness soils formed in loess and clayey residuum over limestone bedrock, which is at a depth of 8 to 20 inches. They are on the lower side slopes. Sparta soils formed in sandy eolian deposits under a native vegetation of prairie grasses. They are on ridges and strongly sloping side slopes. Terril soils formed in loamy colluvium and alluvium and have a thick, dark surface soil. They are moderately well drained and are on foot slopes and alluvial fans and in drainageways and closed depressions. Winneshiek soils formed in loamy sediment and a thin layer of residuum. They are underlain by limestone bedrock at a depth of 20 to 40 inches. They are on ridges and side slopes.

Most of the undulating to rolling soils in this association are used for row crops, hay, or pasture. The steeper areas are used for permanent pasture, woodland, or wildlife habitat.

The undulating or gently rolling areas are moderately well suited or poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay in these areas. The steeper areas are better suited to permanent pasture or woodland. The main management needs are measures that control wind erosion and water erosion, reduce droughtiness in the sandy soils,

and improve tilth and fertility. A system of conservation tillage that leaves most of the crop residue on the surface helps to conserve soil moisture and prevent excessive soil loss. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to control erosion. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility.

## 7. Pillot-Rockton-Dinsdale Association

*Gently sloping and moderately sloping, well drained and moderately well drained soils formed in loess and the underlying loamy sediment, loamy material and a thin layer of residuum over limestone bedrock, and loess and the underlying glacial till; on uplands*

This association consists of soils on broad ridges and on side slopes. The landscape is undulating and gently rolling. Slopes range from 2 to 9 percent.

This association makes up about 2 percent of the county. It is about 30 percent Pillot and similar soils, 16 percent Rockton soils, 16 percent Dinsdale soils, and 38 percent minor soils.

Pillot and Rockton soils are well drained and are on gently sloping ridges and moderately sloping side slopes. Dinsdale soils are moderately well drained and are on gently sloping ridges and side slopes.

Typically, the surface layer of the Pillot soils is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown silt loam about 14 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, friable silty clay loam; the next part is yellowish brown, friable silty clay loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown loamy sand.

Typically, the surface layer of the Rockton soils is very dark brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is dark yellowish brown, friable clay loam about 12 inches thick. Limestone bedrock is at a depth of about 28 inches.

Typically, the surface layer of the Dinsdale soils is very dark grayish brown silt loam about 7 inches thick. The subsurface layer also is very dark grayish brown silt loam. It is about 4 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, friable silt loam; the next part is brown, friable silty clay loam; and the lower part is yellowish brown, firm clay loam mottled with strong brown and grayish brown. The substratum to a depth of about 60 inches is yellowish brown clay loam mottled with strong brown.

Minor in this association are the Dolbee, Ely,

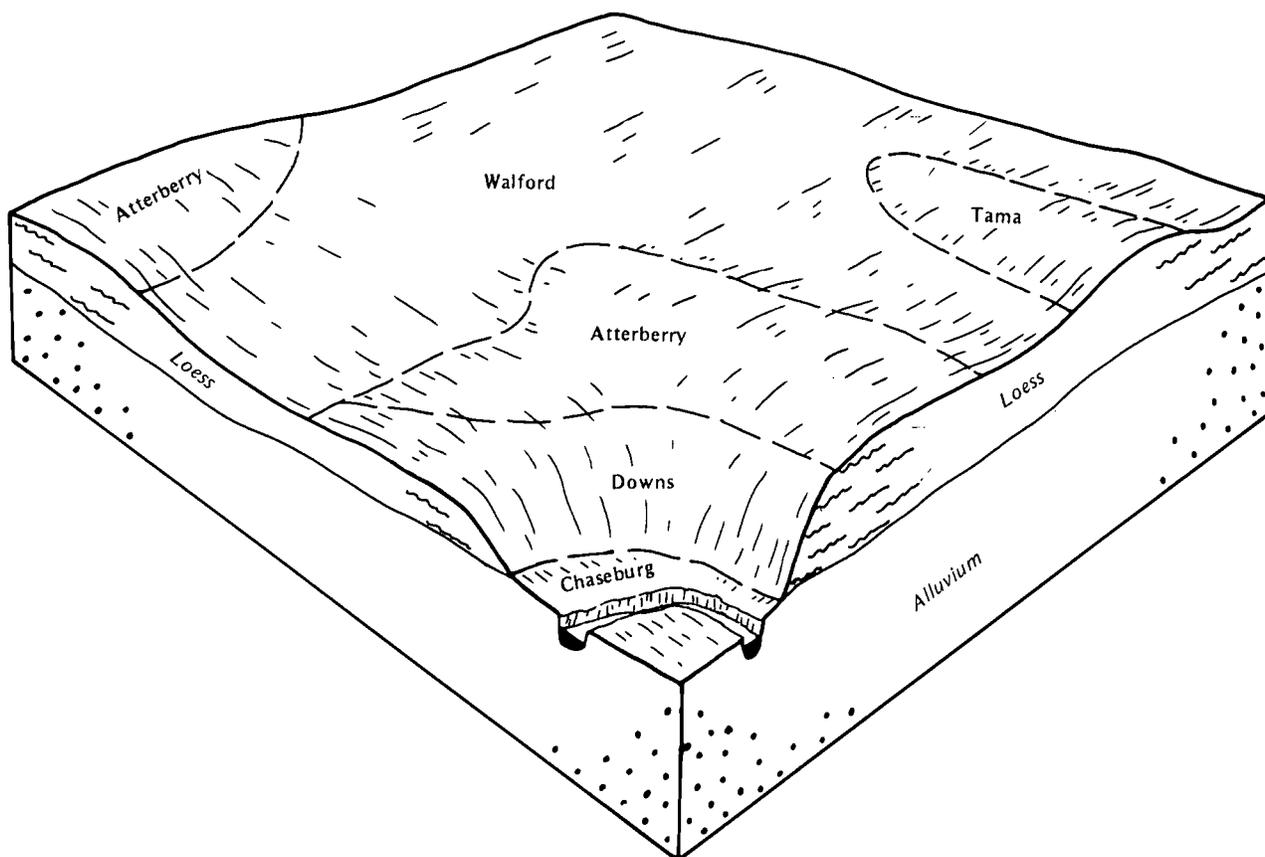


Figure 6.—Typical pattern of soils and parent material in the Walford-Atterberry-Downs association.

Emeline, and Tama soils. Dolbee and Ely soils formed in silty colluvium or alluvium on foot slopes and alluvial fans and in upland drainageways. Dolbee soils are poorly drained, and Ely soils are somewhat poorly drained. Emeline soils formed in 4 to 12 inches of loamy material over limestone bedrock. They are on ridges and side slopes. Tama soils formed in more than 5 feet of loess on ridges and side slopes.

Most areas in this association are used for crop production. Some are used for hay and pasture. The gently sloping soils are well suited to corn, soybeans, small grain, and hay, and the moderately sloping soils are moderately well suited. The main management needs are measures that control water erosion and maintain fertility and tilth. Droughtiness may be a problem in the Pillot and Rockton soils in years of below normal rainfall. A system of conservation tillage that leaves most of the crop residue on the surface helps to conserve soil moisture and prevent excessive soil loss. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to control erosion. Leaving crop residue on the surface or

regularly adding livestock waste improves tilth and fertility.

### 8. Walford-Atterberry-Downs Association

*Nearly level to gently sloping, well drained to poorly drained soils formed in loess; on high stream benches*

This association consists of soils on broad stream benches. The landscape is nearly level to undulating. Slopes range from 0 to 4 percent.

This association makes up about 1 percent of the county. It is about 50 percent Walford soils, 25 percent Atterberry soils, 15 percent Downs soils, and 10 percent minor soils (fig. 6).

Walford soils are poorly drained and are in broad, nearly level areas. Atterberry soils are somewhat poorly drained and are on nearly level, slight rises. Downs soils are well drained and are on gently sloping rises and side slopes.

Typically, the surface layer of the Walford soils is very dark gray silt loam about 9 inches thick. The subsurface layer is gray silt loam about 6 inches thick.

The subsoil is friable silty clay loam about 45 inches thick. It has strong brown mottles. The upper part is grayish brown, and the lower part is light olive gray and light gray.

Typically, the surface layer of the Atterberry soils is black silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 43 inches thick. It is friable. The upper part is brown silty clay loam mottled with strong brown and light brownish gray, the next part is light brownish gray silty clay loam mottled with strong brown, and the lower part is light brownish gray silt loam mottled with strong brown.

Typically, the surface layer of the Downs soils is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of more than 60 inches. It is friable. The upper part is brown silty loam, the next part is dark yellowish brown and yellowish brown silty clay loam, and the lower part is yellowish brown silty clay loam and silt loam mottled with strong brown and light brownish gray.

Minor in this association are the Chaseburg, Muscatine, and Tama soils. Chaseburg soils are well drained and formed in stratified, silty alluvium on bottom land. Muscatine and Tama soils are in positions on the

landscape similar to those of the Atterberry and Downs soils. They have a thick, dark surface soil. Muscatine soils are somewhat poorly drained, and Tama soils are well drained.

Most of this association is used for corn or soybeans. A few areas are used for hay and pasture. The areas on bottom land are used mainly for crop production.

This association is well suited to row crops and small grain. The well drained soils are well suited to grasses and legumes for hay and pasture. If drained, the somewhat poorly drained and poorly drained soils also are well suited.

The main management needs are measures that reduce wetness in the nearly level soils and control water erosion and wind erosion and maintain fertility and tilth in areas of the gently sloping soils. A drainage system, possibly including surface inlets, reduces wetness and allows timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to conserve moisture and prevent excessive soil loss. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to control erosion. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility.



## Detailed Soil Map Units

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The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Fayette silt loam, 9 to 14 percent slopes, moderately eroded, is a phase of the Fayette series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Dorerton-Lacrescent complex, 18 to 60 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named.

Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

### Soil Descriptions

#### 11B—Colo-Ely complex, 0 to 5 percent slopes.

These gently sloping soils are in upland drainageways and on foot slopes. The poorly drained Colo soil is in drainageways and is subject to flooding. The somewhat poorly drained Ely soil is on foot slopes below the more sloping upland soils. Commonly, areas range from 5 to 75 acres in size and are elongated or irregularly shaped. They are about 65 percent Colo soil and 35 percent Ely soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Colo soil has a surface layer of black silt about 6 inches thick. The subsurface layer is black and very dark gray silty clay loam about 31 inches thick. The subsoil is about 18 inches thick. It is firm. The upper part is dark gray silty clay loam, and the lower part is dark gray and light brownish gray silt loam. The substratum to a depth of about 60 inches is light brownish gray silt loam. In places the thickness of the surface layer combined with that of the subsurface layer is less than 36 inches.

Typically, the Ely soil has a surface layer of very dark brown silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 14 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of about 60 inches is friable silty clay loam that has strong brown mottles. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is light brownish gray.

Permeability is moderate in both soils. Runoff is slow on the Colo soil and medium on the Ely soil. Available water capacity is very high in the Ely soil and high in the Colo soil. Both soils have a seasonal high water table. The content of organic matter is about 5 to 7 percent in the surface layer of the Colo soil and 4 to 6 percent in the surface layer of the Ely soil. The subsoil of the Colo soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Ely soil generally has a low supply of available phosphorus and potassium. Tilth is fair in the Colo soil and good in the Ely soil.

Most areas are used for crop production. If drained and protected from flooding, these soils are well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Floodwater and the deposition of sediments on the Colo soil may damage crops in some years. The soils can be protected from excess runoff by terraces or diversions on the adjacent uplands. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to grasses and legumes for hay and pasture. A drainage system and protection from flooding are needed to allow for optimum hay production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is Ilw.

**27B—Terril loam, 2 to 5 percent slopes.** This gently sloping and moderately sloping, moderately well drained soil is on foot slopes, on alluvial fans, and in upland drainageways. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer also is very

dark brown loam. It is about 25 inches thick. The subsoil is about 27 inches thick. The upper part is very dark grayish brown, friable loam; the next part is brown, very friable sandy loam; and the lower part is dark yellowish brown, very friable sandy loam. In places the surface layer and subsurface layer are coarser textured.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to corn, soybeans, and small grain. In places runoff from upslope areas results in the formation of gullies. Measures that control runoff are needed. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is Ilc.

**41B—Sparta loamy sand, 2 to 5 percent slopes.**

This gently sloping, excessively drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is very friable sand about 28 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is pale brown sand.

Permeability is rapid, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is poor.

Most areas are used for crop production. This soil is not suited to corn or soybeans. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are

hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVs.

#### **41C—Sparta loamy sand, 5 to 9 percent slopes.**

This moderately sloping, excessively drained soil is on upland side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is very friable sand about 26 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is pale brown sand.

Permeability is rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. Also, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils unless the surface is protected by a plant cover.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can

tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VI.

#### **41D—Sparta loamy sand, 9 to 14 percent slopes.**

This strongly sloping, excessively drained soil generally is on upland side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 7 inches thick. The subsoil is very friable sand about 24 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is pale brown sand.

Permeability is rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is poor.

Most areas are used for crop production or pasture. This soil is very poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. Also, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils unless the surface is protected by a plant cover.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the

soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VI<sub>s</sub>.

**63B—Chelsea loamy sand, 2 to 5 percent slopes.**

This gently sloping, excessively drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 25 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown loamy fine sand that has bands of brown sandy loam 0.25 inch to 2 inches thick. In cultivated areas the surface layer is dark grayish brown or brown loamy sand about 8 inches thick.

Included with this soil in mapping are areas in small, closed depressions. These areas may terminate a surface water drainageway and can be wetter than the surrounding Chelsea soil. They make up less than 5 percent of the unit.

Permeability is rapid in the Chelsea soil, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is less than 1.5 percent. The subsurface layer generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and cover crops help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned

later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IV<sub>s</sub>.

**63C—Chelsea loamy sand, 5 to 9 percent slopes.**

This moderately sloping, excessively drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 3 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 24 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick. In cultivated areas the surface layer is dark grayish brown or brown loamy fine sand about 8 inches thick.

Included with this soil in mapping are areas in small, closed depressions. These areas may terminate a surface water drainageway and can be wetter than the surrounding Chelsea soil. They make up less than 5 percent of the unit.

Permeability is rapid in the Chelsea soil, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is less than 1.5 percent. The subsurface layer generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and cover crops help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted

at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVs.

**63D—Chelsea loamy sand, 9 to 14 percent slopes.**

This strongly sloping, excessively drained soil is on upland side slopes, high stream benches, and stream terraces. Commonly, areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy fine sand about 6 inches thick. The subsurface layer is loamy sand about 23 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Permeability is rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is less than 1.5 percent. The subsurface layer generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production or for pasture. A few small areas are used for woodland. This soil is very poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. Also, water erosion and wind erosion are serious hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils unless the surface is protected by a plant cover.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIs.

**63F—Chelsea loamy sand, 14 to 30 percent**

**slopes.** This moderately steep to very steep, excessively drained soil is on upland side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 22 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Permeability and runoff are rapid. Available water capacity is low. The content of organic matter in the surface layer is less than 1.5 percent. The subsurface layer generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for woodland. A few are used for pasture. This soil is not suited to row crops and is poorly suited to hay. It is better suited to woodland and to grasses and deep-rooted legumes for pasture. If this droughty soil is used for pasture, yields are low unless rainfall is abundant and timely. If the surface is not protected by vegetation, the soil is subject to water erosion and wind erosion. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Natural and planted seedlings, however, do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the soil is droughty. Measures that control erosion are needed until the trees are large enough to provide a protective cover. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is VIIs.

**65E2—Lindley silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, moderately well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt

loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown clay loam from the subsoil into the surface layer. The subsoil is about 38 inches thick. It is yellowish brown. The upper part is friable clay loam, the next part is firm clay loam, and the lower part is firm clay loam and loam mottled with strong brown and grayish brown. The substratum to a depth of about 60 inches is yellowish brown, mottled loam.

Included with this soil in mapping are small areas of severely eroded soils. These soils are in positions on the landscape similar to those of this Lindley soil. They have a lower content of organic matter and a lower fertility level than this Lindley soil. Also, tilth is poorer. Also included, on the lower parts of side slopes, are some small areas where limestone bedrock crops out or is within a depth of 40 inches. Included areas make up less than 10 percent of the unit.

Permeability is moderately slow in the Lindley soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for hay or pasture. A few are used for row crops. This soil is very poorly suited to row crops because of a serious hazard of further erosion.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

**65F2—Lindley silt loam, 18 to 25 percent slopes, moderately eroded.** This steep, moderately well drained soil is on side slopes in the uplands. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt

loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown clay loam from the subsoil into the surface layer. The subsoil is about 38 inches thick. It is yellowish brown. The upper part is friable clay loam, the next part is firm clay loam, and the lower part is firm clay loam and loam mottled with strong brown, grayish brown, and light grayish brown. The substratum to a depth of about 60 inches is yellowish brown, mottled loam.

Included with this soil in mapping are small areas of severely eroded soils. These soils are in positions on the landscape similar to those of this Lindley soil. They have a lower organic matter content and fertility level than the Lindley soil. Also, tilth is poorer. Also included, on the lower parts of side slopes, are some small areas where limestone bedrock crops out or is within a depth of 40 inches. Included areas make up less than 10 percent of the unit.

Permeability is moderately slow in the Lindley soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for hay and pasture. This soil is not suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIIe.

**110C2—Lamont sandy loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes and on stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown sandy loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand.

Permeability is moderately rapid, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is less than 1 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops. It is better suited to small grain and hay. Drought is a hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Selection of forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Seedlings may require supplemental water in dry years. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

#### **118—Garwin silty clay loam, 0 to 2 percent slopes.**

This nearly level, poorly drained soil is on concave slopes at the head of drainageways and in slight depressions on broad flats in the uplands. Commonly, areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer also is black silty clay loam. It is about 11 inches thick. The subsoil is about 33 inches thick. It is friable and mottled. The upper part is dark gray silty clay loam, the next part is grayish brown silty clay loam, and the lower part is light olive gray silt loam. The substratum to a depth of about 60 inches is light olive gray, mottled silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a

seasonal high water table. The content of organic matter in the surface layer is about 6 to 7 percent. The shrink-swell potential is high. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. If drained, this soil is well suited to corn, soybeans, and small grain. In some areas water ponds for short periods. Crop growth may be impaired by wetness in some years. A drainage system is needed to lower the seasonal high water table. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIw.

**119B—Muscatine silty clay loam, 2 to 5 percent slopes.** This gently sloping, somewhat poorly drained soil is on broad ridges and side slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 30 inches thick. It is friable. The upper part is dark grayish brown silty clay loam, the next part is grayish brown silty clay loam mottled with strong brown, and the lower part is grayish brown silty clay loam mottled with strong brown and yellowish red. The substratum to a depth of about 60 inches has the same color and texture as the lower part of the subsoil. In places the surface layer and subsurface layer are thinner.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 4 to 6 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork often is delayed during wet periods because of the high water table. In most years a drainage system is needed

to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to hay and pasture. A cover of grasses and legumes is very effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**120B—Tama silt loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range from 10 to more than 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 42 inches thick. It is friable. The upper part is dark brown and brown silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of moderately well drained soils. These soils are in positions on the landscape similar to those of the Tama soil. They commonly are wetter than the Tama soil and can be improved by a drainage system. They make up less than 5 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In most areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves

fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**120B2—Tama silt loam, 2 to 5 percent slopes, moderately eroded.** This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range from 5 to more than 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 41 inches thick. It is friable. The upper part is dark brown and brown silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of moderately well drained soils. These soils are in positions on the landscape similar to those of the Tama soil. They commonly are wetter than the Tama soil and can be improved by a drainage system. They make up less than 5 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In most areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and

increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**120C—Tama silt loam, 5 to 9 percent slopes.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 40 inches thick. It is friable. The upper part is dark brown and brown silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of moderately well drained soils. These soils are in positions on the landscape similar to those of the Tama soil. They commonly are wetter than the Tama soil and can be improved by a drainage system. They make up less than 5 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste minimizes surface crusting and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of

grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**120C2—Tama silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark brown and brown silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of moderately well drained soils. These soils are in positions on the landscape similar to those of the Tama soil. They are commonly wetter than the Tama soil and can be improved by a drainage system. They make up less than 5 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste minimizes surface crusting and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion.

Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**120D2—Tama silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, well drained soil is on upland side slopes. Commonly, areas range from 20 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 37 inches thick. It is friable. The upper part is dark brown and brown silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of severely eroded soils. These soils are in positions on the landscape similar to those of the Tama soil. They commonly have a thinner surface layer, a lower content of organic matter, and a lower fertility level than the Tama soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste minimizes surface crusting and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of

grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**128—Chaseburg-Perks complex, 0 to 2 percent slopes.** These nearly level soils are on bottom land. They are subject to flooding. The Chaseburg soil is well drained. The Perks soil is excessively drained and is on slight rises adjacent to streams and on sandbars within stream meanders. Both soils are subject to flooding. Commonly, areas range from 10 to 80 acres in size and are elongated or irregularly shaped. They are about 60 percent Chaseburg soil and 40 percent Perks soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chaseburg soil has a surface layer of very dark grayish brown silt loam about 6 inches thick. The substratum to a depth of about 60 inches is stratified dark grayish brown, very dark grayish brown, and brown silt loam.

Typically, the Perks soil has a surface layer of very dark grayish brown sandy loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark grayish brown overwash material into the surface layer. The substratum to a depth of about 60 inches is stratified very dark grayish brown, dark grayish brown, yellowish brown, brown, and pale brown loamy sand, loamy fine sand, and sand.

Permeability is moderate in the Chaseburg soil and rapid in the Perks soil. Runoff is slow on both soils. Available water capacity is very high in the Chaseburg soil and low in the Perks soil. The content of organic matter is about 1.0 to 3.0 percent in the surface layer of the Chaseburg soil and 0.5 to 1.0 percent in the surface layer of the Perks soil. The Chaseburg soil has a low supply of available phosphorus, and the Perks soil has a very low supply. Both soils have a very low supply of available potassium. Tilth is fair in the Chaseburg soil and poor in the Perks soil.

Most areas are used for crop production. Areas that are inaccessible or are in narrow drainageways generally are used for permanent pasture or woodland. If protected from flooding and siltation, these soils are moderately well suited to row crops and small grain. Drought is a hazard in areas of the Perks soil in most years unless rainfall is abundant and timely. Windblown

sand grains can damage seedlings on this soil and on the adjacent Chaseburg soil. Because the two soils occur as areas so intricately mixed and the areas of the Perks soil are so small, the effective management of crop production is difficult. During periods of heavy rainfall, the soils are subject to flooding. Floodwater and the deposition of sediment can damage crops in some years. The soils can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding, overflow from the more sloping upland soils, and the droughtiness of the Perks soil. Restricted access and streambank erosion are problems in some areas. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. These soils are moderately well suited to trees. In areas of the Perks soil, natural and planted seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Seedlings may require supplemental water because the Perks soil is droughty. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIw.

**129B—Chaseburg-Arenzville silt loams, 2 to 5 percent slopes.** These gently sloping soils are in upland drainageways. They are subject to flooding. The Chaseburg soil is well drained, and the Arenzville soil is moderately well drained. Commonly, areas range from 10 to 60 acres in size and are long and narrow. They are about 50 percent Chaseburg soil and 40 percent Arenzville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chaseburg soil has a surface layer of dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified

dark grayish brown, brown, very dark grayish brown, and pale brown silt loam.

Typically, the Arenzville soil has a surface layer of dark grayish brown and dark brown silt loam about 12 inches thick. The substratum is stratified very dark grayish brown, brown, and grayish brown silt loam about 20 inches thick. It is mottled in the lower part. Below the substratum is an older buried surface layer of black silt loam about 28 inches thick.

Included with these soils in mapping are small areas of Orion soils. These included soils are somewhat poorly drained, have mottles close to the surface, and are in slight depressions. They make up about 10 percent of the unit.

Permeability is moderate in the Chaseburg and Arenzville soils, and runoff is medium. Available water capacity is very high in the Chaseburg soil and high in the Arenzville soil. The Arenzville soil has a seasonal high water table. The organic matter content is about 1.0 to 2.0 percent in the surface layer of the Chaseburg soil and 1.5 to 2.5 percent in the surface layer of the Arenzville soil. Both soils have a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for pasture or crop production along with the surrounding upland soils. Some areas remain wooded. If protected from flooding, gullyng, and siltation, these soils are well suited to row crops and small grain. During periods of heavy rainfall, they are subject to overflow. Floodwater and the deposition of sediment can damage crops. The soils can be protected from excessive overflow by terraces or diversions on the adjacent uplands. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. Restricted access, gullyng, and streambank erosion are problems in some areas. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. These soils are well suited to trees. No major hazards or limitations affect planting or harvesting if suitable

species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**133—Colo silty clay loam, 0 to 2 percent slopes.**

This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 10 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 6 inches thick. The subsurface layer is black and very dark gray silty clay loam about 31 inches thick. The subsoil is about 18 inches thick. It is firm. The upper part is dark gray silty clay loam, and the lower part is dark gray and light brownish gray silt loam. The substratum to a depth of about 60 inches is light brownish gray silt loam. In places the thickness of the surface layer combined with that of the subsurface is less than 36 inches.

Included with this soil in mapping are some areas that have 8 to 14 inches of very dark grayish brown silt loam overwash. These areas are adjacent to the uplands and along stream channels. They make up about 5 percent of the unit.

Permeability is moderate in the Colo soil, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 5 to 7 percent. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. If drained and protected from flooding, this soil is well suited to row crops and small grain. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. A drainage system works well if it is properly installed and if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A drainage system and protection from flooding are needed to allow for optimum hay production. Streambank erosion is a problem in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely

applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIw.

**142—Chaseburg silt loam, 0 to 2 percent slopes.**

This nearly level, well drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 50 to 100 acres in size and are elongated.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified dark grayish brown, brown, very dark grayish brown, and pale brown silt loam. In places a dark buried soil is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Orion soils. These soils are somewhat poorly drained, have mottles close to the surface, and are in somewhat depressional areas. They make up about 5 percent of the unit.

Permeability is moderate in the Chaseburg soil, and runoff is slow. Available water capacity is very high. The content of organic matter in the surface layer is about 1 to 2 percent. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production (fig. 7). Areas that are inaccessible or are in narrow drainageways generally are used for permanent pasture or woodland. If protected from flooding and siltation, this soil is well suited to row crops and small grain. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. Restricted access and streambank erosion are problems in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or



Figure 7.—Soybeans in an area of Chaseburg silt loam, 0 to 2 percent slopes. This soil is well suited to row crops if flooding is controlled.

limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is 1.

**158—Dorchester silt loam, 0 to 2 percent slopes.**

This nearly level, well drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The substratum is stratified dark grayish brown, brown, grayish brown, and very dark grayish brown silt loam about 22 inches thick. Below this is an older buried surface layer of very dark brown and dark brown silt loam about 31 inches thick.

Included with this soil in mapping are small areas of the poorly drained Caneek soils. These soils are in low areas or below seeps or springs near the more sloping uplands. They make up about 5 percent of the unit.

Permeability is moderate in the Dorchester soil, and runoff is slow. Available water capacity is very high. The

content of organic matter in the surface layer is about 0.5 to 1.5 percent. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium. Tillage is fair.

Most areas are used for crop production. Areas that are inaccessible or are in narrow drainageways generally are used for permanent pasture or woodland. If protected from flooding and siltation, this soil is well suited to row crops and small grain. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. Restricted access and streambank erosion are problems in some areas. Overgrazing or

grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

**159B—Finchford loamy sand, 1 to 4 percent slopes.** This gently sloping, excessively drained soil is on stream terraces. Commonly, areas range from 10 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is black loamy sand about 8 inches thick. The subsurface layer is about 21 inches of black and very dark brown loamy sand and sand. The subsoil is loose gravelly sand about 19 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In places, the sand is finer and the content of gravel is lower.

Permeability is very rapid, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. The subsoil has a low supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for hay and pasture. A few small areas are used for row crops. This soil is poorly suited to row crops. It is better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a severe hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, wind erosion is a hazard. Windblown sand grains can damage newly seeded crops on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment

of grazing during dry periods help to keep the pasture in good condition.

The land capability classification is IVs.

**162B—Downs silt loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for strip cropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**162B2—Downs silt loam, 2 to 5 percent slopes, moderately eroded.** This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range

from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsurface material into the surface layer. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**162C—Downs silt loam, 5 to 9 percent slopes.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is brown silt loam; the next part

is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to more than 200 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsurface material into the surface layer. The subsoil is about 53 inches thick. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic

matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff (fig. 8). Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**162D—Downs silt loam, 9 to 14 percent slopes.**

This strongly sloping, well drained soil is on upland side slopes. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. A few are used for pasture. This soil is moderately well suited to

corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, well drained soil is on upland side slopes. Commonly, areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsurface material into the surface layer. The subsoil is about 51 inches thick. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Newvienna soils and the severely eroded Downs soils. These soils are in positions on the landscape similar to those of this Downs soil. Newvienna soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Downs soils have a lower organic matter content and fertility level than this Downs soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.



Figure 8.—A contour terrace system and no-till corn in an area of Downs silt loam, 5 to 9 percent slopes, moderately eroded.

Permeability is moderate in the Downs soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tillth is fair.

Most areas are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet,

however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**162D3—Downs silty clay loam, 9 to 14 percent slopes, severely eroded.** This strongly sloping, well drained soil is on upland side slopes. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of very dark grayish brown silt loam into the surface layer. The subsoil is about 50 inches thick. It is friable. The upper part is dark

yellowish brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Newvienna soils. These soils are moderately well drained and commonly are seepy during wet periods. They are in positions on the landscape similar to those of the Downs soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Downs soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is moderately well suited to corn occasionally grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Downs soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, fertility improvement, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is IVe.

**162E2—Downs silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 49 inches thick. It is friable. The upper part is brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Newvienna soils and the severely eroded Downs soils. These soils are in positions on the landscape similar to those of this Downs soil. Newvienna soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Downs soils have a lower content of organic matter and a lower fertility level than this Downs soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Downs soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable

forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**162E3—Downs silty clay loam, 14 to 18 percent slopes, severely eroded.** This moderately steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of very dark grayish brown silt loam into the surface layer. The subsoil is about 48 inches thick. It is friable. The upper part is dark yellowish brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are some small areas of Newvienna soils. These soils are moderately well drained and commonly are seepy during wet periods. They are in positions on the landscape similar to those of the Downs soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Downs soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of a serious hazard of further erosion. Cultivated crops should be grown in rotation with small grain and hay. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the

rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Downs soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**162F2—Downs silt loam, 18 to 25 percent slopes, moderately eroded.** This steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 47 inches thick. It is friable. The upper part is brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Newvienna soils and the severely eroded Downs soils. These soils are in positions on the landscape similar to those of this Downs soil. Newvienna soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Downs soils have a lower content of organic matter and a lower fertility level than this Downs soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Downs soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is

very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

**163B—Fayette silt loam, 2 to 5 percent slopes.**

This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 9 inches thick. The subsoil is about 44 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam. In cultivated areas the surface layer is dark grayish brown or brown silt loam about 8 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for permanent pasture or crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving

crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**163C—Fayette silt loam, 5 to 9 percent slopes.**

This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 9 inches thick. The subsoil is about 42 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of the organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for permanent pasture. A few are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to 150 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 41 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour stripcropping help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion.

Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**163D—Fayette silt loam, 9 to 14 percent slopes.**

This strongly sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil is about 40 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland or permanent pasture. A few have been cleared of trees and are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves

fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**163D2—Fayette silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 10 to 200 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Rozetta soils and the severely eroded Fayette soils. Also included are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Fayette soils have a lower content of organic matter and a lower fertility level than this Fayette soil. Also, tilth is poorer. Included areas make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. This soil is moderately well suited to

corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss (fig. 9). In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**163D3—Fayette silty clay loam, 9 to 14 percent slopes, severely eroded.** This strongly sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of brown and dark yellowish brown silt loam into the surface layer. The subsoil is about 38 inches thick. It is friable. The upper part is yellowish brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Rozetta soils. Also included are areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. Included areas make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil, and



**Figure 9.—Contour stripcropping in an area of Fayette silt loam, 9 to 14 percent slopes, moderately eroded, where corn is grown in rotation with small grain and hay.**

runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.4 to 2.0 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is moderately well suited to corn occasionally grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding

livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Fayette soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is suited well to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or

limitations affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is IVe.

**163E—Fayette silt loam, 14 to 18 percent slopes.**

This moderately steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil is about 38 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas where limestone bedrock crops out or is in within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland. Some are used for permanent pasture.

This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely

applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**163E2—Fayette silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 37 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are some small areas of Rozetta soils and the severely eroded Fayette soils. Also included are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Fayette soils have a lower content of organic matter and a lower fertility level than this Fayette soil. Also, tilth is poorer. Included areas make up 5 to 15 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and

thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**163E3—Fayette silty clay loam, 14 to 18 percent slopes, severely eroded.** This moderately steep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are elongated.

Typically, the surface layer is yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of brown and dark yellowish brown silt loam into the surface layer. The subsoil is about 36 inches thick. It is friable. The upper part is yellowish brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Rozetta soils. Also included are areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. Included areas make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.4 to 2.0 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of a serious hazard of further erosion. Cultivated crops should be grown in rotation with small grain and hay. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Fayette soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**163F—Fayette silt loam, 18 to 25 percent slopes.** This steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 7 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas

where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland. Some are used for permanent pasture. This soil is very poorly suited to cultivated crops because of the slope and a severe hazard of erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is Vle.

**163F2—Fayette silt loam, 18 to 25 percent slopes, moderately eroded.** This steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 35 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Rozetta soils and the severely eroded Fayette soils. Also included are small areas where limestone bedrock

crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. The severely eroded Fayette soils have a lower content of organic matter and a lower fertility level than this Fayette soil. Also, tilth is poorer. Included areas make up 5 to 10 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is Vle.

**163F3—Fayette silty clay loam, 18 to 25 percent slopes, severely eroded.** This steep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of brown and dark yellowish brown silt loam into the surface layer. The subsoil is about 34 inches thick. It is friable. The upper part is yellowish brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of

Rozetta soils. Also included are areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. Rozetta soils are moderately well drained and commonly are seepy during wet periods. Included areas make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.4 to 2.0 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**163G—Fayette silt loam, 25 to 40 percent slopes.**

This very steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is brown silt loam about 7 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas where limestone bedrock crops out or is within a depth

of 40 inches. These areas are in positions on the landscape similar to those of the Fayette soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Fayette soil, and runoff is very rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland. Some are used for permanent pasture. This soil is not suited to cultivated crops and is poorly suited to hay and pasture because of the slope and a severe hazard of erosion.

The older stands of trees remain in some areas. This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIIe.

**175B—Dickinson fine sandy loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsurface layer is dark brown fine sandy loam about 14 inches thick. The subsoil is about 16 inches thick. It is very friable. The upper part is brown fine sandy loam, and the lower part is dark yellowish brown and yellowish brown loamy fine sand. The substratum to a depth of about 60 inches is dark yellowish brown and brown loamy fine sand that has thin bands of yellowish brown sand.

Permeability is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops. It is better suited to small grain and hay. Drought is a hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock

waste improves fertility and tilth.

This soil is moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

**175C2—Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 16 inches thick. It is very friable. The upper part is brown fine sandy loam, and the lower part is dark yellowish brown and yellowish brown loamy fine sand. The substratum to a depth of about 60 inches is dark yellowish brown and brown loamy fine sand that has thin bands of yellowish brown sand.

Permeability is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops. It is better suited to small grain and hay. Drought is a hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

**198B—Floyd loam, 1 to 4 percent slopes.** This gently sloping, somewhat poorly drained soil is on foot

slopes and in upland drainageways. Commonly, areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer also is very dark brown loam. It is about 13 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, friable loam; the next part is olive brown, friable, mottled loam and sandy clay loam; and the lower part is mottled grayish brown, light olive brown, and yellowish brown, firm loam.

Included with this soil in mapping are areas where the surface layer, the subsurface layer, and the upper part of the subsoil are silty clay loam. These areas are in positions on the landscape similar to those of the Floyd soil or are on the lower part of the foot slopes or drainageways. They make up less than 15 percent of the unit.

Permeability is moderate in the Floyd soil, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 5 to 6 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to corn, soybeans, and small grain. Fieldwork can be delayed during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Measures that help to control runoff from the higher elevations are needed. A system of conservation tillage that leaves most of the crop residue on the surface and contour stripcropping help to prevent excessive soil loss. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIw.

**249—Zwingle silt loam, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on stream terraces along tributaries of the Mississippi River. Commonly,

areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is yellowish brown, friable silty clay loam; the next part is brown and yellowish brown, mottled, very firm clay; and the lower part is brown, mottled, very firm silty clay.

Included with this soil in mapping are small areas where the surface layer consists of stratified, silty sediment. These areas are adjacent to the uplands. They make up less than 5 percent of the unit.

Permeability is very slow in the Zwingle soil, and runoff is slow. Available water capacity is moderate. The soil has a seasonal high water table. The shrink-well potential is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for permanent pasture. Some are used for crop production. This soil is poorly suited to row crops and small grain. It is sticky when wet because of the very high content of clay. Also, fertility is low. Tile cannot drain the soil satisfactorily. A surface drainage system works best. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and minimizes surface crusting.

If drained, this soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is moderately well suited to trees. The use of equipment should be restricted to the drier periods or to winter months when the ground is frozen. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees increases the hazard of windthrow.

The land capability classification is IIIw.

**291B—Atterberry silt loam, 2 to 5 percent slopes.**

This gently sloping, somewhat poorly drained soil is on

broad ridges and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 41 inches thick. It is friable. The upper part is brown, mottled silty clay loam; the next part is light brownish gray, mottled silty clay loam; and the lower part is light brownish gray silt loam mottled with strong brown and dark reddish brown. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam.

Included with this soil in mapping are a few small areas of poorly drained soils on the lower parts of ridgetops. These soils commonly are wetter for longer periods than the Atterberry soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Atterberry soil, and runoff is medium. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**293C2—Fayette-Lamont-Chelsea complex, 5 to 9 percent slopes, moderately eroded.** These moderately sloping soils are on upland ridges and side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 15 acres in size and are irregularly shaped. They are about 50 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 41 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of dark grayish brown sandy loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand.

Typically, the Chelsea soil has a surface layer of dark grayish brown loamy sand about 8 inches thick. The subsurface layer is loamy sand about 20 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is medium on all three soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 0.5 to 2.5 percent in the surface layer of the Fayette soil and is less than 0.5 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for crop production. These soils are moderately well suited to row crops. They are better

sued to small grain and to grasses and deep-rooted legumes for hay and pasture. Drought is a hazard in the Lamont and Chelsea soils in most years unless rainfall is abundant and timely. If cultivated crops are grown, further water erosion and wind erosion are hazards. Windblown sand grains from the Lamont and Chelsea soils can damage seedlings on these soils and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**293D—Fayette-Lamont-Chelsea complex, 9 to 14 percent slopes.** These strongly sloping soils are on upland ridges and side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil is about 40 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a

depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 50 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 23 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on the Fayette soil and medium on the Lamont and Chelsea soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 2 to 3 percent in the surface layer of the Fayette soil and is less than 0.5 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for woodland or permanent pasture. These soils are poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soils are better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a hazard in the Lamont and Chelsea soils in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains from the Lamont and Chelsea soils can damage seedlings on these soils and on the adjacent soils. A

system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. This soil is moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**293D2—Fayette-Lamont-Chelsea complex, 9 to 14 percent slopes, moderately eroded.** These strongly sloping soils are on upland ridges and side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 30 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of dark grayish brown sandy loam about 7 inches thick. The subsoil is about 51 inches thick. The upper part is dark

yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of dark grayish brown loamy sand about 8 inches thick. The subsurface layer is loamy sand about 19 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on the Fayette soil and medium on the Lamont and Chelsea soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 1.5 to 2.5 percent in the surface layer of the Fayette soil and is less than 1 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tillage is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for crop production. A few are used for pasture. These soils are poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soils are better suited to small grain and to grasses and deep-rooted legumes for hay or pasture. Drought is a hazard in the Lamont and Chelsea soils in most years unless rainfall is abundant and timely. If cultivated crops are grown, further water erosion and wind erosion are hazards. Windblown sand grains from the Lamont and Chelsea soils can damage seedlings on these soils and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop

residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**293E2—Fayette-Lamont-Chelsea complex, 14 to 18 percent slopes, moderately eroded.** These moderately steep soils are on upland side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 15 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 37 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of dark grayish brown sandy loam about 7 inches thick. The subsoil is about 49 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of dark grayish brown loamy sand about 8 inches thick.

The subsurface layer is loamy sand about 18 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on all three soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 1.5 to 2.5 percent in the surface layer of the Fayette soil and is less than 1 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for crop production. A few are used for pasture. These soils are very poorly suited to row crops because of the slope, the hazards of further water erosion and wind erosion, and droughtiness.

These soils are moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of

erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is VIe.

**293F—Fayette-Lamont-Chelsea complex, 18 to 25 percent slopes.** These steep soils are on upland side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 7 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 46 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 22 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on all three soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 2 to 3 percent in the surface layer of the Fayette soil and is less than 1 percent in the surface layer of the Lamont and Chelsea

soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for woodland or permanent pasture. These soils are not suited to row crops because of the slope, the hazards of wind erosion and water erosion, and droughtiness.

These soils are moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is VIIe.

**293F2—Fayette-Lamont-Chelsea complex, 18 to 25 percent slopes, moderately eroded.** These steep soils are on upland side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 35 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next

part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of dark grayish brown sandy loam about 7 inches thick. The subsoil is about 47 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, very friable sandy loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of dark grayish brown loamy sand about 8 inches thick. The subsurface layer is loamy sand about 17 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on all three soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 1.5 to 2.5 percent in the surface layer of the Fayette soil and is less than 1 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for crop production or permanent pasture. These soils are not suited to row crops because of the slope, the hazards of further wind erosion and water erosion, and droughtiness.

These soils are moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and

increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in many areas. These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is Vllc.

**293G—Fayette-Lamont-Chelsea complex, 25 to 40 percent slopes.** These very steep soils are on upland side slopes. The Fayette and Lamont soils are well drained, and the Chelsea soil is excessively drained. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 45 percent Fayette soil, 30 percent Lamont soil, and 20 percent Chelsea soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Fayette soil has a surface layer of very dark gray silt loam about 2 inches thick. The subsurface layer is brown silt loam about 7 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Typically, the Lamont soil has a surface layer of very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, very friable loam and loamy sand; and the lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is brownish yellow sand.

Typically, the Chelsea soil has a surface layer of very dark gray loamy sand about 6 inches thick. The subsurface layer is loamy sand about 21 inches thick. The upper part is brown, and the lower part is brown and yellowish brown. The subsoil to a depth of about 60 inches is brown and light yellowish brown, loose sand that has bands of brown sandy loam 0.25 inch to 2 inches thick.

Included with these soils in mapping are small areas where limestone bedrock crops out or is within a depth of 40 inches. These areas are in positions on the landscape similar to those of the Fayette, Lamont, and Chelsea soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Fayette soil, moderately rapid in the Lamont soil, and rapid in the Chelsea soil. Runoff is rapid on all three soils. Available water capacity is high in the Fayette soil, moderate in the Lamont soil, and low in the Chelsea soil. The content of organic matter is about 2 to 3 percent in the surface layer of the Fayette soil and is less than 0.5 percent in the surface layer of the Lamont and Chelsea soils. The subsoil of the Fayette soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Lamont soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Chelsea soil generally has a very low supply of available phosphorus and a low supply of available potassium. Tillage is fair in the Fayette and Lamont soils and poor in the Chelsea soil.

Most areas are used for woodland or permanent pasture. These soils are not suited to row crops and are poorly suited to hay and pasture because of the slope, the hazards of wind erosion and water erosion, and droughtiness.

The older stands of trees remain in a few areas. These soils are moderately well suited to trees. Seedlings may require supplemental water in dry years. Seedling mortality is moderate on the Chelsea soil. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is Vllc.

**320—Arenzville silt loam, 0 to 2 percent slopes.** This nearly level, moderately well drained soil is on bottom land. It is subject to flooding. Areas range from 10 to 50 acres in size and are elongated.

Typically, the surface layer is dark grayish brown and dark brown silt loam about 12 inches thick. The substratum is stratified very dark grayish brown, brown, and grayish brown silt loam about 20 inches thick. It is mottled in the lower part. Below the substratum is an older buried surface layer of black silt loam about 28 inches thick. In places depth to the buried soil is more than 40 inches.

Included with this soil in mapping are small areas of Orion soils. These soils are somewhat poorly drained, have mottles closer to the surface than those in the Arenzville soil, and are in somewhat depressional areas

on the bottom land. They make up less than 5 percent of the unit.

Permeability is moderate in the Arenzville soil, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The supply of available phosphorus generally is low, and the supply of available potassium is very low. Tilth is fair.

Most areas are used for crop production. Areas that are inaccessible or are in narrow drainageways generally are used for permanent pasture or woodland. If protected from flooding and siltation, this soil is well suited to row crops and small grain. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. Restricted access and streambank erosion are problems in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

### **352B—Whittier silt loam, 2 to 5 percent slopes.**

This gently sloping, well drained soil is on upland ridges and high stream benches. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown, friable silt loam and silty clay loam; the next part is yellowish brown, friable loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish

brown and dark yellowish brown loamy sand.

Permeability is moderate in the upper part the Whittier soil and rapid in the lower part. Runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain, but it is somewhat droughty in years of below normal rainfall. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes generally are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Terrace cuts should be held to a minimum so that the coarse textured underlying material is not exposed. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate droughtiness and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

### **354—Aquolls, ponded, 0 to 2 percent slopes.**

These nearly level, very poorly drained soils are in depressional areas on bottom land. They are frequently flooded or ponded for long periods. Commonly, areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam or silty clay loam about 10 inches thick. The subsurface layer is black or very dark gray silt loam or silty clay loam about 25 inches thick. The substratum to a depth of about 60

inches is dark gray or gray, friable silt loam or silty clay loam. In some places the soils have strata of material that is redder and has a higher content of clay. In other places they consist of stratified, silty sediment of various colors.

Permeability is moderate, and runoff is ponded. The seasonal high water table is near or above the surface. Available water capacity is very high. The content of organic matter in the surface layer is more than 1.5 percent. The supply of available phosphorus and potassium varies in the substratum.

Most of the acreage is idle land or is used as wildlife habitat. These soils generally support a cover of water-tolerant marsh plants. They are not suited to cultivated crops and are poorly suited to hay and pasture because most areas are covered with water much of the year. Installing an adequate drainage system is very difficult because suitable outlets are not available.

The land capacity classification is VIIw.

### **377B—Dinsdale silt loam, 2 to 5 percent slopes.**

This gently sloping, moderately well drained soil is on ridges in the uplands. Commonly, areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, friable silt loam; the next part is brown, friable silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In places it is sandy loam or loamy sand.

Permeability is moderate, and runoff is medium. Available water capacity is high. The organic matter content in the surface layer is about 3 to 4 percent. The supply of available phosphorus and potassium generally is very low. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion.

Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capacity classification is IIe.

**377B2—Dinsdale silt loam, 2 to 5 percent slopes, moderately eroded.** This gently sloping, moderately well drained soil is on ridges in the uplands. Commonly, areas range from 2 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown, friable silt loam; the next part is brown, friable silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In places it is sandy loam or loamy sand.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The supply of available phosphorus and potassium generally is very low. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capacity classification is IIe.

**412C—Emeline loam, 2 to 9 percent slopes.** This gently sloping and moderately sloping, very shallow, somewhat excessively drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black loam about 10 inches thick. Limestone bedrock is at a depth of about 10 inches.

Included with this soil in mapping are scattered areas where limestone bedrock crops out or is within a depth of 4 inches. Also included are small areas of Rockton soils. These soils are underlain by limestone bedrock at a depth of 20 to 40 inches. All of the included areas are in positions on the landscape similar to those of the Emeline soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Emeline soil, and runoff is medium. Available water capacity is very low. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. Tilth is good.

Most areas are used for hay or pasture. This soil is very poorly suited to row crops because it has a very limited root zone and is droughty. Erosion is a serious hazard if the soil is cultivated. Tillage is very difficult because of the shallowness to limestone bedrock and the rock outcrops.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. The use of equipment may be restricted because of the outcrops of limestone bedrock. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level can help to ensure productivity during these periods.

A few areas support hardwoods. This soil is poorly suited to trees because of the very limited root zone and the droughtiness. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is IVs.

**412D—Emeline loam, 9 to 14 percent slopes.** This strongly sloping, very shallow, somewhat excessively

drained soil is on upland side slopes. Commonly, areas range from 2 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is black loam about 9 inches thick. Limestone bedrock is at a depth of about 9 inches.

Included with this soil in mapping are scattered areas where limestone bedrock crops out or is within a depth of 4 inches. These areas are in positions on the landscape similar to those of the Emeline soil. They make up about 5 percent of the unit.

Permeability is moderate in the Emeline soil, and runoff is medium. Available water capacity is very low. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. Tilth is good.

Most areas are used for hay or pasture. This soil is very poorly suited to row crops because it has a very limited root zone and is droughty. Erosion is a serious hazard if the soil is cultivated. Tillage is very difficult because of the shallowness to limestone bedrock and the rock outcrops.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. The use of equipment may be restricted because of the outcrops of limestone bedrock. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level can help to ensure productivity during these periods.

A few areas support hardwoods. This soil is poorly suited to trees because of the very limited root zone and the droughtiness. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is VI<sub>s</sub>.

**412F—Emeline loam, 14 to 25 percent slopes.** This moderately steep to steep, very shallow, somewhat excessively drained soil is on convex side slopes in the uplands. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is black loam about 7

inches thick. Limestone bedrock is at a depth of about 7 inches.

Included with this soil in mapping are scattered areas where limestone bedrock crops out or is within a depth of 4 inches. These areas are in positions on the landscape similar to those of the Emeline soil. Included areas make up about 5 percent of the unit.

Permeability is moderate in the Emeline soil, and runoff is rapid. Available water capacity is very low. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. Tilth is fair.

Most areas are used for hay or pasture. This soil is not suited to row crops because it has a very limited root zone and is droughty. Erosion is a serious hazard if the soil is cultivated. Tillage is very difficult because of the slope, the shallowness to limestone bedrock, and the rock outcrops.

This soil is very poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Some areas are inaccessible, and the use of equipment may be restricted because of the slope and the limestone outcrops. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level can help to ensure productivity during these periods.

A few areas support hardwoods. This soil is poorly suited to trees because of the very limited root zone and the droughtiness. Also, the slope can inhibit woodland management. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is VII<sub>s</sub>.

**420B—Tama silt loam, benches, 1 to 4 percent slopes.** This gently sloping, well drained soil is on high stream benches. Commonly, areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface

layer is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 42 inches thick. It is friable. The upper part is dark brown and brown silty clay loam, the next part is dark yellowish brown and yellowish brown silty clay loam mottled with grayish brown and yellowish brown, and the lower part is yellowish brown silt loam mottled with light brownish gray and strong brown.

Included with this soil in mapping are small areas of Muscatine soils. These soils are somewhat poorly drained and are in slight depressions. They may remain wetter for longer periods than the Tama soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Tama soil, and runoff is medium. Available water capacity is very high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste minimizes surface crusting and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is II<sub>e</sub>.

**428B—Ely silty clay loam, 2 to 5 percent slopes.**

This gently sloping, somewhat poorly drained soil is on foot slopes and alluvial fans. Commonly, areas range from 2 to 15 acres in size and are elongated.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 14 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of about 60 inches is friable, mottled silty clay loam. The upper part is very dark grayish brown, the next part is dark grayish brown and grayish brown, and the lower part is light brownish gray. In places the surface layer and subsurface layer are thinner.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 5 to 6 percent. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. A drainage system may be needed to reduce the wetness and provide good aeration and a deep root zone for plants. The soil can be protected from excess runoff by terraces or diversions on the adjacent uplands. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**450B—Pilot silt loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on upland ridges and high stream benches. Commonly, areas range from 5 to 120 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown silt loam. It is about 14 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown and yellowish brown, friable silty clay loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown loamy sand. In places glacial till is at a depth of more than 40 inches.

Permeability is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is

well suited to row crops and small grain, but it is somewhat droughty in years of below normal rainfall. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In most areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Terrace cuts should be held to a minimum so that the coarse textured underlying material is not exposed. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate droughtiness and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**450C2—Pilot silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland side slopes and high stream benches. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 26 inches thick. The upper part is dark brown, friable silt loam; the next part is dark yellowish brown and yellowish brown, friable silty clay loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown loamy sand. In places glacial till is at a depth of more than 40 inches.

Permeability is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain, but it is somewhat droughty in years of below normal rainfall. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In most areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Terrace cuts should be held to a minimum so that the coarse textured underlying material is not exposed. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate droughtiness and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**462B—Downs silt loam, benches, 1 to 4 percent slopes.** This gently sloping, well drained soil is on high stream benches. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is brown silt loam; the next part is dark yellowish brown and yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silty clay loam and silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tillage is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue

on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**463B—Fayette silt loam, benches, 1 to 4 percent slopes.** This gently sloping, well drained soil is on high stream benches. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 9 inches thick. The subsoil is about 44 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam mottled with strong brown. In cultivated areas the surface layer is dark grayish brown or brown silt loam about 8 inches thick.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tillage is fair.

Most areas are used for permanent pasture or crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion.

Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**463C—Fayette silt loam, benches, 5 to 9 percent slopes.** This moderately sloping, well drained soil is on high stream benches. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 9 inches thick. The subsoil is about 42 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for permanent pasture. A few are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper

stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**463C2—Fayette silt loam, benches, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on high stream benches. Commonly, areas range from 2 to 5 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material and brown subsurface material into the surface layer. The subsoil is about 41 inches thick. It is friable. The upper part is dark yellowish brown silt loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches also is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour stripcropping help to prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for terracing and stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to

keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**478G—Nordness-Rock outcrop complex, 18 to 60 percent slopes.** This steep and very steep map unit occurs as areas of a well drained Nordness soil intermingled with areas of Rock outcrop. The unit is on upland side slopes and escarpments. The Nordness soil is above and between areas of limestone outcrops. Commonly, areas range from 5 to more than 200 acres in size. They are about 50 percent Nordness soil and 45 percent Rock outcrop. The Nordness soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Nordness soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is silty clay loam about 9 inches thick. The upper part is yellowish brown and friable, and the lower part is brown and firm. Limestone bedrock is at a depth of about 17 inches.

Typically, the Rock outcrop consists of bedded limestone bedrock. In places large blocks of limestone bedrock and limestone fragments cover much of the surface.

Included in mapping are a few scattered areas of Dubuque, Dorerton, and Lacrescent soils. Dubuque soils are underlain by limestone bedrock at a depth of 20 to 40 inches. They are in positions on the landscape similar to those of the Nordness soil. Dorerton and Lacrescent soils are on side slopes and nose slopes below the Rock outcrop. Also included are a few small areas of Fayette soils. These soils formed in more than 60 inches of silty material. They are between or downslope from the areas of Rock outcrop. Included soils make up about 5 percent of the unit.

Permeability is moderate in the Nordness soil, and runoff is very rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland. Many areas are fenced and are used for pasture along with the surrounding soils. This map unit is not suited to crop production or to hay and pasture and is poorly suited to woodland because of the slope, a very limited root

zone, droughtiness, and the Rock outcrop. Seedlings in the wooded areas do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope and the limestone outcrops, operating equipment is hazardous in most areas.

The land capability classification is VIIs.

**480C2—Orwood loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown and dark brown loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is dark yellowish brown loam; the next part is yellowish brown silt loam; and the lower part is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Downs soils. These soils contain less sand than the Orwood soil. They are in positions on the landscape similar to those of the Orwood soils. They make up less than 5 percent of the unit.

Permeability is moderate in the Orwood soil, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. In some areas slopes are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet,

however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**480D2—Orwood loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, well drained soil is on upland side slopes. Commonly, areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown and dark brown loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil extends to a depth of about 60 inches. It is friable. The upper part is dark yellowish brown loam; the next part is yellowish brown silt loam; and the lower part is yellowish brown, mottled silt loam.

Included with this soil in mapping are areas of soils that have a higher content of sand than the Orwood soil and small areas of Downs soils. Downs soils contain less sand than the Orwood soil. Also included are some small areas of severely eroded soils. These soils have a lower organic matter content and fertility level than the Orwood soil. Also, tilth is poorer. The included soils are in positions on the landscape similar to those of the Orwood soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Orwood soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by

concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**480F2—Orwood loam, 14 to 25 percent slopes, moderately eroded.** This moderately steep and steep, well drained soil is on upland side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown and dark brown loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 48 inches thick. It is friable. The upper part is dark yellowish brown loam, the next part is yellowish brown silt loam, and the lower part is yellowish brown silt loam mottled with light brownish gray and strong brown. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are areas of soils that have a higher content of sand than the Orwood soil and small areas of Downs soils. Downs soils contain less sand than the Orwood soil. Also included are some small areas of severely eroded soils. These soils have a lower organic matter content and fertility level than the Orwood soil. Also, tilth is poorer. The included soils are in positions on the landscape similar to those of the Orwood soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Orwood soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Many areas are used for crop production. This soil is very poorly suited to row crops because of the slope

and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

**482B—Racine loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on ridges in the uplands. Commonly, areas range from 10 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is dark grayish brown loam about 6 inches thick. The subsoil to a depth of 60 inches or more is loam. The upper part is brown and yellowish brown and is friable; the next part is yellowish brown, mottled, and friable; and the lower part is yellowish brown, mottled, and firm. In places the surface layer is thicker and darker.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good.

Most areas are used for crop production. Some areas are used for hay or pasture. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper

stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIe.

**482C2—Racine loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown loam from the subsoil into the surface layer. The subsoil is loam about 53 inches thick. The upper part is brown and yellowish brown and is friable; the next part is yellowish brown, mottled, and friable; and the lower part is yellowish brown, mottled, and firm. In places the surface layer is thicker and darker.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. Some areas are used for hay or pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Terrace cuts should not expose the less productive underlying glacial till. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or

limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**484—Lawson silt loam, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark grayish brown overwash material into the surface layer. The subsurface layer is black and very dark brown silt loam about 28 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam and dark grayish brown, mottled loam.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 4 to 6 percent. The subsurface layer generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is good.

Most areas are used for crop production. A few are used for pasture. If protected from flooding, this soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. A drainage system may be needed to reduce the wetness and provide good aeration and a deep root zone for plants. A properly installed drainage system works well if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A drainage system and protection from flooding may be needed to allow for optimum hay production. Streambank erosion is a problem in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

**487B—Worthen-Otter silt loams, 0 to 5 percent slopes.** These gently sloping soils are in upland drainageways and on foot slopes. The Worthen soil is well drained and is on foot slopes below the more sloping upland soils. The Otter soil is poorly drained and is near the drainageways. It is subject to flooding. Commonly, areas range from 5 to 40 acres in size and are elongated or irregularly shaped. They are about 50 percent Worthen soil and 40 percent Otter soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Worthen soil is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 17 inches thick. The subsoil is friable silt loam about 34 inches thick. The upper part is brown, the next part is yellowish brown, and the lower part is yellowish brown and mottled. In some places the surface soil and subsoil are silty clay loam. In other places the subsurface layer is thinner.

Typically, the surface layer of the Otter soil is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark gray silt loam about 15 inches thick. The subsoil is very dark gray, mottled, friable silt loam. It is about 13 inches thick. The substratum to a depth of about 60 inches is dark gray silt loam mottled with yellowish red.

Included with these soils in mapping are small areas of stratified, silty recent sediment. These areas are lower in content of organic matter and less fertile than the Worthen and Otter soils. They make up less than 10 percent of the unit.

Permeability is moderate in the Worthen and Otter soils. Runoff is medium on the Worthen soil and slow on the Otter soil. Available water capacity is very high on both soils. The Otter soil has a seasonal high water table and in some areas is ponded for short periods. The content of organic matter is about 3 to 5 percent in the surface layer of the Worthen soil and 6 to 7 percent in the surface layer of the Otter soil. The subsoil of the Worthen soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Otter soil generally has a low supply of available phosphorus and potassium. Tilth is good in the Worthen soil and fair in the Otter soil.

Most areas are used for crop production. A few are used for pasture. These soils are well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. In some areas runoff from the soils upslope can result in siltation or

gullyng. Measures that control the runoff are needed. Grassed waterways help to prevent gullyng. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

The Worthen soil and drained areas of the Otter soil are well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The Otter soil is moderately well suited to trees. The use of equipment should be restricted to the drier periods or to winter months when the ground is frozen. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is 1lw.

**488C2—Newvienna silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, moderately well drained soil is on ridges, side slopes, and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 10 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown silty clay loam from the subsoil into the surface layer. The subsoil is mottled, friable silty clay loam about 52 inches thick. The upper part is dark yellowish brown and yellowish brown, and the lower part is light brownish gray and yellowish brown.

Included with this soil in mapping are small areas of Downs soils. These soils are in positions on the landscape similar to those of the Newvienna soil. They are well drained and do not have a seasonal high water table. They make up less than 5 percent of the unit.

Permeability is moderate in the Newvienna soil, and runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2 to 3

percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tillage is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Slopes commonly are long enough and uniform enough for terracing and contour stripcropping. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is 1lle.

**488D2—Newvienna silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown silty clay loam from the subsoil into the surface layer. The subsoil is mottled, friable silty clay loam about 50 inches thick. The upper part is dark yellowish brown and yellowish brown, and the lower part is light brownish gray and yellowish brown. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown silt loam mottled with strong brown.

Included with this soil in mapping are small areas of Downs soils and the severely eroded Newvienna soils.

These soils are in positions on the landscape similar to those of this Newvienna soil. Downs soils are well drained and do not have a seasonal high water table. The severely eroded Newvienna soils have a lower content of organic matter and a lower fertility level than this Newvienna soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Newvienna soil, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**488D3—Newvienna silty clay loam, 9 to 14 percent slopes, severely eroded.** This strongly sloping, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the

uplands. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of very dark grayish brown silt loam into the surface layer. The subsoil is mottled, friable silty clay loam about 49 inches thick. The upper part is dark yellowish brown and yellowish brown, and the lower part is light brownish gray and yellowish brown. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown silt loam mottled with strong brown.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is moderately well suited to corn occasionally grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Newvienna soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if fertility is

improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is IVe.

**488E2—Newvienna silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown silty clay loam from the subsoil into the surface layer. The subsoil is mottled, friable silty clay loam about 48 inches thick. The upper part is dark yellowish brown and yellowish brown, and the lower part is light brownish gray and yellowish brown. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Downs soils and the severely eroded Newvienna soils. These soils are in positions on the landscape similar to those of this Newvienna soil. Downs soils are well drained and do not have a seasonal high water table. The severely eroded Newvienna soils have a lower content of organic matter and a lower fertility level than this Newvienna soil. Also, tilth is poorer. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Newvienna soil, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and

increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**488E3—Newvienna silty clay loam, 14 to 18 percent slopes, severely eroded.** This moderately steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of very dark grayish brown silt loam into the surface layer. The subsoil is mottled, friable silty clay loam about 47 inches thick. The upper part is dark yellowish brown and yellowish brown, and the lower part is light brownish gray and yellowish brown. The substratum to a depth of about 60 inches is mottled light brownish gray and yellowish brown silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of a serious hazard of further erosion. Cultivated crops should be grown in rotation with small grain and hay. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small

drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Newvienna soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**490—Caneek silt loam, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 4 inches thick. The substratum is stratified dark grayish brown, grayish brown, and brown, mottled silt loam about 24 inches thick. Below this to a depth of about 60 inches is an older buried surface layer of black and very dark gray silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is less than 1.5 percent. The substratum has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. If drained and protected from flooding,

this soil is well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. A properly installed drainage system works well if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas on the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. A drainage system may be needed to allow for optimum hay production. Restricted access and streambank erosion are problems in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

**496B—Volney-Dorchester silt loams, 1 to 7 percent slopes.** These gently sloping and moderately sloping, well drained soils are in narrow upland drainageways and on alluvial fans. They are subject to flooding. Generally, the Dorchester soil is adjacent to the channel of the drainageways and the Volney soil is below the steep upland side slopes. Commonly, areas range from 5 to 30 acres in size. They are about 50 percent Volney soil and 40 percent Dorchester soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Volney soil has a surface layer of dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown very gravelly silt loam about 24 inches thick. The substratum to a depth of about 60 inches also is very dark grayish brown very gravelly silt loam.

Typically, the Dorchester soil has a surface layer of dark grayish brown silt loam about 7 inches thick. The substratum is stratified dark grayish brown, brown, grayish brown, and very dark grayish brown silt loam about 22 inches thick. Below this is an older buried surface layer of very dark brown and dark brown silt loam about 31 inches thick.

Included with these soils in mapping are small areas of poorly drained Caneek soils. These soils are in low areas or below seeps or springs near the more sloping uplands. Also included are areas of Dorchester and Volney soils that have limestone boulders on or below the surface. These boulders range from 2 to 10 feet in diameter. They have been dislodged from upslope areas of limestone bedrock. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Dorchester soil. It is moderately rapid in the upper part the Volney soil and very rapid in the lower part. Runoff is medium on both soils. Available water capacity is very high in the Dorchester soil and low in the Volney soil. The content of organic matter is about 0.5 to 1.5 percent in the surface layer of the Dorchester soil and 3.0 to 5.0 percent in the surface layer of the Volney soil. The substratum of both soils generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for pasture or woodland. These soils are not suited to crop production. They are subject to frequent, high-velocity runoff from the very steep soils upslope. Operating farm machinery may be difficult because of the limestone boulders. In some areas access is limited.

These soils are moderately well suited to pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils and because of the limestone boulders. Restricted access, gullying, and erosion are problems in some areas. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture.

These soils are moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VI.

**499D—Nordness silt loam, 5 to 14 percent slopes.**

This moderately sloping and strongly sloping, shallow, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is about 11

inches thick. The upper part is yellowish brown, friable silt loam and silty clay loam, and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 19 inches.

Included with this soil in mapping are areas of Dubuque, Donatus, and Rollingstone silt loams. Dubuque soils are underlain by limestone bedrock at a depth of 20 to 40 inches. Donatus and Rollingstone soils have chert fragments in the subsoil and are underlain by limestone bedrock at a depth of more than 20 inches. Also included are a few small areas where limestone bedrock crops out or is within a depth of 8 inches. The included areas are in positions on the landscape similar to those of the Nordness soil. They make up about 10 percent of the unit.

Permeability is moderate in the Nordness soil, and runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for hay or pasture. A few areas are used for woodland.

This soil is very poorly suited to row crops because of a very limited root zone and droughtiness. If row crops are grown, erosion is a serious hazard. Tillage is difficult because of the shallowness to limestone bedrock and the rock outcrops. Returning crop residue to the soil or regularly adding livestock waste improves fertility and increases the rate of water infiltration.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

Some areas support hardwoods. This soil is poorly suited to trees because of the very limited root zone and the droughtiness. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is VI.

**499F—Nordness silt loam, 14 to 35 percent slopes.**

This moderately steep to very steep, shallow, well drained soil is on side slopes and escarpments in the uplands. Commonly, areas range from 2 to 75 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is silty clay loam about 9 inches thick. The upper part is yellowish brown and friable, and the lower part is brown and firm. Limestone bedrock is at a depth of about 17 inches.

Included with this soil in mapping are areas of Dubuque, Donatus, and Rollingstone silt loams. Dubuque soils are underlain by limestone bedrock at a depth of 20 to 40 inches. Donatus and Rollingstone soils have chert fragments in the subsoil and are underlain by limestone bedrock at a depth of more than 20 inches. Also included are a few small areas where limestone bedrock crops out or is within a depth of 8 inches. The included areas are in landscape positions similar to those of the Nordness soil. They make up about 10 percent of the unit.

Permeability is moderate in the Nordness soil, and runoff is very rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for woodland or wildlife habitat. Some small areas are used for permanent pasture. This soil is not suited to row crops because of the slope, a very limited root zone, droughtiness, and a severe hazard of erosion.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Some areas are inaccessible, and the use of equipment may be restricted because of the slope and the limestone outcrops. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

Many areas support hardwoods. This soil is poorly suited to trees because of the very limited root zone and the droughtiness. The slope can inhibit woodland management. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close

intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is VII<sub>s</sub>.

**520—Coppock silt loam, 0 to 2 percent slopes.**

This nearly level, poorly drained soil is on stream terraces. It is subject to flooding. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is light brownish gray, mottled silt loam about 15 inches thick. The subsoil extends to a depth of about 60 inches. It is light brownish gray, mottled, and friable. The upper part is silt loam, and the lower part is silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. If drained and protected from flooding, this soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A drainage system is needed, however, to allow for optimum hay production. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

**523E2—Rozetta-Derinda silt loams, 14 to 18 percent slopes, moderately eroded.** These moderately steep, moderately well drained soils are on side slopes and concave slopes at the head of drainageways in the uplands. The deep Rozetta soil is on the upper side slopes. The moderately deep Derinda soil is on the lower side slopes and on concave slopes at the head of the drainageways. Commonly, areas range from 2 to 30 acres in size and are irregularly shaped. They are about 60 percent Rozetta soil and 30 percent Derinda soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically the Rozetta soil has a surface layer of brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 39 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Typically, the Derinda soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material into the surface layer. The subsoil is about 19 inches thick. It is yellowish brown. The upper part is friable silty clay loam, and the lower part is mottled, firm silty clay. Below this to a depth of about 60 inches is pale olive clay shale mottled with olive yellow.

Included with these soils in mapping are small areas of Schapville soils and shale outcrops. Schapville soils have a surface layer that is thicker and darker and has a higher content of organic matter than that of the Rozetta and Derinda soils. They are in positions on the landscape similar to those of the Derinda soil. The shale outcrops are on the lower side slopes. Also included are areas that may be seepy during the wetter parts of the year and scattered areas where fragments of limestone a few inches to several feet long are on or below the surface of the Rozetta and Derinda soils. These fragments have been dislodged from the limestone bedrock formation in upslope areas. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Rozetta soil. It is moderate in the upper part of the Derinda soil, slow in the subsoil, and very slow in the underlying shale. Runoff is rapid on both soils. Available water capacity is high in the Rozetta soil and low in the Derinda soil. The Rozetta soil has a seasonal high water table. The content of organic matter is about 1.5 to 2.5 percent in the surface layer of both soils. The subsoil of the Rozetta soil generally has a high supply of available

phosphorus and a low supply of available potassium. The subsoil of the Derinda soil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair in both soils.

Most areas are used for crop production. A few are used for pasture. These soils are poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. These soils are highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. When terraces are constructed, the topsoil should be stockpiled and then should be replaced after construction is complete because of the clayey shale underlying the Derinda soil. A drainage system is needed in most years to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. A drainage system may be needed to allow for optimum hay production. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**523F2—Rozetta-Derinda silt loams, 18 to 25 percent slopes, moderately eroded.** These steep, moderately well drained soils are on side slopes and concave slopes at the head of drainageways in the uplands. The deep Rozetta soil is on the upper side slopes. The moderately deep Derinda soil is on the lower side slopes and on concave slopes at the head of the drainageways. Commonly, areas range from 2 to 20

acres in size and are irregularly shaped. They are about 60 percent Rozetta soil and 30 percent Derinda soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rozetta soil has a surface layer of brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 37 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Typically, the Derinda soil has a surface layer of brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material into the surface layer. The subsoil is about 17 inches thick. It is yellowish brown. The upper part is friable silty clay loam, and the lower part is mottled, firm silty clay. Below this to a depth of about 60 inches is pale olive clay shale mottled with olive yellow.

Included with these soils in mapping are small areas of Schapville soils and shale outcrops. Schapville soils have a surface layer that is thicker and darker and has a higher content of organic matter than that of the Rozetta and Derinda soils. They are in positions on the landscape similar to those of the Derinda soil. The shale outcrops are on the lower side slopes. Also included are areas that may be seepy during the wetter parts of the year and scattered areas where fragments of limestone a few inches to several feet long are on or below the surface of the Rozetta and Derinda soils. These fragments have been dislodged from the limestone bedrock formation in upslope areas. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Rozetta soil. It is moderate in the upper part of the Derinda soil, slow in the subsoil, and very slow in the underlying shale. Runoff is rapid on both soils. Available water capacity is high in the Rozetta soil and low in the Derinda soil. The Rozetta soil has a seasonal high water table. The content of organic matter is about 1.5 to 2.5 percent in the surface layer of both soils. The subsoil of the Rozetta soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Derinda soil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tillth is fair in both soils.

Most areas are used for crop production. These soils are very poorly suited to row crops because of the slope and a serious hazard of further erosion.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the

soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. A drainage system may be needed to allow for optimum hay production. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

**523F3—Rozetta-Derinda silty clay loams, 18 to 25 percent slopes, severely eroded.** These steep, moderately well drained soils are on side slopes and concave slopes at the head of drainageways in the uplands. The deep Rozetta soil is on the upper side slopes. The moderately deep Derinda soil is on the lower side slopes and on concave slopes at the head of the drainageways. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped. They are about 60 percent Rozetta soil and 30 percent Derinda soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rozetta soil has a surface layer of dark yellowish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of brown and dark grayish brown silt loam into the surface layer. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Typically, the Derinda soil has a surface layer of yellowish brown silty clay loam about 8 inches thick. Plowing has mixed streaks and pockets of brown silt loam into the surface layer. The subsoil is about 16 inches thick. It is yellowish brown. The upper part is friable silty clay loam, and the lower part is mottled, firm silty clay. Below this to a depth of about 60 inches is pale olive clay shale mottled with olive yellow.

Included with these soils in mapping are small areas of Schapville soils and shale outcrops. Schapville soils have a surface layer that is thicker and darker and has a higher content of organic matter than that of the Rozetta and Derinda soils. They are in positions on the

landscape similar to those of the Derinda soil. The shale outcrops are on the lower side slopes. Also included are areas that may be seepy during the wetter parts of the year and scattered areas where fragments of limestone a few inches to several feet long are on or below the surface of the Rozetta and Derinda soils. These fragments have been dislodged from the limestone bedrock formation in upslope areas. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Rozetta soil. It is moderate in the upper part the Derinda soil, slow in the lower part, and very slow in the underlying shale. Runoff is rapid on both soils. Available water capacity is high in the Rozetta soil and low in the Derinda soil. The Rozetta soil has a seasonal high water table. The content of organic matter is about 0.4 to 2.0 percent in the surface layer of both soils. The subsoil of the Rozetta soil generally has a high supply of available phosphorus and a low supply of available potassium. The subsoil of the Derinda soil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is poor in both soils.

Most areas are used for crop production. These soils are not suited to row crops because of the slope and a serious hazard of further erosion.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. A drainage system may be needed to allow for optimum hay production. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIIe.

**589—Otter silt loam, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 5 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark gray silt loam about 15 inches thick. The subsoil is very dark gray, mottled, friable silt loam about 13 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table and in some areas is ponded for short periods. The content of organic matter in the surface layer is about 6 to 7 percent. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. If drained and protected from flooding, this soil is well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. A properly installed drainage system works well if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. A drainage system and protection from flooding are needed to allow for optimum hay production. Streambank erosion is a problem in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. The use of equipment should be restricted to the drier periods or to winter months when the ground is frozen. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is IIw.

**623D2—Rozetta silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 41 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Fayette soils and the severely eroded Rozetta soils. Fayette soils are well drained and do not have a seasonal high water table. The severely eroded Rozetta soils have a lower content of organic matter and a lower fertility level than this Rozetta soil. Also, tilth is poorer. The included soils are in positions on the landscape similar to those of the Rozetta soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Rozetta soil, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to corn grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper

stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**623D3—Rozetta silty clay loam, 9 to 14 percent slopes, severely eroded.** This strongly sloping, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of brown and dark grayish brown silt loam into the surface layer. The subsoil is friable silty clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 0.5 to 2.0 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is moderately well suited to corn occasionally grown in rotation with small grain and hay. It is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Rozetta soils. Also, more intensive management is needed to maintain

productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is IVe.

**623E2—Rozetta silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is friable silty clay loam about 39 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Fayette soils and the severely eroded Rozetta soils. Fayette soils are well drained and do not have a seasonal high water table. The severely eroded Rozetta soils have a lower content of organic matter and a lower fertility level than this Rozetta soil. Also, tilth is poorer. The included soils are in positions on the landscape similar to those of the Rozetta soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Rozetta soil, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. A system of conservation tillage that leaves most of the crop residue on the surface, contour

farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**623E3—Rozetta silty clay loam, 14 to 18 percent slopes, severely eroded.** This moderately steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of brown and dark grayish brown silt loam into the surface layer. The subsoil is friable silty clay loam about 38 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 0.5 to 2.0 percent. The subsoil generally has a high supply of available

phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of a serious hazard of further erosion. Cultivated crops should be grown in rotation with small grain and hay. A system of conservation tillage that leaves most of the crop residue on the surface, contour farming, crop rotations that include grasses and legumes, and contour stripcropping help to prevent excessive soil loss. In many areas where slopes are irregular, runoff concentrates in small drainageways and thus increases the hazard of further erosion. Terrace systems or well maintained grassed waterways can help to control the erosion caused by concentrated runoff. The soil is seepy during wet periods because of the seasonal high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration. Fertilizer requirements are greater on this soil than on the less eroded Rozetta soils. Also, more intensive management is needed to maintain productivity and improve tilth.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**623F2—Rozetta silt loam, 18 to 25 percent slopes, moderately eroded.** This steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown

subsoil material into the surface layer. The subsoil is friable silty clay loam about 37 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of Fayette soils and the severely eroded Rozetta soils. Fayette soils are well drained and do not have a seasonal high water table. The severely eroded Rozetta soils have a lower content of organic matter and a lower fertility level than this Rozetta soil. Also, tilth is poorer. The included soils are in positions on the landscape similar to those of the Rozetta soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Rozetta soil, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. A drainage system may be needed to allow for optimum hay production. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

**623F3—Rozetta silty clay loam, 18 to 25 percent slopes, severely eroded.** This steep, moderately well drained soil is on side slopes and concave slopes at the head of drainageways in the uplands. Commonly, areas range from 5 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark yellowish brown

silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of brown and dark grayish brown silt loam into the surface layer. The subsoil is friable silty clay loam about 36 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 0.5 to 2.0 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tilth is poor.

Most areas are used for crop production. This soil is very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. A drainage system may be needed to allow for optimum hay production. Reseeding or pasture renovation may be needed in some areas. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if fertility is improved, suitable species are selected for planting, and the stand is managed properly.

The land capability classification is VIe.

**703C2—Dubuque silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 30 inches. In

places the lower part of the subsoil is thicker and has a higher content of clay.

Permeability is moderate in the upper part of the profile and slow in the lower part. Runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for permanent pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. In years of below average rainfall, the soil is droughty. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**703D—Dubuque silt loam, 9 to 14 percent slopes.** This strongly sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface

layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 32 inches. In places the lower part of the subsoil is thicker and has a higher content of clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the Dubuque soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for woodland or permanent pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. It is droughty in years of below average rainfall. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the limited depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This

soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**703D2—Dubuque silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 28 inches. In places the lower part of the subsoil is thicker and has a higher content of clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the Dubuque soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for permanent pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. It is droughty in years of below average rainfall. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the limited depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in

controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

### **703E—Dubuque silt loam, 14 to 18 percent slopes.**

This moderately steep, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 30 inches. In places the lower part of the subsoil is thicker and has a higher content of clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the Dubuque soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for woodland or permanent pasture. This soil is very poorly suited to row crops because of the slope and a severe hazard of erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during

wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour help to reduce the hazard of soil erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

### **703E2—Dubuque silt loam, 14 to 18 percent slopes, moderately eroded.**

This moderately steep, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 26 inches. In places the lower part of the subsoil is thicker and has a higher content of clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the Dubuque soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for permanent pasture. This soil is very poorly suited to row crops because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction,

which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIe.

#### **703F—Dubuque silt loam, 18 to 25 percent slopes.**

This steep, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, friable silty clay loam; and the lower part is brown, very firm silty clay. Limestone bedrock is at a depth of about 28 inches. In places the lower part of the subsoil is thicker and has a higher content of clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the Dubuque soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Dubuque soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for woodland or permanent pasture. This soil is not suited to row crops because of the slope and a severe hazard of erosion. Cultivated crops should be grown only to reestablish pastures.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too

wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a limited root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is VIIe.

#### **712F—Schapville silt loam, 18 to 30 percent slopes.**

This steep and very steep, moderately deep, moderately well drained soil is on side slopes in the uplands. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 17 inches thick. The upper part is dark yellowish brown, friable silty clay loam, and the lower part is pale olive, mottled, very firm silty clay. Below this to a depth of about 60 inches is pale olive and greenish gray clay shale that has a few fragments of hard shale. In places the surface layer and subsurface layer are thinner.

Included with this soil in mapping are small areas that are wet and seepy. These areas generally are near drainageways. Also included are small areas where limestone fragments are throughout the profile. The inclusions make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Schapville soil, slow in the lower part of the subsoil, and very slow in the underlying shale. Runoff is rapid. Available water capacity is moderate. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good.

Most areas are used for permanent pasture or woodland. This soil is very poorly suited to row crops because of the slope and a severe hazard of erosion. Operating farm machinery is difficult because of the

slope and because of many seeps and small drainageways.

This soil is poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. In some areas operating the equipment used in applying lime and fertilizer is difficult because of the slope. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is VIe.

**749—Zwingle Variant silty clay, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on stream terraces along tributaries of the Mississippi River. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay about 4 inches thick. The subsoil is about 56 inches thick. It is mottled and very firm. The upper part is grayish brown clay, the next part is yellowish brown clay, and the lower part is reddish brown and brown clay and silty clay. In places the surface layer is thicker.

Included with this soil in mapping are small areas where the surface layer consists of stratified, silty sediment. These areas are adjacent to the uplands. They make up less than 5 percent of the unit.

Permeability is very slow in the Zwingle Variant soil, and runoff is slow. Available water capacity is moderate. The soil has a seasonal high water table and in some areas is ponded for short periods. The shrink-swell potential is high. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is poor.

Most areas are used for permanent pasture. Some are used for crop production. This soil is poorly suited to row crops and small grain. It is sticky when wet because of the very high content of clay. Also, fertility is low. Tile cannot drain the soil satisfactorily. A surface drainage system is effective in removing excess water. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and minimizes surface crusting.

If drained, this soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates,

pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. This soil is moderately well suited to trees. The use of equipment should be restricted to the drier periods or to winter months when the ground is frozen. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow.

The land capability classification is IIIw.

**775B—Billett sandy loam, 2 to 5 percent slopes.** This gently sloping, well drained soil is on upland ridges, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown and yellowish brown, very friable sandy loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown loamy sand.

Permeability is moderately rapid, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops. It is better suited to small grain and hay. Drought is a hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving the crop residue on the surface or regularly adding livestock waste improves fertility and tilth.

This soil is moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry

periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedlings may require supplemental water in dry years. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIs.

**775C2—Billett sandy loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, well drained soil is on upland ridges and side slopes, high stream benches, and stream terraces. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 32 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown and yellowish brown, very friable sandy loam; and the lower part is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown loamy sand.

Permeability is moderately rapid, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is about 0.5 to 1.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tillage is fair.

Most areas are used for crop production. This soil is moderately well suited to row crops. It is better suited to small grain and hay. Drought is a hazard in most years unless rainfall is abundant and timely. If cultivated crops are grown, water erosion and wind erosion are hazards. Windblown sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves most of the crop residue on the surface and crop rotations that include grasses and legumes help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility and tillage.

This soil is moderately well suited to grasses and deep-rooted legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Planting forage species that can tolerate droughty conditions improves production. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedlings may require supplemental water in dry years. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**799G—Dorerton-Lacrescent complex, 18 to 60 percent slopes.** These steep and very steep, well drained soils are on upland side slopes and nose slopes. The Dorerton soil is on the upper side slopes and near the head of drainageways. The Lacrescent soil is on the lower side slopes and nose slopes. Commonly, areas range from 5 to 30 acres in size and are elongated. They are about 55 percent Dorerton soil and 35 percent Lacrescent soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Dorerton soil has a surface layer of very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 32 inches thick. It is yellowish brown and friable. The upper part is silty clay loam, and the lower part is flaggy silt loam. The substratum to a depth of about 60 inches is yellowish brown very flaggy silt loam. In some places the subsoil has a higher content of clay. In other places the subsoil and substratum have a higher content of chert fragments.

Typically, the Lacrescent soil has a surface layer of very dark brown channery silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown channery silt loam about 6 inches thick. The subsoil is yellowish brown, friable very channery silt loam about 28 inches thick. The substratum to a depth of about 60 inches is yellowish brown very channery silt loam.

Included with these soils in mapping are a few small areas of Fayette soils and areas where limestone boulders 2 to 30 feet in diameter are on or below the surface. Fayette soils and the areas of limestone boulders are in positions on the landscape similar to those of the Dorerton and Lacrescent soils. Fayette soils formed in more than 60 inches of silty material. The limestone boulders have been dislodged from the limestone bedrock formation in upslope areas. Also included are small areas where shale crops out or is within a depth of 40 inches. These areas are usually wet and seepy and may include springs. They are on the lower side slopes or in drainageways. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Dorerton and Lacrescent soils, and runoff is very rapid. Available water capacity is low. The content of organic matter is about 1 to 2 percent in the surface layer of the Dorerton soil and 3 to 5 percent in the surface layer of the Lacrescent soil. The subsoil of both soils generally has a very low supply of available phosphorus and potassium. Tillage is fair.

Most areas are used for woodland. Some areas are

used for pasture along with the surrounding areas. These soils are not suited to crop production or to hay and pasture because of the slope, a limited root zone, and droughtiness.

The older stands of trees remain in many areas. These soils are moderately well suited to trees. The slope may restrict woodland management. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Seedling mortality is moderate on the Dorerton soil.

The land capability classification is VIIe.

**814B—Rockton silt loam, 2 to 5 percent slopes.**

This gently sloping, moderately deep, well drained soil is on ridges in the uplands. Commonly, areas range from 10 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark yellowish brown, friable clay loam about 14 inches thick. Limestone bedrock is at a depth of about 31 inches.

Included with this soil in mapping are small areas of Emeline soils. These soils are in positions on the landscape similar to those of the Rockton soil. They have less than 12 inches of loamy material over limestone bedrock. They make up less than 5 percent of the unit.

Permeability is moderate in the Rockton soil, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tillth is good.

Most areas are used for crop production. Some are used for pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. In years of below average rainfall, the soil is droughty. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming and crop rotations that include grasses and legumes also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the

soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**814C—Rockton silt loam, 5 to 9 percent slopes.**

This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is dark yellowish brown, friable clay loam about 12 inches thick. Limestone bedrock is at a depth of about 28 inches.

Included with this soil in mapping are small areas of Emeline soils. These soils are in positions on the landscape similar to those of the Rockton soil. They have less than 12 inches of loamy material over limestone bedrock. They make up less than 5 percent of the unit.

Permeability is moderate in the Rockton soil, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tillth is good.

Most areas are used for crop production. Some are used for pasture. This soil is moderately well suited to row crops and small grain. It is highly erodible if cropped too intensively. In years of below average rainfall, it is droughty. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**814C2—Rockton silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is dark yellowish brown, friable clay loam about 12 inches thick. Limestone bedrock is at a depth of about 21 inches.

Included with this soil in mapping are small areas of Emeline soils. These soils are in positions on the landscape similar to those of the Rockton soil. They have less than 12 inches of loamy material over limestone bedrock. They make up less than 5 percent of the unit.

Permeability is moderate in the Rockton soil, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair.

Most areas are used for crop production. Some are used for pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. In years of below average rainfall, the soil is droughty. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on

the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**826—Rowley silt loam, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on stream terraces. It is subject to flooding. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is very dark brown silt loam about 9 inches thick. The subsoil is about 43 inches thick. The upper part is dark grayish brown and brown, mottled, friable silty clay loam; the next part is grayish brown, friable silt loam mottled with strong brown; and the lower part is light brownish gray, mottled, very friable sandy loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 4 to 5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface

compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is 1lw.

**903C2—Frankville silt loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 22 inches thick. The upper part is dark yellowish brown and yellowish brown, friable silty clay loam, and the lower part is yellowish brown, very firm clay. Limestone bedrock is at a depth of about 31 inches. In places the layer of clay in the subsoil is thicker.

Permeability is moderate in the upper part of the profile and slow in the lower part. Runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for permanent pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. In years of below average rainfall, the soil is droughty. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in

controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is 1lle.

**903D2—Frankville silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 5 acres in size and are irregular in shape.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface level. The subsoil is about 20 inches thick. The upper part is dark yellowish brown and yellowish brown, friable silty clay loam, and the lower part is yellowish brown, very firm clay. Limestone bedrock is at a depth of about 29 inches. In places the layer of clay in the subsoil is thicker.

Permeability is moderate in the upper part of the profile and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. It is droughty in years of below average rainfall. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion

caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**914C2—Winneshiek loam, 5 to 9 percent slopes, moderately eroded.** This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown and strong brown, very firm clay. Limestone bedrock is at a depth of about 31 inches.

Included with this soil in mapping are small areas where the surface layer and subsoil have a higher content of sand. These areas are in positions on the landscape similar to those of the Winneshiek soil. They make up about 10 percent of the unit.

Permeability is moderate in the Winneshiek soil, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tillage is fair.

Most areas are used for crop production. Some are used for pasture. This soil is moderately well suited to row crops and small grain. If cultivated crops are grown, further erosion is a hazard. In years of below average rainfall, the soil is droughty. The root zone is limited by the depth to limestone bedrock. A system of

conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**914D2—Winneshiek loam, 9 to 14 percent slopes, moderately eroded.** This moderately sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown and strong brown, very firm clay. Limestone bedrock is at a depth of about 29 inches. In places the surface layer is more than 7 inches thick.

Included with this soil in mapping are small areas where the surface layer and subsoil have a higher content of sand. These areas are in positions on the landscape similar to those of the Winneshiek soil. They make up about 10 percent of the unit.

Permeability is moderate in the Winneshiek soil, and

runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. Tilt is fair.

Most areas are used for crop production. Some are used for pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. It is droughty in years of below average rainfall. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVE.

**926—Canoe silt loam, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on stream terraces. It is subject to flooding. Commonly, areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is

about 43 inches thick. It is mottled and friable. The upper part is brown silt loam, the next part is grayish brown silty clay loam, and the lower part is light brownish gray silty clay loam. In places the surface layer is thicker.

Included with this soil in mapping are small areas of Coppock soils. These soils are poorly drained and are in slight depressions. They may remain wet for longer periods than the Canoe soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Canoe soil, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilt is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is I.

**930—Orion silt loam, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 4 inches thick. The substratum is stratified brown, dark grayish brown, grayish brown, and very dark grayish brown, mottled silt loam about 30 inches thick. Below this to a depth of about 60 inches is an older buried surface layer of black silt loam.

Included with this soil in mapping are small areas of poorly drained soils in slight depressions. These soils make up about 10 percent of the unit.

Permeability is moderate in the Orion soil, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1 to 3 percent. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. Many narrow areas that are very frequently flooded are used for permanent pasture or woodland. If protected from flooding, this soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. A drainage system may be needed to reduce the wetness and provide good aeration and a deep root zone for plants. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive overflow from areas in the adjacent uplands by terraces or diversions in those areas. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. A drainage system may be needed to allow for optimum hay production. Restricted access and streambank erosion are problems in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIw.

**930B—Orion silt loam, 2 to 5 percent slopes.** This gently sloping, somewhat poorly drained soil is in upland drainageways. It is subject to flooding. Commonly, areas range from 10 to 30 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown and brown silt loam about 4 inches thick. The substratum is

stratified brown, dark grayish brown, grayish brown, and very dark grayish brown, mottled silt loam about 28 inches thick. Below this to a depth of about 60 inches is an older buried surface layer of black silt loam.

Included with this soil in mapping are small areas of the moderately well drained Arenzville soils on slight rises in the drainageways. Also included are small areas of poorly drained soils in slight depressions. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Orion soil, and runoff is medium. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1 to 3 percent. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production along with the surrounding uplands. Many narrow areas that are very frequently flooded are used for permanent pasture or woodland. If protected from flooding, gullying, and siltation, this soil is well suited to row crops and small grain. During periods of heavy rainfall, it is subject to overflow. Floodwater and the deposition of sediment can damage crops. The soil can be protected from excessive overflow by the use of terraces or diversions on the adjacent uplands. Fieldwork is often delayed in the spring and during other wet periods because of the high water table. A drainage system may be needed to reduce the wetness and provide good aeration and a deep root zone for plants. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. Management may be difficult because of flooding or overflow from the more sloping upland soils. A drainage system may be needed to allow for optimum hay production. Restricted access, gullying, and streambank erosion are problems in some areas. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIw.

**938D2—NewGlarus silt loam, 9 to 14 percent slopes, moderately eroded.** This strongly sloping, moderately deep, well drained soil is on upland ridges and side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown and brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, friable silt loam, and the lower part is strong brown, firm clay. Limestone bedrock is at a depth of about 30 inches. In places the lower part of the subsoil is thinner and contains less clay.

Included with this soil in mapping are small areas of Nordness soils and the severely eroded NewGlarus soils. These soils are in positions on the landscape similar to those of this NewGlarus soil. Nordness soils are underlain by limestone bedrock at a depth of 8 to 20 inches. The severely eroded NewGlarus soils have a lower organic matter content and fertility level than this NewGlarus soil. Also, tilth is poorer. Included soils make up about 10 percent of the unit.

Permeability is moderate in the upper part of the NewGlarus soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 0 to 1 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for pasture. This soil is poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soil is highly erodible if cropped too intensively. It is droughty in years of below average rainfall. The root zone is limited by the depth to limestone bedrock. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soil is not suited to terracing because of the limited depth to limestone bedrock. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the

runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if the proper species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

**938E—NewGlarus silt loam, 14 to 18 percent slopes.** This moderately steep, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, friable silt loam, and the lower part is strong brown, very firm clay. Limestone bedrock is at a depth of about 31 inches. In places the lower part of the subsoil is thinner and contains less clay.

Included with this soil in mapping are small areas of Nordness soils. These soils are in positions on the landscape similar to those of the NewGlarus soil. They are underlain by limestone bedrock at a depth of 8 to 20 inches. They make up less than 5 percent of the unit.

Permeability is moderate in the upper part of the NewGlarus soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 1 to 2 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for woodland. Some are used for permanent pasture. This soil is very poorly suited to row crops because of the slope and a severe hazard of erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good

condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few areas. This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**938E2—NewGlarus silt loam, 14 to 18 percent slopes, moderately eroded.** This moderately steep, moderately deep, well drained soil is on upland side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown and brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown subsoil material into the surface layer. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, friable silt loam, and the lower part is strong brown, firm clay. Limestone bedrock is at a depth of about 28 inches. In places the lower part of the subsoil is thinner and contains less clay.

Included with this soil in mapping are small areas of Nordness soils and the severely eroded NewGlarus soils. These soils are in positions on the landscape similar to those of this NewGlarus soil. Nordness soils are underlain by limestone bedrock at a depth of 8 to 20 inches. The severely eroded NewGlarus soils have a lower organic matter content and fertility level than this NewGlarus soil. Also, tilth is poorer. Included soils make up about 10 percent of the unit.

Permeability is moderate in the upper part of the NewGlarus soil and slow in the lower part. Runoff is rapid. Available water capacity is low. The content of organic matter in the surface layer is about 0 to 1 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. A few are used for permanent pasture. This soil is very poorly suited to crop production because of the slope and a serious hazard of further erosion.

This soil is moderately well suited to hay and pasture. A cover of grasses and legumes is effective in

controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**939D—Donatus-Rollingstone silt loams, 9 to 14 percent slopes.** These strongly sloping, well drained soils are on upland ridges and side slopes. The moderately deep Donatus soil is on the lower side slopes. The deep Rollingstone soil is on ridges and the upper side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 55 percent Donatus soil and 35 percent Rollingstone soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Donatus soil has a surface layer of very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown very cherty silt loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is reddish brown, very firm very cherty clay. Limestone bedrock is at a depth of about 38 inches.

Typically, the Rollingstone soil has a surface layer of very dark grayish brown silt loam about 3 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is yellowish red, very firm cherty clay.

Included with these soils in mapping are small areas of Fayette soils. These included soils formed in more than 60 inches of silty material. They are in positions on the landscape similar to those of the Donatus and Rollingstone soils. They make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Donatus soil and slow in the lower part. It is slow in the Rollingstone soil. Runoff is rapid on both soils. Available water capacity is low in the Donatus soil and moderate in the Rollingstone soil. The content of organic matter is about 1 to 2 percent in the surface layer of both soils. The subsoil of the Donatus soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Rollingstone soil generally has a very low supply of available phosphorus and potassium. Tilth is fair in both soils.

Most areas are used for woodland. A few are used for permanent pasture.

These soils are poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soils are highly erodible if cropped too intensively. They are droughty in years of below average rainfall. In some areas the root zone is limited by the depth to limestone bedrock. Also, tillage may be difficult because of the shallowness to chert fragments. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soils are not suited to terracing because of the limited depth to limestone bedrock and the cherty clay in the subsoil. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

A few small areas support hardwoods. These soils are moderately well suited to trees. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. No other problems affect planting or harvesting if suitable species are

selected for planting and the stand is managed properly.

The land capability classification is IVe.

**939D2—Donatus-Rollingstone silt loams, 9 to 14 percent slopes, moderately eroded.** These strongly sloping, well drained soils are on upland ridges and side slopes. The moderately deep Donatus soil is on the lower side slopes. The deep Rollingstone soil is on ridges and the upper side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 55 percent Donatus soil and 35 percent Rollingstone soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Donatus soil has a surface layer of brown silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is reddish brown, very firm very cherty clay. Limestone bedrock is at a depth of about 37 inches.

Typically, the Rollingstone soil has a surface layer of brown silt loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is yellowish red, very firm cherty clay.

Included with these soils in mapping are scattered small areas where chert fragments crop out and small areas of Fayette soils. The areas of chert outcrops can hinder tillage and haying. They are less fertile and more droughty than the Donatus and Rollingstone soils. Also, tilth is poorer. Fayette soils formed in more than 60 inches of silty material. They are in positions on the landscape similar to those of the Donatus and Rollingstone soils. Included areas make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Donatus soil and slow in the lower part. It is slow in the Rollingstone soil. Runoff is rapid on both soils. Available water capacity is low in the Donatus soil and moderate in the Rollingstone soil. The content of organic matter is less than 1 percent in the surface layer of both soils. The subsoil of the Donatus soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Rollingstone soil generally has a very low supply of available phosphorus and potassium. Tilth is fair in both soils.

Most areas are used for crop production. A few are used for pasture. These soils are poorly suited to row crops. Corn can be occasionally grown in rotation with small grain and hay. The soils are highly erodible if cropped too intensively. They are droughty in years of below average rainfall. In some areas the root zone is limited by the depth to limestone bedrock. Also, tillage

may be difficult because of the shallowness to chert fragments. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming, crop rotations that include grasses and legumes, and contour stripcropping also help to prevent excessive soil loss. Generally, the soils are not suited to terracing because of the limited depth to limestone bedrock and the cherty clay in the subsoil. Well maintained grassed waterways can help to control the erosion caused by concentrated runoff. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in a few small areas. These soils are moderately well suited to trees. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. No other problems affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

**939E2—Donatus-Rollingstone silt loams, 14 to 18 percent slopes, moderately eroded.** These moderately steep, well drained soils are on upland ridges and side slopes. The moderately deep Donatus soil is on the lower side slopes. The deep Rollingstone soil is on ridges and the upper side slopes. Commonly, areas range from 2 to 10 acres in size and are irregularly shaped. They are about 55 percent Donatus soil and 35 percent Rollingstone soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Donatus soil has a surface layer of brown silt loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is reddish brown, very firm very cherty clay. Limestone

bedrock is at a depth of about 35 inches.

Typically, the Rollingstone soil has a surface layer of brown silt loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is yellowish red, very firm cherty clay.

Included with these soils in mapping are scattered small areas where chert fragments crop out and small areas of Nordness soils. The areas of chert outcrops can hinder tillage and haying. They are less fertile and more droughty than the Donatus and Rollingstone soils. Also, tillage is poorer. Nordness soils are underlain by limestone bedrock at a depth of 8 to 20 inches and do not contain chert fragments. They are in positions on the landscape similar to those of the Donatus and Rollingstone soils. Included areas make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Donatus soil and slow in the lower part. It is slow in the Rollingstone soil. Runoff is rapid on both soils. Available water capacity is low in the Donatus soil and moderate in the Rollingstone soil. The content of organic matter is 0.5 to 2.5 percent in the surface layer of both soils. The subsoil of the Donatus soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Rollingstone soil generally has a very low supply of available phosphorus and potassium. Tillage is fair in both soils.

Most areas are used for row crops. These soils are very poorly suited to row crops because of the slope and a serious hazard of further erosion.

These soils are moderately well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soils are too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

These soils are moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow.

The land capability classification is VIe.

**939F—Donatus-Rollingstone silt loams, 18 to 25 percent slopes.** These steep, well drained soils are on upland side slopes. The moderately deep Donatus soil is on the lower part of the side slopes, and the deep Rollingstone soil is on the upper part. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped. They are about 55 percent Donatus soil and 35 percent Rollingstone soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Donatus soil has a surface layer of very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is reddish brown, very firm very cherty clay. Limestone bedrock is at a depth of about 34 inches.

Typically, the Rollingstone soil has a surface layer of very dark grayish brown silt loam about 3 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is yellowish red, very firm cherty clay.

Included with these soils in mapping are small areas of Nordness soils. These included soils are in positions on the landscape similar to those of the Donatus and Rollingstone soils. They are underlain by limestone bedrock at a depth of 8 to 20 inches and do not contain chert fragments. They make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Donatus soil and slow in the lower part. It is slow in the Rollingstone soil. Runoff is rapid on both soils. Available water capacity is low in the Donatus soil and moderate in the Rollingstone soil. The content of organic matter is about 1 to 3 percent in the surface layer of both soils. The subsoil of the Donatus soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Rollingstone soil generally has a very low supply of available phosphorus and potassium. Tilth is fair in both soils.

Most areas are used for woodland. A few are used for permanent pasture. These soils are not suited to crop production because of the slope and a severe hazard of erosion.

These soils are poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Because of the slope, some areas are inaccessible and the use of equipment may be restricted. Overgrazing or grazing when the soils are

wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. These soils are moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow.

The land capability classification is VIle.

**939F2—Donatus-Rollingstone silt loams, 18 to 25 percent slopes, moderately eroded.** These steep, well drained soils are on upland side slopes. The moderately deep Donatus soil is on the lower part of the side slopes, and the deep Rollingstone soil is on the upper part. Commonly, areas range from 5 to 20 acres in size and are irregularly shaped. They are about 55 percent Donatus soil and 35 percent Rollingstone soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Donatus soil has a surface layer of brown silt loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is reddish brown, very firm very cherty clay. Limestone bedrock is at a depth of about 33 inches.

Typically, the Rollingstone soil has a surface layer of brown silt loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is yellowish red, very firm cherty clay.

Included with these soils in mapping are scattered small areas where chert fragments crop out and small areas of Nordness soils. The areas of chert outcrops can hinder tillage and haying. They are less fertile and more droughty than the Donatus and Rollingstone soils. Also, tilth is poorer. Nordness soils are underlain by limestone bedrock at a depth of 8 to 20 inches and do not contain chert fragments. They are in positions on the landscape similar to those of the Donatus and

Rollingstone soils. Included areas make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Donatus soil and slow in the lower part. It is slow in the Rollingstone soil. Runoff is rapid on both soils. Available water capacity is low in the Donatus soil and moderate in the Rollingstone soil. The content of organic matter is 0.5 to 2.5 percent in the surface layer of both soils. The subsoil of the Donatus soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Rollingstone soil generally has a very low supply of available phosphorus and potassium. Tilth is fair in both soils.

Most areas are used for hay or pasture. A few are used for crop production. These soils are not suited to row crops because of the slope and a serious hazard of further erosion.

These soils are poorly suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Because of the slope and the limestone outcrops, some areas are inaccessible and the use of equipment may be restricted. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture in good condition. Reseeding or pasture renovation may be needed in some areas. Forage yields are likely to be reduced during dry periods. Planting forage species that can tolerate a very shallow root zone and maintaining an appropriate fertility level help to ensure productivity during these periods. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The older stands of trees remain in some areas. These soils are moderately well suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Harvest methods that do not leave the remaining trees widely spaced can reduce the hazard of windthrow.

The land capability classification is Vlle.

**941G—Medary Variant silty clay loam, 18 to 60 percent slopes.** This steep and very steep, moderately well drained soil is on escarpments on stream terraces along tributaries of the Mississippi River. Commonly, areas range from 2 to 15 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 44 inches thick. The upper part is dark grayish

brown, friable silty clay loam; the next part is brown, reddish brown, and light brownish gray, firm silty clay; and the lower part is brown, friable silty clay loam. The substratum to a depth of about 60 inches is brown, mottled silt.

Permeability is very slow, and runoff is very rapid. Available water capacity is moderate. The content of organic matter in the surface layer is about 1 to 2 percent. The soil has a seasonal high water table. The shrink-swell potential is high. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is poor.

Most areas are used for permanent pasture. A few are used for woodland. This soil is not suited to crop production. Many areas are too steep for the use of ordinary farm machinery. Erosion is a serious hazard if cultivated crops are grown.

This soil is very poorly suited to grasses and legumes for hay and pasture. Productivity generally is low. Planting forage species that are tolerant of wetness can improve productivity. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Weed control and timely applications of lime and fertilizer improve the productivity of the pasture or hayland. Applying lime and fertilizer is difficult because of the slope.

The older stands of trees remain in a few areas. This soil is poorly suited to trees. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Careful thinning is needed because a wide interval between the trees can increase the hazard of windthrow. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous.

The land capability classification is Vlle.

**976B—Raddle silt loam, 1 to 4 percent slopes.** This gently sloping, well drained soil is on stream terraces. It is subject to flooding. Commonly, areas range from 2 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer also is very dark gray silt loam. It is about 8 inches thick. The subsoil is friable silt loam about 45 inches thick. The upper part is very dark grayish brown, and the lower part is dark yellowish brown and yellowish brown. In places the soil has a substratum of fine sand within a depth of 60 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is about 3 to 4 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tillth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is 1le.

**978B—Festina silt loam, 1 to 4 percent slopes.**

This gently sloping, well drained soil is on stream terraces. It is subject to flooding. Commonly, areas range from 2 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is friable silt loam about 33 inches thick. The upper part is brown and dark yellowish brown, the next part is yellowish brown mottled with grayish brown and strong brown, and the lower part is yellowish brown mottled with light brownish gray and yellowish red. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The organic matter content of the surface layer is about 2.5 to 3.5 percent. The subsoil generally has a high supply of available phosphorus and a very low supply of available potassium. Tillth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding

livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is 1le.

**981B—Worthen silt loam, 2 to 5 percent slopes.**

This gently sloping, well drained soil is on foot slopes and alluvial fans. Commonly, areas range from 2 to 30 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 17 inches thick. The subsoil is friable silt loam about 34 inches thick. The upper part is brown, the next part is yellowish brown, and the lower part is yellowish brown and mottled. In some places the surface soil and subsoil are silty clay loam. In other places the subsurface layer is thinner.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The content of organic matter in the surface layer is about 3 to 5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tillth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. In some areas runoff from upslope areas results in siltation or gullying. Measures that control the runoff are needed. Grassed waterways help to prevent gullying. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper

stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIe.

**981C—Worthen silt loam, 5 to 9 percent slopes.**

This moderately sloping, well drained soil is on foot slopes and alluvial fans. Commonly, areas range from 2 to 20 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 16 inches thick. The subsoil is friable silt loam about 32 inches thick. The upper part is brown, the next part is yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the surface soil and subsoil are silty clay loam. In other places the subsurface layer is thinner.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The content of organic matter in the surface layer is about 3 to 5 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is moderately well suited to row crops and small grain. In some areas runoff from upslope areas results in siltation or gulying. Measures that control the runoff are needed. Grassed waterways help to prevent gulying. A system of conservation tillage that leaves most of the crop residue on the surface and contour farming help to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is well suited to hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

The land capability classification is IIIe.

**1119—Muscatine silty clay loam, benches, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on high stream benches. Commonly, areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 11 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is dark grayish brown, the next part is grayish brown and mottled, and the lower part also is grayish brown and mottled. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 5 to 6 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

The land capability classification is I.

**1160—Walford silt loam, benches, 0 to 2 percent slopes.** This slightly depressional or level, poorly drained soil is on high stream benches. Commonly, areas range from 10 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is gray silt loam about 6 inches thick. The subsoil is mottled, friable silty clay loam about 45 inches thick. The upper

part is grayish brown, and the lower part is light olive gray and light gray. In places the soil has a thicker surface layer and has no subsurface layer.

Included with this soil in mapping are small areas of Atterberry soils. These soils are somewhat poorly drained and are slightly higher on the landscape than the Walford soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Walford soil, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is about 2.5 to 3.5 percent. The soil has a seasonal high water table and in some areas is ponded for short periods. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. If drained, this soil is well suited to row crops and small grain. Crop growth may be restricted by wetness in some years. A drainage system, possibly including surface inlets and drainage tile, is needed to reduce the wetness and provide good aeration and a deep root zone for plants. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A drainage system is needed, however, to allow for optimum hay production. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is moderately well suited to trees. The use of equipment should be restricted to the drier periods or to winter months when the ground is frozen. Seedlings do not survive well. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved.

The land capability classification is IIIw.

**1291—Atterberry silt loam, benches, 0 to 2 percent slopes.** This nearly level, somewhat poorly drained soil is on high stream benches. Commonly, areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 43 inches thick. It is friable. The upper part is

brown, mottled silty clay loam; the next part is light brownish gray silty clay loam mottled with strong brown; and the lower part is light brownish gray, mottled silt loam.

Included with this soil in mapping are small areas of Walford soils. These soils are poorly drained and are in slight depressions. They may remain wet for longer periods than the Atterberry soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Atterberry soil, and runoff is slow. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 3 to 4 percent. Available water capacity is very high. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good.

Most areas are used for crop production. This soil is well suited to row crops and small grain. Fieldwork may be delayed during wet periods because of the high water table. In most years a drainage system is needed to lower the water table and to permit timely fieldwork. A system of conservation tillage that leaves most of the crop residue on the surface helps to prevent excessive soil loss. Leaving crop residue on the surface or regularly adding livestock waste improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture or hayland.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is I.

**1490—Caneek silt loam, channeled, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on bottom land along islands in the Mississippi River (fig. 10). It is subject to flooding. Commonly, areas range from 5 to several hundred acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 4 inches thick. The substratum is stratified dark grayish brown, grayish brown, and brown, mottled silt loam about 24 inches thick. Below this to a depth of about 60



Figure 10.—An area of Caneek silt loam, channeled, 0 to 2 percent slopes, on a flood plain along the Mississippi River south of Bellevue.

inches is an older buried surface layer of black and very dark gray silt loam.

Included with this soil in mapping are a few small areas of shallow oxbows and old river channels. These areas are ponded part of the year, depending on the fluctuation of water levels in the river. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Caneek soil, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is less than 1.5

percent. The substratum has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for wildlife habitat or woodland. A few are used for permanent pasture. This soil is not suited to row crops or to grasses and legumes for hay because of the high water table, the flooding, and the deposition of sediment. Also, many areas are not easily accessible because they are channeled.

If protected from flooding, this soil is moderately well suited to pasture. Because of restricted access and

ponding, however, management may be difficult. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and reduces the rate of water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer improve the productivity of the pasture.

The land capability classification is Vw.

**1587—Dolbee silty clay loam, 0 to 2 percent slopes.** This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Commonly, areas range from 10 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer also is black silty clay loam. It is about 8 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is dark gray, the next part is olive gray, and the lower part is olive gray and mottled. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the subsurface layer is thicker.

Permeability is moderate, and runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 2 to 3 percent. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. If drained and protected from flooding, this soil is well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. A properly installed drainage system works well if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A good management system and protection from flooding are needed to allow for optimum hay production. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed

control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

The land capability classification is IIw.

**1587B—Dolbee silty clay loam, 2 to 5 percent slopes.** This gently sloping, poorly drained soil is on alluvial fans and in upland drainageways. It is subject to flooding. Commonly, areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer also is black silty clay loam. It is about 7 inches thick. The subsoil is friable silty clay loam about 28 inches thick. The upper part is dark gray, the next part is olive gray, and the lower part is olive gray and mottled. The substratum to a depth of about 60 inches is light olive gray, mottled silty clay loam. In places the subsurface layer is thicker.

Permeability is moderate, and runoff is medium. Available water capacity is very high. The soil has a seasonal high water table. The content of organic matter in the surface layer is about 1.5 to 2.5 percent. The shrink-swell potential is high. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair.

Most areas are used for crop production. If drained and protected from flooding, this soil is well suited to row crops and small grain. Fieldwork is often delayed during wet periods because of the high water table. A drainage system is needed to reduce the wetness and provide good aeration and a deep root zone for plants. A properly installed drainage system works well if an adequate outlet is available. Floodwater and the deposition of sediment can damage crops in some years. The soil can be protected from excessive runoff by terraces or diversions on the adjacent uplands. Leaving crop residue on the surface or regularly adding livestock waste improves tilth and fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A good management system and protection from flooding are needed to allow for optimum hay production. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, weed control, and timely applications of lime and fertilizer increase the productivity of the pasture or hayland.

The land capability classification is IIw.

**4000—Urban land.** This map unit generally is in level and nearly level areas on high stream benches and

uplands in and around the cities of Maquoketa and Bellevue. Commonly, areas range from 2 to 40 acres in size and are rectangular or irregularly shaped.

This map unit is covered by streets, parking lots, and buildings that so obscure or alter the soils that identification of the soil series is not feasible. In many areas the structures are built on cut or fill material 2 to more than 4 feet thick. Most areas are drained by sewer systems, gutters, and drainage tile.

No land capability classification is assigned.

**5010—Pits, sand and gravel.** This map unit generally consists of open gravel or sand pits on alluvial terraces along the major streams. In a few small areas it is in the uplands. Commonly, areas range from 2 to 100 acres in size and are irregularly shaped.

About 10 to 40 feet of coarse textured material has been removed from the pits, primarily for use in road construction and construction on farmsteads. The pits generally have steep sides. The spoil surrounding the pits varies in texture but generally is sandy or loamy and may have small amounts of gravel. In some areas the spoil has been leveled and smoothed, but in other areas it is very uneven. Some of the pits contain water 2 to more than 20 feet deep.

Some of the pits have been smoothed and seeded to grasses. Rough areas have a dense growth of brush, trees, grasses, and weeds. Some pits can be leveled or shaped and planted to trees. Seedlings may not survive and grow well, however, if the soil material is sandy. As a result, a large number of seedlings should be planted at close intervals. The surviving trees can be thinned later so that the desired stand density is achieved. Supplemental water is needed in droughty areas.

All of the pits are well suited to wildlife habitat. The pits that contain at least 8 feet of water can support fish. Because of the danger associated with the steep sides of the pits and the variable depth of the water, the suitability for recreational uses is somewhat limited. Onsite investigation is needed to determine the suitability of each site.

No land capability classification is assigned.

**5030—Pits, limestone quarries.** This map unit consists of pits from which limestone has been quarried, primarily for use in road construction and as agricultural lime. Commonly, areas range from 5 to 50 acres in size and are irregularly shaped.

The pits are 20 to more than 40 feet deep and have vertical sides. Some contain water 5 to 20 feet deep. The spoil surrounding the pits varies in texture but generally is loamy and has varying amounts of

limestone fragments. It is derived from glacial till, eolian material, or a mixture of these. In some areas the spoil has been leveled and smoothed. Rough areas have a dense growth of brush, trees, grasses, and weeds. In the leveled and smoothed areas, grasses and trees grow reasonably well. The content of organic matter is low in most of these areas. Adding fertilizer, manure, or other organic material improves fertility and tilth.

The spoil surrounding the pits is well suited to wildlife habitat. The pits that contain at least 8 feet of water can support fish. Because of the steep sides of the pits and the variable depth of the water, areas of this unit could be dangerous as sites for recreation and wildlife habitat. Onsite investigation is needed to determine the hazard.

No land capability classification is assigned.

**5040B—Orthents, loamy, 1 to 5 percent slopes.**

These very gently sloping and gently sloping soils are in borrow areas and in cut and fill areas. In some places the original soil has been removed to a depth of 5 to more than 25 feet. In other places the topsoil has been redistributed. The soils range from excessively drained to poorly drained, depending on the kind of material in which they formed. Commonly, areas range from 2 to 20 acres in size and are rectangular or irregularly shaped.

The soil material varies from one area to another, but the upper 60 inches typically is yellowish brown, friable silt loam. In areas where the topsoil has been redistributed, the surface layer may be very dark grayish brown or dark grayish brown.

Included with these soils in mapping are small areas of sandy soils. These included soils are droughty and have a low available water capacity. Also included are some small areas where the overburden has been removed and limestone bedrock is exposed. In these areas establishing vegetation is very difficult. Included areas make up less than 10 percent of the unit.

Permeability varies in the Orthents but generally is moderate to slow. Runoff is slow or medium. Available water capacity is moderate or low. The content of organic matter is very low unless the topsoil has been redistributed. Many areas have been compacted by the equipment used in cutting and filling. Tilth is poor. The supply of available phosphorus and potassium is very low.

Most areas are vegetated with grasses or woody shrubs. Vegetation can be established in smoothed areas if proper seeding or planting techniques are used. Adding fertilizer, manure, or other organic material improves fertility and tilth.

No land capability classification is assigned.

## Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the

criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 64,600 acres in Jackson County, or nearly 16 percent of the total acreage, meets the soil requirements for prime farmland. Nearly all of this prime farmland is used for crops. The crops grown on this land, mainly corn, soybeans, and hay, account for an estimated 15 to 20 percent of the county's total agricultural income each year. Most of the corn grown in the county is fed to livestock.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.



# Use and Management of the Soils

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This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Warren Johnson, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of

land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1987, about 240,000 acres in Jackson County was used for crops, mainly corn, oats, and hay. About 74,000 acres was used for pasture. This acreage included some rotational pasture and hayland used as pasture.

The paragraphs that follow describe the main management concerns in the areas used for crops and pasture.

*Water erosion* is a major concern on more than 80 percent of the cropland in Jackson County. The hazard of erosion is influenced by the slope, the texture and structure of the soil, rainfall, the amount and type of plant cover, and tillage practices. Downs, Dubuque, Fayette, Rozetta, Chelsea, and Nordness are the major soils in the county on which erosion control is needed.

The major kind of erosion in the county is sheet and rill erosion in cropped fields. It occurs when raindrops impact on unprotected soil, causing soil particles to be detached. These particles are then transported in uniform layers when water runs down the slope toward drainageways.

The loss of topsoil through sheet and rill erosion is damaging in many ways. First, productivity is reduced as more and more material from the subsoil is mixed into the topsoil through a combination of erosion and plowing. The subsoil has a higher content of clay than the topsoil, making it more difficult to work, especially if it is wet. It also has a lower content of organic matter, a lower fertility level, and a lower available water capacity. In Dubuque, Nordness, and other soils that are shallow or moderately deep over limestone bedrock, root development becomes even more restricted as topsoil is eroded away.

A second problem associated with sheet and rill erosion is the deposition of sediment into drainageways. The sediment can damage grassed waterways, fill ponds and ditches along public roads, clog river channels used for navigation, and destroy fish and wildlife habitat. Soil conservation practices that minimize sheet and rill erosion reduce the amount of sedimentation in rivers and streams and thus improve the quality of water for municipal use, for recreation, and for fish and wildlife.

A third problem associated with sheet and rill erosion is the pollution of water by fertilizer and pesticides. Many agricultural chemicals that are applied to cropped fields attach to soil particles. As the soil erodes, these chemicals are carried into ponds, streams, and rivers. Soil conservation practices that control sheet and rill erosion reduce this hazard.

Many soil conservation practices can be used to control sheet and rill erosion. The most effective practices are those that leave a protective plant cover on the surface to lessen the impact of raindrops.

A conservation tillage system that leaves a protective amount of crop residue on the surface can be effective in controlling sheet and rill erosion. To be effective, at least 30 percent of the surface should be covered after planting. This amount can be achieved by a chisel-disk or disk-plant tillage system. Soil-saving benefits increase as the percentage of coverage increases. In an area where a system of no-till farming is applied, less than 10 percent of the surface is disturbed and normally 50 to 90 percent of the surface is covered with residue. The cover of residue is effective in controlling sheet and rill erosion. A conservation tillage system is best suited to well drained soils, such as Tama, Downs, and Fayette soils.

Crop rotations that include grasses and legumes are effective in controlling erosion because they maintain a protective plant cover approximately half of the time. A typical crop rotation includes 2 or 3 years of corn, 1 year of oats, and 2 or 3 years of hay. On soils that have a slope of more than 14 percent, fewer years of corn and more years of hay are needed in the rotation. Legumes provide nitrogen and improve tilth for the following crop. Generally, corn yields are higher when the previous crop was alfalfa rather than corn. Crop rotations are best suited to deep, well drained soils, such as Fayette, Downs, and Tama soils.

Crop rotations are especially effective in controlling erosion if used in conjunction with contour stripcropping. Alternating strips of row crops and hay provide the same benefits as a crop rotation. Also, the strips of hay slow runoff and filter sediment from the adjacent strips of row crops. Contour stripcropping is best suited to soils with long, uniform slopes, such as Downs and

Tama soils and some Fayette soils (fig. 11).

Contour farming involves soil preparation, planting, and cultivating crops along the natural contour of the land. This practice should be used on all sloping cropland. It is most effective on slopes of 9 percent or less. It works well in combination with other practices, such as conservation tillage, stripcropping, and terracing.

Terracing reduces the hazard of sheet erosion by shortening the length of slopes. Because of the slope length and topography, terraces generally are more frequently used to control gully erosion than to control sheet and rill erosion in Jackson County. On some soils, such as Tama and Downs soils, however, terraces are effective in controlling sheet erosion. Fayette soils are well suited to terraces. Because of short, steep slopes, the terraces on these soils control runoff and gully erosion rather than sheet erosion. Moderately deep soils, such as Dubuque and NewGlarus soils, can be terraced, but care must be taken in selecting borrow areas so that the underlying bedrock is not exposed.

The use of soils for pasture is an excellent soil conservation practice. The deep, well drained soils produce excellent forage yields if managed properly. Good pasture management includes the establishment of high-yielding forage species, applications of fertilizer based on soil tests, rotation grazing, weed and brush control, proper stocking rates, and adequate watering facilities. Erosion can occur if the pasture is overgrazed or if the plant cover is destroyed when the pasture is renovated. Gully erosion can be severe in heavily grazed areas where livestock create paths up and down steep slopes.

Gully erosion is a hazard in unvegetated drainageways and in areas where runoff from cropped fields drops into steeper pasture or woodland. Gully erosion is less damaging to the productive soil resource than sheet erosion because it accounts for fewer tons of soil loss. It can restrict fieldwork on cropland, can cause a safety hazard, and can cause sedimentation in downstream areas. Grassed waterways, grade stabilization structures, terraces, water- and sediment-control basins, and ponds help to control gully erosion.

Grassed waterways are most effective in areas where sheet erosion is controlled above the waterway. Excessive sheet erosion can silt in the waterway, and the chemicals commonly carried with the sediment can destroy the protective grass. Grassed waterways require stable outlets.

Grade stabilization structures, which require earthfill, should be located in areas where borrow material can be obtained without exposing the underlying bedrock.

Ponds can control gully erosion effectively if permanent

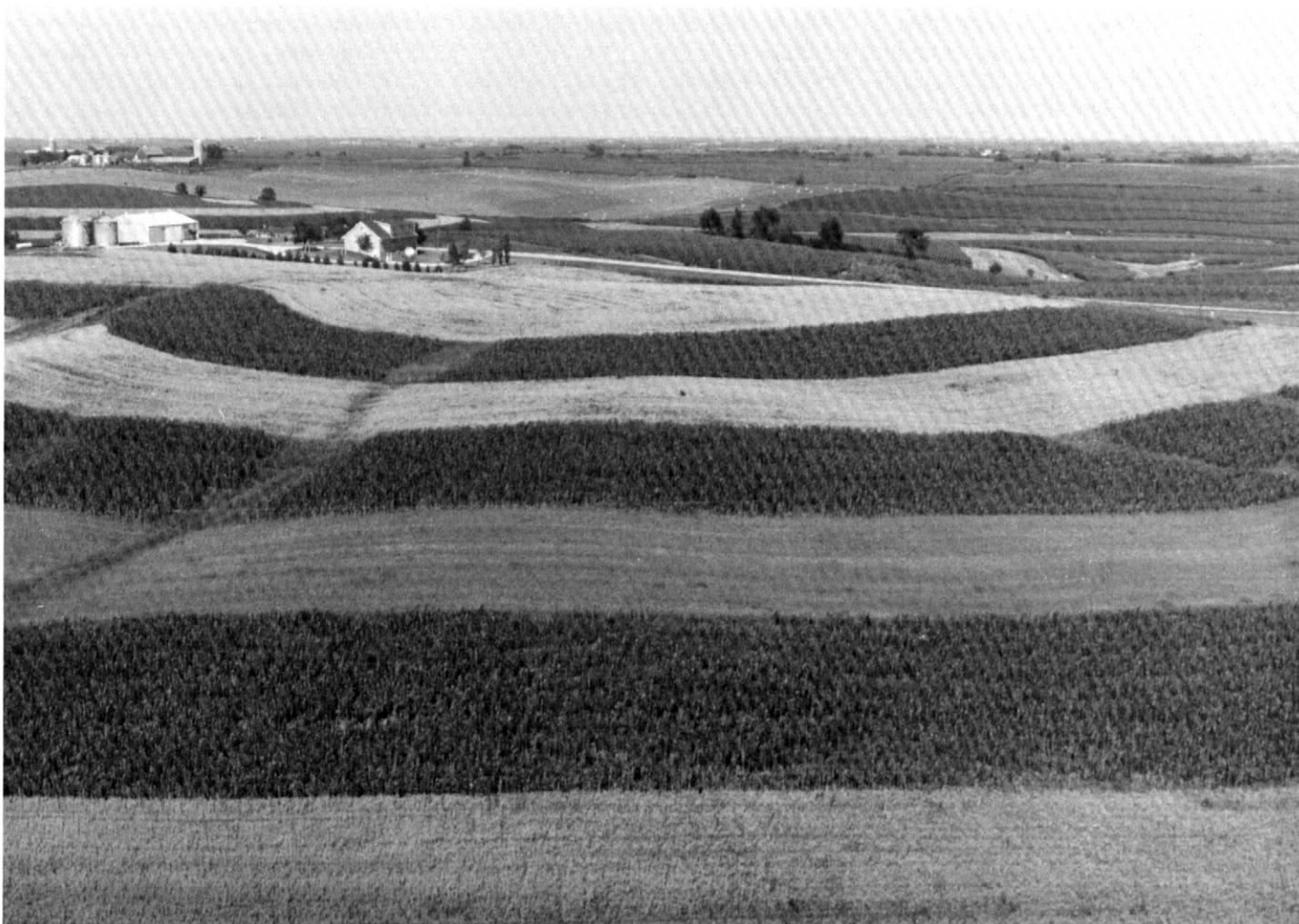


Figure 11.—Contour stripcropping in an area of Downs silt loam, 9 to 14 percent slopes, moderately eroded.

water levels can be maintained. Many ponds constructed in areas of Fayette and Dubuque soils do not hold water effectively because of seepage through the soils and into the underlying limestone bedrock. Rozetta and Derinda soils are well suited to ponds because of a good available water capacity in the shale parent material and the common occurrence of seeps and springs.

*Wind erosion* is a hazard in the county, especially on sandy soils, such as Chelsea, Lamont, and Sparta soils. It can be minimized by maintaining a plant cover, leaving crop residue on the surface, and using a tillage method that leaves the surface rough.

*Drainage* is a minor management concern in Jackson County. Very poorly drained to somewhat poorly drained soils make up less than 10 percent of the total acreage. In most years a drainage system is needed to

permit timely fieldwork on moderately well drained soils, such as Rozetta, Derinda, and Newvienna soils.

The design of both surface and subsurface drainage systems varies with the kind of soil. Surface drains and measures that control runoff from the higher elevations are needed in most areas of the somewhat poorly drained and poorly drained soils that are used for intensive row cropping. In general, subsurface drains should be spaced closer together in moderately slowly permeable soils than in moderately permeable soils.

*Fertility* is affected by the supply of available phosphorus and potassium in the subsoil, by soil reaction, and by the content of organic matter in the surface layer. The supply of available phosphorus and potassium is low or very low in most of the soils in the county. Fayette soils, however, have an ample supply of available phosphorus.

Most of the upland soils have an acid subsoil. Generally, applications of ground limestone are needed on these soils to raise the pH level sufficiently for alfalfa and other crops to grow well.

The content of organic matter in the surface layer of most of the medium textured, well drained soils that formed under forest vegetation in the uplands, such as Fayette soils, is about 1 to 2 percent. In the eroded soils, however, it generally is less than 1 percent. It is about 2 to 3 percent in the medium textured, well drained soils that formed under prairie grasses and deciduous trees, such as Downs soils. It is about 3 to 4 percent in the medium textured soils that formed under prairie grasses, such as Tama soils. Generally, it is less than 2 percent in the coarse textured upland soils, such as Chelsea soils, and is 6 to 7 percent in the poorly drained upland soils, such as Garwin soils.

The soils that formed in alluvium on bottom land, such as Caneek and Otter soils, are generally neutral or mildly alkaline. They generally have a low or very low supply of available phosphorus and potassium in the subsoil. The content of organic matter generally is less than 1 percent in the surface layer of the Caneek soils and 6 to 7 percent in the surface layer of the Otter soils.

Applications of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of lime and fertilizer that should be applied.

*Tilth* is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth generally have a high content of organic matter and are granular and porous.

Most of the upland soils in the county have a light colored surface layer that has a moderately low or low content of organic matter. Generally, the surface layer has weak structure and crusts during periods of intense rainfall. The crust is hard when dry. It reduces the rate of water infiltration and increases the runoff rate. Leaving crop residue on the surface or regularly adding livestock waste minimizes crusting and increases the rate of water infiltration.

Fall plowing generally is not desirable in the county because it increases the hazard of wind erosion. It also increases the hazard of water erosion during periods of snowmelt and during spring rains.

Several legumes and cool- and warm-season grasses are suited to the soils and climate in Jackson County. Most of the permanent pastures in the county support bluegrass or bromegrass. Other cool-season grasses that are well adapted to the county include orchardgrass, timothy, and reed canarygrass.

Alfalfa is the most common legume grown for hay. It also is grown for pasture in mixtures with orchardgrass,

bromegrass, or timothy. Other legumes that are adapted to the county include crownvetch, ladino, alsike clover, and red clover.

Warm-season grasses that are adapted to the county include switchgrass, big bluestem, little bluestem, and indiagrass. These grasses grow well during the summer, but they require special management.

Good grazing management is necessary for high production of all pasture species. On steeply sloping soils preventing surface compaction and gully erosion is especially important. Proper management includes applications of fertilizer, weed and brush control, rotation or deferred grazing, proper stocking rates, and adequate watering facilities for livestock.

If cultivated crops are grown before forage crops are seeded, soil losses can be reduced by conservation tillage, contour farming, and grassed waterways. Interseeding grasses and legumes into the existing sod eliminates the need for removing the plant cover during seedbed preparation.

Many pastured areas in the county have steep, irregular topography. Commonly, they have rock outcrops. They are dominated by Fayette, Dubuque, and Nordness soils and rock outcrop. The rough terrain makes pasture management difficult or impossible. Many areas have an extensive forest cover. Control of multiflora rose and other brush species can be a problem, especially if stocking rates are excessive.

### **Yields Per Acre**

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure,

and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

### Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

### Woodland Management and Productivity

Steve Swinonos, district forester, Iowa Department of Natural Resources, helped prepare this section.

About 57,600 acres in the county, or 14 percent of the total acreage, is woodland. The trees are used for firewood or wood products, which are either sold commercially or used on the farm. Woodland helps to control erosion and provides habitat for wildlife.

Trees formerly covered most of Jackson County, except for the areas between Nashville and Maquoketa and between Preston and Miles. These areas were covered dominantly by prairie grasses. Woodland was highly valued by the early settlers, who used the trees for building material and fuel. Wood was especially valuable as fuel for the lime kilns at Hurstville and for the steamboats that traveled the Mississippi River. Only the best trees were harvested. Gradually, the less desirable trees dominated the woodland and reduced its economic value. Some areas of the wooded soils, notably Dubuque, Fayette, Lindley, and Rozetta soils, were cleared for farming. Many of the cleared areas are now moderately or severely eroded and should be replanted to suitable trees.

Because of the extensive harvesting of trees in the late 1880's, it is doubtful that any native woodland still exists in the county. The older stands of trees can be

kept relatively productive by good management practices, which can include protecting the woodland from fire, limiting access to livestock, group selection and clear-cut harvesting, thinning, planting, and weeding. Many of the wooded tracts that have been used for grazing have been poorly managed. Grazing can damage a wooded area as much as overcutting or burning. The livestock trample the soil and cause excessive erosion. Their browsing damages or kills young trees and undergrowth. Wooded areas that are used for grazing generally do not provide enough forage to be desirable as pasture.

The present pattern of tree cover in the county can be related to the eight associations described under the heading "General Soil Map Units." The largest proportion of woodland is in the Fayette-Nordness-Rock outcrop association. In the other associations there are many woodlots, trees bordering drainageways and streams, and trees in fence rows and on farmsteads. Soils in many wooded areas of the Fayette-Nordness-Rock outcrop association are steep or very steep and are shallow to limestone bedrock. As a result, they are unsuitable for cultivation. Many areas of cropland in the county have a border of woods, and some trees grow in most pastured areas. Many of the steep or very steep areas bordering the North Fork of the Maquoketa River and the Maquoketa and Mississippi Rivers are not suited to pasture. In these areas the trees are extremely important in controlling erosion.

There is a good demand in Jackson County for oak and walnut logs and for other trees for lumber. Most of the sawmills in the county are operated on a part-time basis. Several mills and forest product industries, however, operate on a full-time basis. The logs for the sawmills are generally obtained by selective cutting on a number of sites rather than by harvesting an entire tract.

The management of a wooded area depends on its present condition and on the kinds of trees to be grown. The objective in woodland management is to attain sustained production by cutting the same amount of wood as the stand is producing in yearly growth. This cutting can be done each year or every 5 to 10 years. Some woodlands are of such poor quality that the best procedure is to convert them from poor-quality hardwoods to more valuable species, such as oak, walnut, and ash. Competition from undesirable species of trees and from shrubs and weeds should be controlled by mowing and spraying.

Soils differ in their suitability for woodland. The factors that affect the suitability for trees are somewhat different from those that affect the suitability for cultivated crops. Also, they are less restrictive.

Moisture, aspect, soil reaction, and fertility are important management factors.

The ability of the soil to supply moisture is directly related to the growth of trees. The available water capacity of any soil depends largely on the slope, the effective rooting depth, texture, permeability, and internal drainage. Chelsea, Nordness, and Sparta are examples of soils that have a low available water capacity.

Aspect is the direction in which a slope faces. There is a definite relationship between aspect and the rate of tree growth. Trees generally grow better on slopes that face north and east, on gently sloping or nearly level valley flats, and on broad ridgetops than on slopes that face south or west. Long, steep slopes that have various exposures are typical in areas of Fayette and Nordness soils and the Nordness-Rock outcrop complex.

Soil reaction and fertility influence the growth of different species of trees. For example, walnut and locust trees grow best on neutral or slightly calcareous soils. Pine requires a slightly acid soil. Most species of pine, especially the native species, grow poorly on soils that have a high content of lime. Hardwoods, however, commonly grow well on those soils. Eastern redcedar also is tolerant of lime. Caneek and Dorchester soils have excessive lime to a depth of 2 or 3 feet. Most of the other soils on bottom land in Jackson County are neutral. Hardwoods should not be planted on eroded or depleted soils and generally grow poorly on formerly cultivated soils. Pine, however, grows fairly well on those soils.

Several agencies in Iowa assist woodland owners in improving and marketing their wood products. The Soil Conservation Service can help woodland owners to determine which soils are suitable for trees and what conservation treatment is needed. State foresters can assist in developing plans for managing new or old stands of trees.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a

letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *R*, *X*, *W*, *T*, *D*, *C*, *S*, and *F*.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

*Erosion hazard* is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

*Equipment limitation* reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

*Seedling mortality* refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality

is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

*Windthrow hazard* is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

*Trees to plant* are those that are suitable for commercial wood production.

## Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, reduce

energy requirements, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

## Recreation

Many parks and recreation areas that provide opportunities for camping, picnicking, and hiking are throughout the county. The Maquoketa Caves State Park (fig. 12) is northwest of Maquoketa. Bellevue State Park overlooks the Mississippi River directly south of Bellevue. Most of the communities in the county have at least one park.

The county has several wildlife preserves and nature areas. These include the Buzzard Ridge Wildlife Area east of Canton and the Upper Mississippi River Wildlife and Fish Refuge near Green Island.

Many of the rural areas provide opportunities for hunting and fishing. Areas along the Mississippi River provide many opportunities for waterskiing and boating.

In many areas of the county, small creeks are spring fed and are cold enough to be stocked with trout. These streams include Brush Creek, Mill Creek, and Little Mill Creek. Trees and limestone bluffs line many of the creeks and rivers. In the fall the colorful leaves of the trees attract many tourists.

The deep valleys and hilly areas in the county provide excellent opportunities for downhill and cross-country skiing and for snowmobiling. A few county parks include cross-country skiing trails.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic

quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than



Figure 12.—One of the many caves in the Maquoketa Caves State Park.

once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

### Wildlife Habitat

Bob Sheets, wildlife biologist, Iowa Department of Natural Resources, helped prepare this section.

Jackson County has a unique combination of wildlife species and associated habitat. Its topography varies from landscapes dominated by limestone bluffs and rock outcrops in the northern part of the county to rolling farmland in the southern part. Well managed woodland in the northern part supports stable numbers

of ruffed grouse, whitetail deer, reestablished wild turkey flocks, squirrel, raccoon, fox, several species of weasel, about 14 species of migrant and resident hawks and owls, and 11 species of songbirds.

Excessive grazing of woodland and timber harvesting have reduced the carrying capacity for forest wildlife in the county. The forest understory, however, has been protected on several well distributed tracts throughout the county. Protection measures include boundary fencing, reforestation, state and county acquisition, and tax incentives offered under provisions of the Forest Reserve Law and the Iowa Wildlands Tax Exemption Bill. In the future the forested areas will likely have a dense understory.

One unique wildlife species that illustrates the value of protected forests is the bobcat. A few well documented sightings of bobcats occurred in the early 1980's. Although they are rare, they still occur in the "semiwilderness" regions in the extreme east and west parts of the county.

The Maquoketa River and the North Fork of the Maquoketa River provide many miles of travel lanes for

the more mobile wildlife species, such as deer, turkey, fox, and coyote. These rivers, combined with the many backwater lakes along the Mississippi River, support reliable populations of 15 to 20 species of fish, including catfish, smallmouth bass, largemouth bass, bluegill, crappie, and walleye.

Upland game populations, including those of pheasant and quail, seriously declined during the late 1970's and early 1980's. The conversion of marginal farmland to areas that are row cropped year after year eliminated many acres of nesting cover. The loss of hayland has seriously limited the habitat for all ground-nesting birds. A low breeding population of pheasants persists. Bobwhite quail is becoming extremely difficult to locate in any region of the county. Hungarian partridge, which is a winter-hardy species, is increasing in number and distribution. It now inhabits every township in the county.

About 5,500 acres of parks and wildlife areas managed by the state and county is on uplands in Jackson County. This acreage, however, is not sufficient to supply the habitat needed for stable wildlife populations throughout the county. The future for wildlife lies with the private landowner. The best solution to declining populations is maintaining good crop diversity, which can offer better food, cover, and habitat for most species.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that

limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

*Coniferous plants* furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites.

Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same, or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

### Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil

properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established

and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of calcium carbonate affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

### Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the

surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid.

Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

### Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs

in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the

borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

### Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment (fig. 13). Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against



Figure 13.—A pond in an area of Rozetta soils.

overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to

seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

*Aquifer-fed excavated ponds* are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a

permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 14). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than

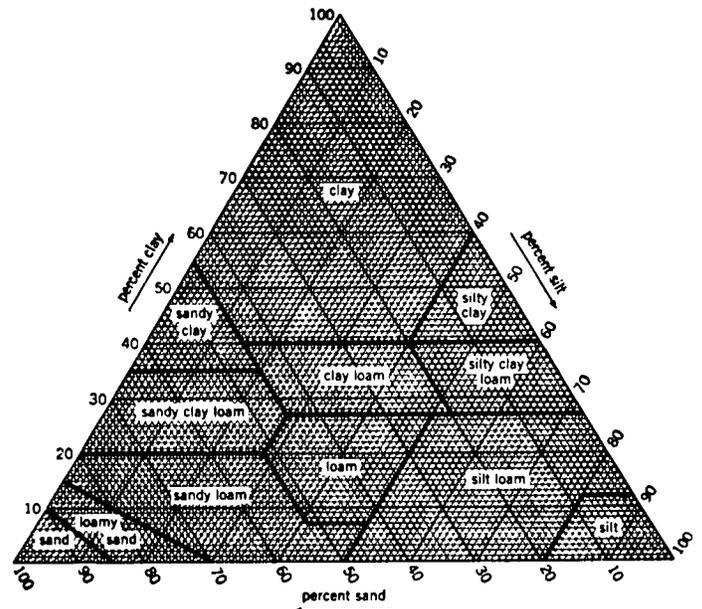


Figure 14.—Percentages of sand, clay, and silt in the basic USDA soil textural classes.

sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

*Classification* of the soils is determined according to the Unified soil classification system (4) and the system adopted by the American Association of State Highway and Transportation Officials (3).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to

those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit and plasticity index (Atterberg limits)* indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at  $\frac{1}{3}$  bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume

change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive

measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

## Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These

soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water

in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field

capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed

as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.



# Classification of the Soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (23). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

**ORDER.** Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *quolls*, the suborder of the Mollisols that has an aquic moisture regime).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

**FAMILY.** Families are established within a subgroup

on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Haplaquolls.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (22). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (23). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

### Arenzville Series

The Arenzville series consists of moderately well drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in stratified, silty recent alluvium 20 to 40 inches deep

over an older buried soil (fig. 15). The native vegetation was deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Arenzville silt loam, 0 to 2 percent slopes, in a permanent pasture; 140 feet west and 220 feet north of the southeast corner of sec. 30, T. 84 N., R. 3 E.

A—0 to 12 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) and light brownish gray (10YR 6/2) dry; few thin light yellowish brown (10YR 6/4) lamellae; massive but parts to moderate medium platy fragments; friable; common very fine roots; strongly acid; clear smooth boundary.

C—12 to 32 inches; stratified very dark grayish brown (10YR 3/2), brown (10YR 5/3), and grayish brown (10YR 5/2) silt loam; few fine distinct strong brown (7.5YR 4/6) and yellowish red (5YR 5/8) mottles in the lower part; appears massive but parts to weak thin to thick platy fragments; friable; neutral; abrupt wavy boundary.

Ab—32 to 60 inches; black (10YR 2/1) silt loam; weak fine and medium subangular blocky structure parting to weak fine granular; friable; neutral.

Depth to the Ab horizon ranges from 20 to 40 inches. The content of clay ranges from 10 to 18 percent in the 10- to 40-inch control section. The color, arrangement, and thickness of all horizons vary because of the source of the sediment and the method of deposition.

The A or Ap horizon has value of 3 to 5 and chroma of 2 to 4. The C horizon has value of 3 to 6 and chroma of 2 or 3. It typically is silt loam, but some pedons have thin strata of silt or sand. The Ab horizon has value of 2 or 3 and chroma of 1 or 2. It typically is silt loam, but in some pedons it is silty clay loam.

### Atterberry Series

The Atterberry series consists of somewhat poorly drained, moderately permeable soils on uplands and high stream benches. These soils formed in loess. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Atterberry silt loam, benches, 0 to 2 percent slopes, in a cultivated field; 1,960 feet west and 520 feet north of the center of sec. 29, T. 84 N., R. 5 E.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; common very fine roots; neutral; abrupt smooth boundary.

E—9 to 17 inches; dark grayish brown (10YR 4/2) silt



Figure 15.—Profile of Arenzville silt loam, 0 to 2 percent slopes. Stratified recent alluvium is about 32 inches deep over a dark buried surface horizon. Depth is marked in feet.

loam, light brownish gray (10YR 6/2) dry; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak medium and thin platy structure parting to weak fine and very fine subangular blocky; friable; few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; common very fine roots; slightly acid; clear smooth boundary.

Bt—17 to 23 inches; brown (10YR 5/3) silty clay loam; common fine distinct strong brown (7.5YR 5/6) and few fine faint light brownish gray (10YR 6/2) mottles; moderate fine and very fine subangular blocky structure; friable; common faint dark grayish brown (10YR 4/2) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Btg1—23 to 33 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; common distinct grayish brown (10YR 5/2) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Btg2—33 to 45 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine and medium prominent strong brown (7.5YR 4/6) and few fine prominent dark reddish brown (5YR 3/4) mottles; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; common distinct grayish brown (10YR 5/2) clay films on faces of peds and few distinct very dark gray (10YR 3/1) clay films in root channels; very few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

BCg—45 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common fine and medium prominent strong brown (7.5YR 4/6) and few fine prominent dark reddish brown (5YR 3/4) mottles; weak medium prismatic structure; friable; few distinct very dark gray (10YR 3/1) clay films in root channels; few very fine roots; few dark concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 40 to more than 60 inches. The Ap horizon ranges from 6 to 9 inches in thickness. It has value of 2 or 3 and chroma of 1 or 2. The E horizon is 4 to 8 inches thick. The Bt and Btg horizons have hue of 10YR or 2.5Y, value of 4

to 6, and chroma of 2 to 4. The BCg horizon typically is silt loam, but in some pedons it is loam.

## Billett Series

The Billett series consists of well drained, moderately rapidly permeable soils on upland ridges and side slopes, high stream benches, and stream terraces. These soils formed in sandy and loamy material that was deposited mainly by the wind. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Billett sandy loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 200 feet west and 1,340 feet south of the center of sec. 15, T. 84 N., R. 5 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; few streaks and pockets of dark yellowish brown (10YR 4/4) material; common distinct very dark brown (10YR 2/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate medium granular; friable; few very fine roots; neutral; clear smooth boundary.

Bt1—8 to 15 inches; dark yellowish brown (10YR 4/4) sandy loam; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; gradual smooth boundary.

Bt2—15 to 23 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; gradual smooth boundary.

Bt3—23 to 32 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; very friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; gradual smooth boundary.

BC—32 to 40 inches; yellowish brown (10YR 5/6) loamy sand; weak medium subangular blocky structure parting to single grain; very friable; few distinct brown (10YR 4/3) clay films on faces of peds; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; brown (7.5YR 4/4) loamy sand lamellae, 0.5 inch thick, at depths of 47 and 54 inches, and very pale brown (10YR 7/4) sand lamellae, 0.5 inch thick, at depths of 48 and 58 inches; neutral.

The thickness of the solum ranges from 30 to more than 60 inches. The Ap horizon has value of 2 or 3 and chroma of 1 to 3. The Bt, BC, and C horizons have value and chroma of 4 to 6. The C horizon is loamy sand or sand. In some pedons it has no lamellae.

### Caneek Series

The Caneek series consists of poorly drained, moderately permeable soils on bottom land. These soils formed in calcareous, silty alluvium over an older buried soil. The native vegetation was deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Caneek silt loam, 0 to 2 percent slopes, in a permanent pasture; 300 feet west and 440 feet south of the northeast corner of sec. 23, T. 86 N., R. 4 E.

- Ap—0 to 4 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; many fine distinct strong brown (7.5YR 4/6) mottles; appears massive but parts to moderate medium and thin platy fragments; friable; common very fine roots; very slight effervescence; moderately alkaline; gradual smooth boundary.
- Cg1—4 to 14 inches; stratified dark grayish brown (2.5Y 4/2), grayish brown (10YR 5/2), and very dark grayish brown (10YR 3/2) silt loam; many fine distinct strong brown (7.5YR 4/6) mottles; moderate medium and thin platy structure, which is the result of deposition; friable; common very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.
- Cg2—14 to 28 inches; stratified grayish brown (2.5Y 5/2), dark grayish brown (10YR 4/2), and brown (10YR 5/3) silt loam; common fine distinct strong brown (7.5YR 5/6), few medium distinct dark gray (10YR 4/1), and few fine distinct dark brown (7.5YR 3/4) mottles; appears massive but parts to moderate medium and thin platy fragments; friable; few very fine roots; few dark concretions (iron and manganese oxide); very slight effervescence; few dark organic fillings in root channels; mildly alkaline; gradual smooth boundary.
- 2Ab1—28 to 48 inches; black (10YR 2/1) silt loam; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; neutral; clear smooth boundary.
- 2Ab2—48 to 60 inches; very dark gray (10YR 3/1) silt loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; friable; few very fine roots; neutral.

Depth to the 2Ab horizon ranges from 20 to 40 inches. The 10- to 40-inch control section ranges from 18 to 26 percent clay.

The Ap or A horizon typically has value of 4 or 5 and chroma of 2 or 3. In some pedons, however, it has strata with value of 3 and chroma of 2. The C horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 to 3. It has mottles with hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 1 to 6. It typically is silt loam, but in some pedons it has thin strata of silt or sand. The 2Ab horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is silt loam or silty clay loam.

### Canoe Series

The Canoe series consists of somewhat poorly drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Canoe silt loam, 0 to 2 percent slopes, in a cultivated field; 1,000 feet west and 640 feet north of the center of sec. 32, T. 84 N., R. 3 E.

- Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few very fine roots; slightly acid; clear smooth boundary.
- E—9 to 17 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few distinct dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak medium platy structure parting to moderate very fine subangular blocky; friable; few very fine roots; medium acid; clear smooth boundary.
- BE—17 to 22 inches; brown (10YR 5/3) silt loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few very fine roots; strongly acid; gradual smooth boundary.
- Btg1—22 to 32 inches; grayish brown (10YR 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few distinct dark grayish brown (2.5Y 4/2) clay films and light gray (2.5Y 7/2 dry) silt coatings on faces of peds; few very fine roots; strongly acid; gradual smooth boundary.
- Btg2—32 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium prominent strong

brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; many faint grayish brown (2.5Y 5/2) clay films and light gray (2.5Y 7/2 dry) silt coatings on faces of peds; few very fine roots; strongly acid; gradual smooth boundary.

BC—42 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; friable; few faint grayish brown (2.5Y 5/2) clay films and very few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; slightly acid.

The thickness of the solum ranges from 40 to 70 inches. The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5. The Btg and BC horizons are silty clay loam or silt loam. They have hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2 or 3.

### Chaseburg Series

The Chaseburg series consists of well drained, moderately permeable soils on bottom land, on alluvial fans, and in upland drainageways. These soils formed in stratified, silty alluvium. The native vegetation was deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Chaseburg silt loam, 0 to 2 percent slopes, in a permanent pasture; 1,700 feet north and 520 feet east of the center of sec. 4, T. 84 N., R. 4 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common very fine roots; neutral; gradual smooth boundary.

C1—9 to 26 inches; dark grayish brown (10YR 4/2) silt loam; thin brown (10YR 4/3 and 5/3), pale brown (10YR 6/3), and very dark grayish brown (10YR 3/2) strata; appears massive but parts to weak thin and medium platy fragments; friable; common very fine roots; neutral; gradual smooth boundary.

C2—26 to 46 inches; dark grayish brown (10YR 4/2) silt loam; thin brown (10YR 4/3) and very dark grayish brown (10YR 3/2) strata; appears massive but parts to weak very thin, thin, and medium platy fragments; friable; common very fine roots; 1-inch stratum of yellowish brown (10YR 5/4) sand at a depth of about 29 inches; neutral; gradual smooth boundary.

C3—46 to 60 inches; dark grayish brown (10YR 4/2) silt loam; thin brown (10YR 4/3), pale brown (10YR 6/3), and very dark grayish brown (10YR 3/2) strata; appears massive but parts to weak medium platy fragments; friable; neutral.

The color, arrangement, and thickness of all horizons vary because of the source of the parent material and the method of deposition. The 10- to 40-inch control section ranges from 10 to 18 percent clay.

The Ap horizon has value of 4 or 5. The A horizon, if it occurs, is very dark grayish brown (10YR 3/2) silt loam less than 6 inches thick. The C horizon has value of 3 to 6 and chroma of 2 to 4. It typically is silt loam, but in some pedons it has thin strata of silt or sand. Some pedons have a buried soil below a depth of 40 inches.

### Chelsea Series

The Chelsea series consists of excessively drained, rapidly permeable soils on upland ridges and side slopes, high stream benches, and stream terraces. These soils formed dominantly in sandy wind-deposited material. The native vegetation was deciduous trees. Slopes range from 2 to 40 percent.

Typical pedon of Chelsea loamy sand, 14 to 30 percent slopes, in a permanent pasture; 500 feet south and 940 feet west of the northeast corner of sec. 13, T. 84 N., R. 1 E.

A—0 to 6 inches; very dark gray (10YR 3/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; common very fine roots; medium acid; clear smooth boundary.

E1—6 to 12 inches; brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; dark brown (10YR 3/3) organic coatings on faces of peds; weak fine and medium granular structure parting to single grain; very friable; few very fine roots; strongly acid; clear smooth boundary.

E2—12 to 18 inches; brown (10YR 5/3) loamy sand, very pale brown (10YR 7/3) dry; brown (10YR 4/3) organic coatings on faces of peds; weak medium granular structure parting to single grain; very friable; few very fine roots; strongly acid; gradual smooth boundary.

E3—18 to 28 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) loamy sand, very pale brown (10YR 7/3) dry; single grain; loose; few very fine roots; strongly acid; gradual smooth boundary.

E&Bt—28 to 60 inches; brown (10YR 5/3) and light yellowish brown (10YR 6/4) sand; single grain; loose; few very fine roots; brown (7.5YR 4/4) sandy loam lamellae (Bt) 0.5 inch thick at a depth of 29 inches, 0.25 inch thick at a depth of 31 inches, 2 inches thick at a depth of 39 inches, 1.25 inches thick at a depth of 41 inches, and 1 inch thick at a depth of 52 inches; strongly acid.

The thickness of the solum ranges from 48 to more than 60 inches. The A horizon has chroma of 1 or 2. Some pedons have an Ap horizon, which has value of 4 and chroma of 2 or 3. The E horizon has value of 4 to 6 and chroma of 3 to 6. The E&Bt horizon has thin lamellae that have hue of 7.5YR or 10YR and value and chroma of 3 or 4. The lamellae are sandy loam or loamy sand. Depth to the uppermost lamella is 27 to 46 inches. The total thickness of the lamellae is less than 6 inches. The E horizon and the E part of the E&Bt horizon are loamy sand, fine sand, or sand.

### Colo Series

The Colo series consists of poorly drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in silty alluvial deposits. The native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in a cultivated field on a flood plain; 2,050 feet west and 1,340 feet north of the southeast corner of sec. 31, T. 84 N., R. 6 E.

- Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; neutral; clear smooth boundary.
- A1—6 to 11 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak fine granular; few very fine roots; friable; slightly acid; gradual smooth boundary.
- A2—11 to 18 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; firm; neutral; gradual smooth boundary.
- A3—18 to 26 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate medium subangular blocky structure; firm; neutral; clear smooth boundary.
- A4—26 to 37 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine prismatic structure parting to moderate fine subangular blocky; firm; sheen on faces of peds; neutral; gradual smooth boundary.
- Btg—37 to 46 inches; dark gray (10YR 4/1) silty clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; firm; few distinct very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear smooth boundary.
- BC—46 to 55 inches; dark gray (10YR 4/1) and light brownish gray (2.5Y 6/2) silt loam; few fine distinct strong brown (7.5YR 4/6) mottles; weak fine

prismatic structure parting to moderate fine subangular blocky; firm; few distinct very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear smooth boundary.

Cg—55 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common fine and medium distinct strong brown (7.5YR 4/6 and 5/6) mottles; massive; firm; few dark gray (10YR 4/1) root channel fillings; neutral.

The thickness of the solum ranges from 36 to 60 inches. Typically, the Ap horizon has value of 2 or 3 and chroma of 1 to 3. The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The content of clay in the A horizon generally ranges from 30 to 35 percent. Some pedons have overwash of silt loam in which the content of clay is 18 to 25 percent. The combined thickness of the A horizons is 30 to 40 inches. The Btg horizon has value of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 or less. It is silt loam or silty clay loam.

### Coppock Series

The Coppock series consists of poorly drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Coppock silt loam, 0 to 2 percent slopes, in a permanent pasture; 740 feet north and 240 feet west of the southeast corner of sec. 6, T. 85 N., R. 3 E.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of light brownish gray (10YR 6/2) subsurface material in the lower part; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; neutral; clear smooth boundary.
- E1—8 to 16 inches; light brownish gray (10YR 6/2) silt loam, white (10YR 8/2) dry; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine distinct strong brown (7.5YR 5/6) mottles; weak thin platy structure; friable; few distinct grayish brown (10YR 5/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.
- E2—16 to 23 inches; light brownish gray (10YR 6/2) silt loam, white (10YR 8/2) dry; common fine distinct strong brown (7.5YR 5/6) mottles; weak thin platy structure parting to weak fine subangular blocky;

friable; few distinct grayish brown (10YR 5/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.

BE—23 to 28 inches; light brownish gray (10YR 6/2) silt loam; common fine distinct strong brown (7.5YR 5/6 and 4/6) mottles; moderate fine subangular blocky structure; friable; few distinct grayish brown (10YR 5/2) clay films and common distinct white (10YR 8/1 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Btg1—28 to 38 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6 and 4/6) mottles; weak fine prismatic structure parting to moderate medium and fine subangular blocky; friable; few distinct grayish brown (10YR 5/2) clay films and common distinct white (10YR 8/1 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Btg2—38 to 52 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6 and 4/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; friable; few distinct grayish brown (10YR 5/2) clay films and white (10YR 8/1 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

BCg—52 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct strong brown (7.5YR 5/6 and 4/6) mottles; weak coarse prismatic structure; few distinct grayish brown (10YR 5/2) clay films and white (10YR 8/1 dry) silt coatings on faces of peds; few concretions (iron and manganese oxide); strongly acid.

The thickness of the solum ranges from 40 to 70 inches. The Ap or A horizon has chroma of 1 or 2. The E horizon has value of 4 to 6 and chroma of 1 or 2. The Btg and BCg horizons have hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 1 or 2.

### Derinda Series

The Derinda series consists of moderately deep, moderately well drained soils on upland side slopes and head slopes. These soils formed in 15 to 30 inches of loess and in the underlying weathered shale bedrock. The native vegetation was deciduous trees. Permeability is moderate in the upper part of the solum and slow in the lower part. It is very slow below the

solum. Slopes range from 14 to 25 percent.

Typical pedon of Derinda silt loam, in a pastured area of Rozetta-Derinda silt loams, 14 to 18 percent slopes, moderately eroded; 820 feet north and 260 feet west of the center of sec. 23, T. 87 N., R. 4 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; mixed with some streaks and pockets of yellowish brown (10YR 5/4) subsoil material; few distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; weak medium platy structure parting to weak fine subangular blocky; friable; common very fine roots; medium acid; clear smooth boundary.

Bt1—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine and very fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common very fine roots; medium acid; gradual smooth boundary.

Bt2—14 to 20 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and very fine angular and subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

2Bt3—20 to 27 inches; yellowish brown (10YR 5/4) silty clay; few fine distinct light yellowish brown (2.5Y 6/4) and strong brown (7.5YR 4/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; clear wavy boundary.

2Cr—27 to 60 inches; pale olive (5Y 6/3) clay shale; few fine prominent olive yellow (2.5Y 6/6) mottles; appears massive but has some vertical cleavage planes; very firm; few brown (10YR 4/3) accumulations of clay; about 5 percent chert and limestone fragments 1 to 2 centimeters in size; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The Ap horizon has chroma of 2 or 3. It is silt loam or silty clay loam. The A horizon, if it occurs, is less than 5 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon. In cultivated areas this horizon is incorporated into the Ap horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam, silty clay, or clay. The Cr horizon has hue of 2.5Y, 5Y, or 5GY, value of 5 or 6, and chroma of 3 to 6. It is weathered shale that has a

texture of clay or silty clay. Some pedons do not have limestone and chert fragments.

### Dickinson Series

The Dickinson series consists of well drained, moderately rapidly permeable soils on upland ridges and side slopes, high stream benches, and stream terraces. These soils formed in sandy and loamy material that was deposited mainly by the wind. The native vegetation was prairie grasses. Slopes range from 2 to 14 percent.

Typical pedon of Dickinson fine sandy loam, 2 to 5 percent slopes, in a cultivated field; 220 feet east and 1,000 feet north of the southwest corner of sec. 36, T. 84 N., R. 2 E.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; many distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; neutral; gradual smooth boundary.
- A1—9 to 17 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak very fine granular; very friable; neutral; gradual smooth boundary.
- A2—17 to 23 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; neutral; gradual smooth boundary.
- Bw—23 to 30 inches; brown (10YR 4/3) fine sandy loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure; very friable; few very fine roots; slightly acid; gradual smooth boundary.
- BC—30 to 39 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) loamy fine sand; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; weak fine prismatic structure parting to weak fine subangular blocky; very friable; few very fine roots; neutral; gradual smooth boundary.
- C—39 to 60 inches; dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4) loamy fine sand; single grain; loose; yellowish brown (10YR 5/6) sand lamellae, 0.5 inch thick, at depths of 43, 49, and 53 inches; slightly acid.

The thickness of the solum ranges from 24 to 50 inches. The Ap and A horizons have value of 2 or 3. They have chroma of 1 or 2 in the upper part and 2 or 3 in the lower part. They are loam, fine sandy loam, or sandy loam. The Bw horizon has value of 4 or 5 and chroma of 3 to 6. It is fine sandy loam or sandy loam. The BC and C horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. They typically are loamy fine sand or fine sand. In some pedons the C horizon does not have lamellae.

Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded, is a taxadjunct to the series because it does not have a mollic epipedon.

### Dinsdale Series

The Dinsdale series consists of moderately well drained, moderately permeable soils on ridges and side slopes in the uplands. These soils formed in 24 to 40 inches of loess and in the underlying glacial till. The native vegetation was prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Dinsdale silt loam, 2 to 5 percent slopes, in a cultivated field; 260 feet west and 1,430 feet north of the southeast corner of sec. 29, T. 84 N., R. 2 E.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine granular structure; friable; few very fine roots; neutral; gradual smooth boundary.
- A—7 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine and very fine subangular blocky structure parting to weak fine and very fine granular; friable; few very fine roots; neutral; clear smooth boundary.
- BA—11 to 16 inches; dark brown (10YR 3/3) silt loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.
- Bt1—16 to 27 inches; brown (10YR 4/3) silty clay loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; common distinct dark brown (10YR 3/3) clay films on faces of peds; few very fine roots; strongly acid; gradual smooth boundary.
- 2Bt2—27 to 34 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR

5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate fine and very fine prismatic structure parting to moderate fine and medium subangular blocky; firm; common distinct brown (10YR 5/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

2BC—34 to 48 inches; yellowish brown (10YR 5/4) clay loam; common fine and medium distinct strong brown (7.5YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; weak medium and fine prismatic structure; firm; few distinct brown (10YR 5/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); about 3 percent gravel 2 to 8 millimeters in size; slightly acid; gradual smooth boundary.

2C—48 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; appears massive but has some vertical cleavage planes; firm; few dark concretions (iron and manganese oxide); about 5 percent gravel 2 to 8 millimeters in size; slightly acid.

The thickness of the solum ranges from 42 to 60 inches. The Ap and A horizons have value of 2 or 3. They are silt loam or silty clay loam. The Bt horizon has chroma of 3 or 4. The content of clay in this horizon ranges from about 28 to 34 percent. The 2B and 2C horizons have value of 4 or 5 and chroma of 4 to 8. They are clay loam or loam.

Dinsdale silt loam, 2 to 5 percent slopes, moderately eroded, is a taxadjunct to the series because it has a dark surface layer that is too thin to qualify as a mollic epipedon.

### Dolbee Series

The Dolbee series consists of poorly drained, moderately permeable soils on bottom land, in upland drainageways, and on alluvial fans. These soils formed in silty alluvium and colluvium. The native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Dolbee silty clay loam, 2 to 5 percent slopes, in a cultivated field; 920 feet south and 520 feet east of the center of sec. 29, T. 84 N., R. 2 E.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; friable; few very fine roots; slightly acid; gradual smooth boundary.

A—9 to 16 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine and very

fine granular; friable; few very fine roots; neutral; clear smooth boundary.

Bg1—16 to 22 inches; dark gray (10YR 4/1) silty clay loam; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.

Bg2—22 to 31 inches; olive gray (5Y 5/2) silty clay loam; moderate fine and very fine subangular blocky structure; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.

Bg3—31 to 38 inches; olive gray (5Y 5/2) silty clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.

BCg—38 to 44 inches; olive gray (5Y 5/2) silty clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.

Cg—44 to 60 inches; light olive gray (5Y 6/2), gray (5Y 5/1), and olive gray (5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8 and 4/6) mottles; massive; friable; neutral.

The thickness of the solum ranges from 40 to 70 inches. The Ap and A horizons have hue of 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 or 1. They are silty clay loam or silt loam. The Bg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. The content of clay in this horizon ranges from 25 to 34 percent.

### Donatus Series

The Donatus series consists of moderately deep, well drained soils on upland side slopes and ridges. These soils formed in loess and in cherty, clayey residuum over dolomitic limestone bedrock. The depth to bedrock is 20 to 40 inches. The native vegetation was deciduous trees. Permeability is moderate in the upper part of the solum and slow in the lower part. Slopes range from 9 to 25 percent.

Typical pedon of Donatus silt loam, in a cultivated area of Donatus-Rollingstone silt loams, 14 to 18 percent slopes, moderately eroded; 140 feet west and

1,340 feet north of the southeast corner of sec. 6, T. 86 N., R. 4 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; mixed with streaks and pockets of yellowish brown (10YR 5/4) cherty silty clay loam from the subsoil; few distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; neutral; clear smooth boundary.

Bt1—8 to 18 inches; yellowish brown (10YR 5/4) cherty silty clay loam; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common very fine roots; about 25 percent chert fragments 0.3 centimeter to 1.9 centimeters in size; neutral; clear wavy boundary.

2Bt2—18 to 35 inches; reddish brown (5YR 4/4) very cherty clay; strong fine angular blocky structure; very firm; few distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 50 percent chert fragments 0.3 centimeter to 7.6 centimeters in size; medium acid; abrupt wavy boundary.

2R—35 inches; hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The thickness of the loess ranges from 10 to 20 inches.

The Ap horizon has chroma of 3 or 4. The A horizon, if it occurs, is 3 to 5 inches thick. It is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). The E horizon, if it occurs, has value of 3 or 4 and chroma of 1 or 2. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam, silty clay loam, cherty silt loam, or cherty silty clay loam. The 2Bt horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is very cherty silty clay or very cherty clay. It is 10 to 20 inches thick. Some pedons have a thin 2Bt horizon that has a lower content of chert fragments than the 2Bt horizon in the typical pedon.

### Dorchester Series

The Dorchester series consists of well drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in calcareous, silty alluvium over an older buried soil. The native vegetation was deciduous trees. Slopes range from 0 to 7 percent.

Typical pedon of Dorchester silt loam, 0 to 2 percent slopes, in a cultivated field; 500 feet north and 180 feet west of the center of sec. 1, T. 87 N., R. 3 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; appears massive but parts to weak medium platy fragments; friable; common very fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—7 to 29 inches; stratified dark grayish brown (10YR 4/2), brown (10YR 5/3), grayish brown (10YR 5/2), and very dark grayish brown (10YR 3/2) silt loam; appears massive but parts to weak thin and medium platy fragments; friable; few very fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

2Ab1—29 to 50 inches; very dark brown (10YR 2/2) silt loam; many distinct black (10YR 2/1) organic coatings on faces of peds; weak coarse and medium granular structure; friable; few very fine roots; very slight effervescence; mildly alkaline; gradual smooth boundary.

2Ab2—50 to 60 inches; dark brown (10YR 3/3) silt loam; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine and medium subangular blocky structure; friable; very few very fine roots; very slight effervescence; mildly alkaline.

Depth to the 2Ab horizon ranges from 20 to 40 inches. The content of clay in the 10- to 40-inch control section ranges from 18 to 24 percent.

The A horizon has chroma of 2 or 3. The C horizon has value of 3 to 6 and chroma of 2 or 3. It typically is silt loam. In some pedons, however, it has thin strata of loam and sandier material. The 2Ab horizon has value of 2 or 3 and chroma of 1 to 3. It is silt loam or silty clay loam.

### Dorerton Series

The Dorerton series consists of well drained, moderately permeable soils on upland side slopes. These soils formed in a thin mantle of loess or mixed loess and loamy colluvium and in the underlying loamy-skeletal colluvial sediment derived from dolomitic limestone bedrock. The native vegetation was deciduous trees. Slopes range from 18 to 60 percent.

The Dorerton soils in this county are taxadjuncts to the series because the content of sand in the 2B horizon is higher than is definitive for the series.

Typical pedon of Dorerton silt loam, in an area of Dorerton-Lacrescent complex, 18 to 60 percent slopes, in pastured woodland; 700 feet east and 1,620 feet north of the southwest corner of sec. 6, T. 86 N., R. 4 E.

**A**—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few distinct very dark brown (10YR 2/2) organic coatings on faces of peds; weak fine and medium granular structure; friable; common very fine and fine roots; about 2 percent chert fragments 0.6 centimeter to 7.6 centimeters in size; neutral; clear wavy boundary.

**E**—4 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; few distinct very dark brown (10YR 2/2) organic coatings in root channels; weak thin platy structure parting to weak very fine subangular blocky; friable; common very fine and fine roots; about 1 percent chert fragments 0.6 centimeter to 2.5 centimeters in size; neutral; gradual wavy boundary.

**Bt1**—8 to 13 inches; yellowish brown (10YR 5/4) silty clay loam; moderate very fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and very pale brown (10YR 7/3 dry) silt coatings on faces of peds; common very fine roots; about 2 percent chert fragments 0.6 centimeter to 5 centimeters in size; neutral; gradual wavy boundary.

**Bt2**—13 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; strong fine subangular and angular blocky structure; friable; many distinct brown (10YR 4/3) clay films on faces of peds; common very fine roots; about 5 percent chert fragments 0.6 centimeter to 5 centimeters in size; neutral; gradual wavy boundary.

**2Bt3**—16 to 40 inches; yellowish brown (10YR 5/4) flaggy silt loam; weak fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few coarse and very fine roots; about 25 percent limestone fragments 2.5 to 38 centimeters in size and about 5 percent chert fragments 0.6 centimeter to 5 centimeters in size; slight effervescence; mildly alkaline; gradual wavy boundary.

**2C**—40 to 60 inches; yellowish brown (10YR 5/4) very flaggy silt loam; massive; friable; few fine roots; about 40 percent limestone fragments 7.6 to 38 centimeters in size and 20 percent chert fragments 0.6 centimeter to 5 centimeters in size; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 45 inches. The 2Bt and 2C horizons have 25 to 60 percent limestone fragments and 5 to 20 percent chert fragments. The depth to bedrock is more than 5 feet.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or loam. The E horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or loam. The Bt horizon has value of 3 to 5 and chroma of 3 or 4. It is

silt loam, silty clay loam, or clay loam. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is flaggy silt loam, flaggy silty clay loam, very flaggy silt loam, or very flaggy silty clay loam. The 2C horizon has value of 4 to 6 and chroma of 3 to 6. It is flaggy or very flaggy silt loam.

## Downs Series

The Downs series consists of well drained, moderately permeable soils on upland ridges and side slopes and on high stream benches. These soils formed in loess. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 1 to 25 percent.

Typical pedon of Downs silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 980 feet west and 1,580 feet north of the southeast corner of sec. 4, T. 85 N., R. 3 E.

**Ap**—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of brown (10YR 5/3) subsurface material; weak fine subangular blocky structure parting to weak fine and very fine granular; friable; medium acid; abrupt smooth boundary.

**BE**—7 to 12 inches; brown (10YR 4/3) silt loam; dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

**Bt1**—12 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; few distinct dark brown (10YR 3/3) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; strongly acid; gradual smooth boundary.

**Bt2**—17 to 24 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; strongly acid; gradual smooth boundary.

**Bt3**—24 to 30 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds; strongly acid; gradual smooth boundary.

**Bt4**—30 to 47 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct strong brown (7.5Y 5/6) and few fine faint light brownish gray (10YR 6/2) mottles; weak fine and medium prismatic structure parting to weak fine and medium subangular blocky;

friable; few distinct brown (10YR 4/3) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

BC—47 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct strong brown (7.5YR 5/6) and few fine faint light brownish gray (10YR 6/2) mottles; weak medium prismatic structure; friable; few dark concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 42 to more than 60 inches. The Ap or A horizon has value of 2 or 3. It is 6 to 9 inches thick. It is silt loam or silty clay loam. The E horizon, if it occurs, has value of 4 or 5 and chroma of 2 or 3. In cultivated areas this horizon may be incorporated into the Ap horizon. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. The lower part has chroma of 4 to 6. The Bt horizon ranges from 27 to 35 percent clay. Some pedons have a C horizon, which is silt loam and has hue of 10YR, value of 5 or 6, and chroma of 3 to 6.

The severely eroded Downs soils in this county are taxadjuncts to the series because they have a lighter colored surface layer than is definitive for the series.

## Dubuque Series

The Dubuque series consists of moderately deep, well drained soils on upland side slopes and ridges. These soils formed in loess and in a thin layer of clayey residuum over dolomitic limestone bedrock. The native vegetation was deciduous trees. Permeability is moderate in the upper part of the solum and slow in the lower part. Slopes range from 5 to 25 percent.

Typical pedon of Dubuque silt loam, 18 to 25 percent slopes, in a wooded area used for pasture; 1,750 feet east and 420 feet north of the southwest corner of sec. 34, T. 85 N., R. 6 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common very fine roots; medium acid; clear smooth boundary.

E—4 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; weak medium and thin platy structure parting to weak very fine and fine subangular blocky; friable; common prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

BE—10 to 16 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine and medium subangular blocky

structure; friable; few distinct brown (10YR 4/3) clay films and common prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Bt1—16 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular and angular blocky structure; friable; common distinct brown (10YR 4/3) clay films and common prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

2Bt2—23 to 28 inches; brown (7.5YR 4/4) silty clay; moderate fine and very fine angular blocky structure; very firm; common distinct brown (10YR 4/3) clay films and common prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; abrupt wavy boundary.

2R—28 to 30 inches; yellow (10YR 7/6), weathered limestone about 2 inches thick over hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The A horizon has chroma of 1 or 2. It is 2 to 4 inches thick. The Ap horizon, if it occurs, has value and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. In cultivated areas this horizon is incorporated into the Ap horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. It has a content of clay that ranges from 26 to 35 percent. The 2Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 8. It is silty clay or clay. It is 1 to 5 inches thick.

## Ely Series

The Ely series consists of somewhat poorly drained, moderately permeable soils on foot slopes, on alluvial fans, and on foot slopes adjacent to upland drainageways. These soils formed in silty colluvium and alluvium. The native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, in a cultivated field; 740 feet east and 360 feet south of the center of sec. 35, T. 87 N., R. 4 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; slightly acid; gradual smooth boundary.

A1—8 to 15 inches; very dark brown (10YR 2/2) silty

clay loam, dark grayish brown (10YR 4/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine and very fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; medium acid; gradual smooth boundary.

A2—15 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; medium acid; gradual smooth boundary.

BA—22 to 29 inches; very dark grayish brown (10YR 3/2) silty clay loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct brown (7.5YR 4/4) mottles; moderate medium and fine subangular blocky structure; friable; few very fine roots; medium acid; gradual smooth boundary.

Bw1—29 to 36 inches; dark grayish brown (10YR 4/2) silty clay loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate medium and fine subangular blocky; friable; few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; slightly acid; clear smooth boundary.

Bw2—36 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam; very few distinct very dark gray (10YR 3/1) organic coatings in root channels; common fine prominent strong brown (7.5YR 5/6 and 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.

BC—50 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; very few distinct very dark gray (10YR 3/1) organic coatings in root channels; common fine prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure; friable; few dark concretions (iron and manganese oxide); slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The A horizon is 20 to 30 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam or silt loam. The BA horizon has chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It has a content of clay that ranges from 28 to 35 percent.

## Emeline Series

The Emeline series consists of very shallow, somewhat excessively drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loamy material over dolomitic limestone bedrock. The depth to bedrock is 4 to 12 inches. The native vegetation was prairie grasses. Slopes range from 2 to 25 percent.

Typical pedon of Emeline loam, 9 to 14 percent slopes, in a permanent pasture; 710 feet north and 1,360 feet east of the center of sec. 26, T. 84 N., R. 5 E.

A—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; many fine and very fine roots; mildly alkaline; abrupt wavy boundary.

R—9 inches; hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 4 to 12 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. It typically is loam. In some pedons, however, it is silt loam.

## Fayette Series

The Fayette series consists of well drained, moderately permeable soils on upland ridges and side slopes and on high stream benches. These soils formed in loess. The native vegetation was deciduous trees. Slopes range from 1 to 40 percent.

Typical pedon of Fayette silt loam, 9 to 14 percent slopes, moderately eroded, in a pasture; 1,030 feet west and 180 feet north of the center of sec. 33, T. 85 N., R. 1 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; mixed with some streaks and pockets of brown (10YR 5/3) subsurface material and dark yellowish brown (10YR 4/4) subsoil material; weak fine and very fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; medium acid; abrupt smooth boundary.

BE—8 to 12 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine and very fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; slightly acid; gradual smooth boundary.

Bt1—12 to 20 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium subangular

and angular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films and few distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine and fine roots; slightly acid; gradual smooth boundary.

- Bt2—20 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium angular and subangular blocky structure; friable; many distinct dark yellowish brown (10YR 4/4) clay films and few distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.
- Bt3—26 to 32 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine and medium angular and subangular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films and few distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.
- BC—32 to 47 inches; yellowish brown (10YR 5/6) silt loam; common fine distinct strong brown (7.5YR 5/6 and 5/8) and few fine distinct light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; friable; few distinct dark yellowish brown (10YR 4/4) clay films and very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.
- C—47 to 60 inches; yellowish brown (10YR 5/6) silt loam; few fine distinct strong brown (7.5YR 5/6 and 5/8) and light brownish gray (10YR 6/2) mottles; appears massive but has some vertical cleavage planes; friable; very pale brown (10YR 7/3 dry) silt coatings on cleavage planes; few black (10YR 2/1) concretions (iron and manganese oxide); strongly acid.

The thickness of the solum ranges from 36 to 60 inches. The Ap horizon has chroma of 2 or 3. It is silt loam or silty clay loam. In uneroded pedons the A horizon has value of 3 and chroma of 1 or 2. It is 1 to 4 inches thick. It is silt loam. Some pedons have an E horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. The content of clay in this horizon ranges from 28 to 35 percent. Mottles are at a depth of 30 inches in some pedons. The BC horizon has value of 4 or 5 and chroma of 4 to 6. It is silt loam or silty clay loam. The C horizon has value of 4 or 5 and chroma of 4 to 6.

## Festina Series

The Festina series consists of well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 1 to 4 percent.

Typical pedon of Festina silt loam, 1 to 4 percent slopes, in a pasture; 1,000 feet east and 700 feet north of the southwest corner of sec. 2, T. 85 N., R. 3 E.

- A—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; many distinct very dark brown (10YR 2/2) organic coatings on faces of peds; moderate medium granular structure; friable; many very fine roots; medium acid; clear smooth boundary.
- E—9 to 17 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; medium distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak thin platy structure parting to weak fine granular; friable; many very fine roots; medium acid; clear smooth boundary.
- BE—17 to 22 inches; brown (10YR 4/3) silt loam; common distinct dark brown (10YR 3/3) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; common prominent white (10YR 8/2 dry) silt coatings on faces of peds; common very fine roots; medium acid; gradual smooth boundary.
- Bt1—22 to 30 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and common prominent white (10YR 8/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.
- Bt2—30 to 43 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct grayish brown (2.5Y 5/2) and strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and common prominent white (10YR 8/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.
- BC—43 to 50 inches; yellowish brown (10YR 5/4) silt loam; common medium prominent light brownish gray (2.5Y 6/2) and common fine distinct yellowish red (5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; few distinct brown (10YR 4/3) clay films and common prominent white (10YR 8/2 dry) silt coatings on faces of peds; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

C—50 to 60 inches; yellowish brown (10YR 5/4) silt loam; common medium prominent light brownish gray (2.5Y 6/2) and common fine distinct yellowish red (5YR 5/8) mottles; massive; friable; few dark concretions (iron and manganese oxide); 3-inch stratum of sandy loam at a depth of about 52 inches; strongly acid.

The thickness of the solum ranges from 36 to more than 60 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. It has a content of clay that ranges from 24 to 29 percent. The C horizon has chroma of 4 to 6. In some pedons it has thin strata of loam, sandy loam, or sand.

### Finchford Series

The Finchford series consists of excessively drained, very rapidly permeable soils on stream terraces. These soils formed in sandy and gravelly alluvial material. The native vegetation was prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Finchford loamy sand, 1 to 4 percent slopes, in a pasture; 180 feet east and 1,100 feet south of the northwest corner of sec. 18, T. 84 N., R. 7 E.

Ap—0 to 8 inches; black (10YR 2/1) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common very fine roots; about 3 percent gravel 2 to 20 millimeters in size; neutral; gradual smooth boundary.

A1—8 to 18 inches; black (10YR 2/1) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure parting to single grain; very friable; few very fine roots; about 7 percent gravel 2 to 12 millimeters in size; medium acid; gradual smooth boundary.

A2—18 to 29 inches; very dark brown (10YR 2/2) sand, dark grayish brown (10YR 4/2) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; weak fine granular structure parting to single grain; very friable; few very fine roots; about 9 percent gravel 2 to 12 millimeters in size; medium acid; gradual smooth boundary.

Bw1—29 to 41 inches; dark brown (10YR 3/3) gravelly sand; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; single grain; loose; few very fine roots; about 15 percent gravel 2 to 10 millimeters in size; medium acid; gradual smooth boundary.

Bw2—41 to 48 inches; dark yellowish brown (10YR 3/4)

gravelly sand; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; single grain; loose; few very fine roots; about 17 percent gravel 2 to 20 millimeters in size; strongly acid; gradual smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) gravelly sand; single grain; loose; about 15 percent gravel 2 to 10 millimeters in size; slightly acid.

The thickness of the solum ranges from 24 to 48 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loamy sand or sand. The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is sand, loamy sand, or gravelly sand. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 or 5.

### Floyd Series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on foot slopes and in upland drainageways. These soils formed in loamy sediment and in the underlying glacial till. The native vegetation was prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Floyd loam, 1 to 4 percent slopes, in a cultivated field; 940 feet south and 940 west of the center of sec. 9, T. 86 N., R. 1 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine and medium subangular blocky structure parting to moderate fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

A1—7 to 14 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; weak medium subangular blocky structure parting to moderate fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

A2—14 to 20 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine and very fine granular; friable; few very fine roots; slightly acid; clear smooth boundary.

Bw1—20 to 25 inches; dark grayish brown (2.5Y 4/2) loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; few very fine roots; few strong brown (7.5YR 4/6) iron accumulations; slightly acid; clear smooth boundary.

Bw2—25 to 30 inches; olive brown (2.5Y 4/4) loam; few

fine prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); about 1 percent glacial pebbles 3 to 10 millimeters in size; slightly acid; clear smooth boundary.

Bw3—30 to 40 inches; olive brown (2.5Y 4/4) sandy clay loam; common medium distinct grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; about 3 percent glacial pebbles 5 to 15 millimeters in size; 3-inch stratum of loamy sand at a depth of about 33 inches; neutral; clear smooth boundary.

2Bw4—40 to 53 inches; mottled grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/4), and yellowish brown (10YR 5/8) loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; about 3 percent glacial pebbles 2 to 10 millimeters in size; neutral; gradual smooth boundary.

2BC—53 to 60 inches; mottled grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/4), and yellowish brown (10YR 5/8) loam; weak medium prismatic structure; firm; about 3 percent glacial pebbles 3 to 10 millimeters in size; mildly alkaline.

The thickness of the solum ranges from about 40 to 60 inches. The depth to glacial till ranges from 30 to 45 inches. The depth to carbonates ranges from 45 to 75 inches.

The Ap and A horizons have value of 2 or 3 and chroma of 1 or 2. They are silt loam or loam. The Bw horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 6. It is loam, clay loam, or sandy clay loam. The 2Bw and 2BC horizons have hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 8. They typically are loam. In some pedons, however, they are clay loam or sandy clay loam.

### Frankville Series

The Frankville series consists of moderately deep, well drained soils on upland ridges and side slopes. These soils formed in loess and in a thin layer of clayey residuum over dolomitic limestone bedrock. The depth to bedrock is 20 to 40 inches. The native vegetation was mixed prairie grasses and deciduous trees. Permeability is moderate in the upper part of the solum and slow in the lower part. Slopes range from 5 to 14 percent.

Typical pedon of Frankville silt loam, 5 to 9 percent

slopes, moderately eroded, in a cultivated field; 400 feet north and 120 feet east of the southwest corner of sec. 20, T. 84 N., R. 2 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; common distinct very dark brown (10YR 2/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate medium granular; friable; neutral; clear smooth boundary.

Bt1—9 to 15 inches; dark yellowish brown (10YR 4/4) silty clay loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Bt2—15 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

2Bt3—26 to 31 inches; yellowish brown (10YR 5/4) clay; moderate medium prismatic structure parting to strong medium subangular blocky; very firm; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; abrupt wavy boundary.

2R—31 inches; hard, fractured dolomitic limestone bedrock.

The thickness of the solum ranges from 20 to 40 inches. The Ap or A horizon has chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is silty clay loam or silt loam. The 2Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 4 to 6. It is clay or silty clay. It is 1 to 5 inches thick.

### Garwin Series

The Garwin series consists of poorly drained, moderately permeable soils on concave slopes at the head of drainageways or in slight depressions on broad flats in the uplands. These soils formed in loess. The native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Garwin silty clay loam, 0 to 2 percent slopes, in a cultivated field; 930 feet north and 1,440 feet west of the southeast corner of sec. 19, T. 84 N., R. 2 E.

- Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; medium acid; clear smooth boundary.
- A1—7 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; few very fine roots; medium acid; gradual smooth boundary.
- A2—12 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; medium acid; clear smooth boundary.
- Bg—18 to 21 inches; dark gray (10YR 4/1) silty clay loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; few fine distinct yellowish brown (10YR 5/8) and common medium distinct dark grayish brown (2.5Y 4/2) mottles; moderate fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; medium acid; clear smooth boundary.
- Btg1—21 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; friable; few distinct very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.
- Btg2—33 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; friable; few distinct dark gray (10YR 4/1) and dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; slightly acid; gradual smooth boundary.
- BCg—42 to 51 inches; light olive gray (5Y 6/2) silt loam; few medium prominent strong brown (7.5YR 5/8) mottles; weak fine and medium prismatic structure parting to weak fine subangular blocky; friable; few very fine roots; neutral; gradual smooth boundary.
- Cg—51 to 60 inches; light olive gray (5Y 6/2) silt loam; common medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. The Ap and A horizons have hue of 10YR or are neutral in hue. They have chroma of 0 or 1. The combined thickness of the Ap and A horizons ranges from 14 to 24 inches. The Bg horizon has hue of 10YR or 2.5Y and value of 3 or 4. The Btg horizon has hue of 5Y or 2.5Y, value of 3 to 5, and chroma of 1

or 2. The content of clay in this horizon ranges from 28 to 34 percent. The Cg horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 or 2.

### Lacrescent Series

The Lacrescent series consists of well drained, moderately permeable soils on upland side slopes. These soils formed in a thin mantle of loess or mixed loess and loamy colluvium and in the underlying loamy-skeletal colluvial sediment derived from dolomitic limestone bedrock (fig. 16). The native vegetation was deciduous trees. Slopes range from 18 to 60 percent.

The Lacrescent soils in this county are taxadjuncts because they are shallower to carbonates than is defined as the range for the series.

Typical pedon of Lacrescent channery silty clay loam, in an area of Dorerton-Lacrescent complex, 18 to 60 percent slopes, in pastured woodland; 550 feet north and 920 feet west of the center of sec. 15, T. 87 N., R. 3 E.

- A1—0 to 8 inches; very dark brown (10YR 2/2) channery silty clay loam, very dark grayish brown (10YR 3/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine and very fine granular structure; friable; common very fine and few coarse roots; about 15 percent limestone fragments 0.6 centimeter to 15 centimeters in size; slight effervescence; mildly alkaline; gradual wavy boundary.
- A2—8 to 14 inches; very dark grayish brown (10YR 3/2) channery silt loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) organic coatings on faces of peds; moderate fine granular structure; friable; common very fine and few coarse roots; about 30 percent limestone fragments 0.6 centimeter to 15 centimeters in size; slight effervescence; moderately alkaline; gradual wavy boundary.
- Bt1—14 to 28 inches; yellowish brown (10YR 5/4) very channery silt loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; brown (10YR 4/3) clay films on faces of peds; common very fine and few coarse roots; about 45 percent limestone fragments 0.6 centimeter to 15 centimeters in size; strong effervescence; moderately alkaline; gradual wavy boundary.
- Bt2—28 to 42 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable; few distinct brown (10YR 5/3) clay films on faces of peds; few coarse roots; about 40

percent limestone fragments 0.6 centimeter to 15 centimeters in size; strong effervescence; moderately alkaline; gradual wavy boundary.

C—42 to 60 inches; yellowish brown (10YR 5/4) very channery silt loam; massive; friable; few fine roots; about 50 percent limestone fragments 0.6 centimeter to 20 centimeters in size; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 60 inches. The content of limestone fragments generally ranges from 15 to 60 percent throughout the solum, but some pedons do not have limestone fragments in the A horizon. The depth to bedrock ranges from 5 to 12 feet.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, channery silt loam, channery loam, channery silty clay loam, silt loam, or loam. It is 8 to 14 inches thick. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is channery silt loam, channery loam, very channery silt loam, or very channery loam. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is very channery silt loam or very channery loam.

### Lamont Series

The Lamont series consists of well drained, moderately rapidly permeable soils on upland ridges and side slopes and on stream terraces. These soils formed in sandy and loamy material that was deposited mainly by the wind. The native vegetation was deciduous trees. Slopes range from 2 to 40 percent.

Typical pedon of Lamont sandy loam, in a pastured area of Fayette-Lamont-Chelsea complex, 5 to 9 percent slopes, moderately eroded; 350 feet south and 280 feet west of the center of sec. 4, T. 84 N., R. 3 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, pale brown (10YR 6/3) dry; common distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; weak fine granular structure; very friable; common very fine roots; neutral; clear smooth boundary.

Bt1—7 to 14 inches; dark yellowish brown (10YR 4/4) loam; few distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; moderate medium and weak fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/3) clay films on faces of peds; common very fine roots; slightly acid; gradual smooth boundary.

Bt2—14 to 25 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable;



Figure 16.—Profile of Lacrescent channery silty clay loam, in an area of Dorerton-Lacrescent complex, 18 to 60 percent slopes.

few distinct brown (7.5YR 4/4) clay films on faces of peds; common very fine roots; medium acid; gradual smooth boundary.

Bt3—25 to 35 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; few distinct brown (7.5YR 4/4) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

BCt—35 to 44 inches; dark yellowish brown (10YR 4/6) loamy sand; weak medium subangular blocky structure parting to single grain; very friable; few distinct brown (7.5YR 4/4) clay bridges on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

E&Bt—44 to 60 inches; brownish yellow (10YR 6/6) sand; single grain; loose; brown (7.5YR 4/4) loamy sand lamellae (Bt) 1 inch thick at depths of 50 and 53 inches and 2 inches thick at a depth of about 56 inches; strongly acid.

The thickness of the solum ranges from 30 to more than 60 inches. The Ap horizon has chroma of 2 or 3. It is fine sandy loam, sandy loam, or loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is loam, sandy loam, or fine sandy loam. The E&Bt horizon has the same range of colors as the Bt horizon. It is sand, loamy sand, or loamy fine sand. The total thickness of the lamellae in this horizon is less than 6 inches.

### Lawson Series

The Lawson series consists of somewhat poorly drained, moderately permeable soils on bottom land. These soils formed in silty alluvium. The native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Lawson silt loam, 0 to 2 percent slopes, in a cultivated field; 1,380 feet south and 160 feet east of the northwest corner of sec. 36, T. 84 N., R. 2 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; mixed with some streaks and pockets of dark grayish brown (10YR 4/2) overwash material; weak fine granular structure; friable; few very fine roots; mildly alkaline; gradual smooth boundary.

A1—8 to 27 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; common faint black (N 2/0) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

A2—27 to 36 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine and medium subangular blocky structure parting to moderate fine and very fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

C1—36 to 46 inches; very dark grayish brown (10YR 3/2) silt loam; common distinct very dark gray (10YR 3/1) organic coatings on cleavage planes; appears massive but has some vertical cleavage planes; friable; few very fine roots; neutral; gradual smooth boundary.

C2—46 to 60 inches; dark grayish brown (2.5Y 4/2) loam; few distinct dark gray (10YR 4/1) organic coatings on cleavage planes; common fine prominent reddish brown (5YR 4/4) and brown (7.5YR 4/4) mottles; appears massive but has some vertical cleavage planes; friable; about 1 percent gravel 2 to 7 millimeters in size; neutral.

The thickness of the solum, which is the same as the combined thickness of the Ap and A horizons, ranges from 24 to 36 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 3. It is silt loam or loam.

### Lindley Series

The Lindley series consists of moderately well drained, moderately slowly permeable soils on upland side slopes. These soils formed in glacial till. The native vegetation was deciduous trees. Slopes range from 14 to 25 percent.

Typical pedon of Lindley silt loam, 18 to 25 percent slopes, moderately eroded, in a hayfield; 210 feet east and 840 feet north of the center of sec. 15, T. 85 N., R. 3 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; mixed with streaks and pockets of yellowish brown (10YR 5/6) clay loam from the subsoil; many distinct dark brown (10YR 3/3) organic coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; common very fine roots; medium acid; clear smooth boundary.

Bt1—8 to 14 inches; yellowish brown (10YR 5/6) clay loam; few distinct dark grayish brown (10YR 4/2) organic coatings in root channels; moderate fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films on faces

of peds; few very fine roots; slightly acid; gradual smooth boundary.

- Bt2**—14 to 20 inches; yellowish brown (10YR 5/6) clay loam; moderate fine subangular blocky structure; firm; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.
- Bt3**—20 to 29 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct strong brown (7.5YR 4/6) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; firm; few distinct dark yellowish brown (10YR 4/4) clay films and common distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); about 3 percent glacial pebbles 2 to 25 millimeters in size; strongly acid; gradual smooth boundary.
- Bt4**—29 to 40 inches; yellowish brown (10YR 5/6) clay loam; common coarse prominent light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct dark yellowish brown (10YR 4/4) clay films and common distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); about 4 percent glacial pebbles 2 to 25 millimeters in size; strongly acid; gradual smooth boundary.
- BC**—40 to 46 inches; yellowish brown (10YR 5/6) loam; few medium prominent light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; firm; common distinct very pale brown (10YR 7/3 dry) silt coatings on faces of peds; few dark concretions (iron and manganese oxide); about 4 percent glacial pebbles 2 to 25 millimeters in size; strongly acid; gradual smooth boundary.
- C**—46 to 60 inches; yellowish brown (10YR 5/6) loam; common fine distinct strong brown (7.5YR 5/6) mottles; appears massive but has some vertical cleavage planes; firm; few dark concretions (iron and manganese oxide); 1-inch strata of sandy loam at depths of 53 and 57 inches; about 4 percent glacial pebbles 2 to 25 millimeters in size; slightly acid.

The thickness of the solum ranges from 30 to 50 inches. The Ap horizon has value of 4 or 5 and chroma of 2 to 4. It is silt loam or loam. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. The mottles in the lower part of this horizon have hue of 7.5YR to 2.5Y,

value of 4 to 6, and chroma of 2 to 6. The Bt horizon is clay loam or loam. The C horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6.

### Medary Variant

The Medary Variant consists of moderately well drained, very slowly permeable soils on escarpments of stream terraces. These soils formed in clayey lacustrine sediment. The native vegetation was deciduous trees. Slopes range from 18 to 60 percent.

Typical pedon of Medary Variant silty clay loam, 18 to 60 percent slopes, in a permanent pasture; 950 feet east and 1,190 feet north of the center of sec. 1, T. 84 N., R. 7 E.

- A**—0 to 3 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common very fine roots; slightly acid; clear smooth boundary.
- BE**—3 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam; mixed with streaks and pockets of brown (7.5YR 5/4) silty clay from the subsoil; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; common very fine roots; medium acid; clear smooth boundary.
- Bt1**—9 to 17 inches; brown (7.5YR 5/4) and reddish brown (5YR 4/4) silty clay; moderate fine and very fine subangular blocky structure; firm; few prominent brown (10YR 4/3) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.
- Bt2**—17 to 28 inches; brown (7.5YR 4/4) silty clay; moderate fine subangular blocky structure; firm; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few strong brown (7.5YR 5/6) iron accumulations; medium acid; gradual smooth boundary.
- Bt3**—28 to 38 inches; brown (10YR 5/3) and light brownish gray (10YR 6/2) silty clay; weak fine subangular blocky structure; firm; few distinct brown (10YR 4/3) clay films on faces of peds and few prominent very dark grayish brown (10YR 3/2) clay films in root channels; few very fine roots; few strong brown (7.5YR 5/6 and 5/8) iron accumulations; few soft accumulations (calcium carbonate); strong effervescence; mildly alkaline; gradual smooth boundary.
- BC**—38 to 47 inches; brown (7.5YR 4/4 and 10YR 5/3) silty clay loam; common fine distinct strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable;

few distinct dark brown (7.5YR 4/2) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few soft accumulations (calcium carbonate); strong effervescence; mildly alkaline; gradual smooth boundary.

C—47 to 60 inches; brown (10YR 5/3) silt; common fine distinct strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) mottles; appears massive but has vertical cleavage planes; friable; few distinct dark brown (7.5YR 4/2) clay films on vertical cleavage planes; few dark concretions (iron and manganese oxide); few soft accumulations (calcium carbonate); strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 60 inches. The A horizon has value of 3 or 4 and chroma of 1 or 2. It is 2 to 5 inches thick. It is silty clay loam or silt loam. The upper part of the Bt horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. The lower part has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. The Bt horizon is clay, silty clay, or silty clay loam. The C horizon has hue of 5YR to 5Y, value of 4 or 5, and chroma of 2 to 4. It typically is silt, silt loam, or silty clay loam. In some pedons, however, it has thin strata of loamy sand or sand.

## Muscatine Series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on broad, flat uplands and on high stream benches. These soils formed in loess. The native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Muscatine silty clay loam, benches, 0 to 2 percent slopes, in a cultivated field; 1,300 feet east and 680 feet north of the southwest corner of sec. 29, T. 84 N., R. 5 E.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine and medium granular; friable; common very fine roots; neutral; gradual smooth boundary.

A—9 to 15 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak fine and medium granular; friable; common very fine roots; slightly acid; gradual smooth boundary.

AB—15 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine subangular blocky structure; friable; common very

fine roots; medium acid; clear smooth boundary.

Bwg—20 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; common very fine roots; medium acid; gradual smooth boundary.

Btg1—27 to 35 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Btg2—35 to 44 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.

BCg—44 to 52 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Cg—52 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; appears massive but has vertical cleavage planes; friable; few distinct dark grayish brown (2.5Y 4/2) clay films in root channels; few very fine roots; few dark concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 40 to 60 inches. The Ap and A horizons have chroma of 1 or 2. The combined thickness of the Ap and A horizons is 14 to 20 inches. The B horizon has hue of 10YR or 2.5Y and value of 4 or 5. The content of clay in this horizon ranges from 30 to 35 percent. The BCg and Cg horizons have hue of 2.5Y or 5Y and value of 5 or 6. They are silty clay loam or silt loam.

## NewGlarus Series

The NewGlarus series consists of moderately deep, well drained soils on upland side slopes and ridges. These soils formed in loess and in a thin layer of clayey

residuum over dolomitic limestone bedrock. The native vegetation was deciduous trees. Permeability is moderate in the upper part of the solum and slow in the lower part. Slopes range from 9 to 18 percent.

Typical pedon of NewGlarus silt loam, 14 to 18 percent slopes, in a forested area within the Maquoketa Caves State Park; 1,720 feet east and 120 feet south of the northwest corner of sec. 6, T. 84 N., R. 2 E.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; neutral; clear smooth boundary.

E—4 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak fine subangular blocky; friable; few very fine roots; neutral; clear smooth boundary.

Bt1—9 to 17 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; clear smooth boundary.

2Bt2—17 to 31 inches; strong brown (7.5YR 5/6) clay; strong fine angular and subangular blocky structure; very firm; many prominent brown (7.5YR 4/4) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); about 2 percent pebbles 2 to 10 millimeters in size; medium acid; abrupt wavy boundary.

2R—31 inches; hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The A horizon has value of 3 or 4 and chroma of 1 or 2. It is 3 to 6 inches thick. The Ap horizon, if it occurs, has value of 4 and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. In cultivated areas it is incorporated into the Ap horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. The 2Bt horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is clay or silty clay. It is 8 to 20 inches thick.

### Newvienna Series

The Newvienna series consists of moderately well drained, moderately permeable soils on side slopes and ridges in the uplands. These soils formed in loess. The native vegetation was mixed grasses and deciduous trees. Slopes range from 5 to 18 percent.

Typical pedon of Newvienna silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 1,300 feet west and 150 feet north of the southeast corner of sec. 7, T. 84 N., R. 6 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) silty clay loam from the subsoil; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; neutral; abrupt smooth boundary.

Bt1—8 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in root channels; few fine distinct light yellowish brown (2.5Y 6/4) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few distinct dark brown (10YR 3/3) clay films on faces of peds; few very fine roots; slightly acid; clear smooth boundary.

Bt2—14 to 21 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and common distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; clear smooth boundary.

Bt3—21 to 32 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam; few fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

Bt4—32 to 45 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam; common fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

BC—45 to 60 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam; common fine prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; few dark

concretions (iron and manganese oxide); strongly acid.

The thickness of the solum ranges from 30 to more than 60 inches. The Ap horizon has chroma of 2 or 3. It typically is silt loam. In some eroded pedons, however, it is silty clay loam. Some pedons have a BE horizon. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 to 6. It has relict mottles. The lower part has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8.

The severely eroded Newvienna soils in this county are taxadjuncts because they have a lighter colored surface layer than is definitive for the series.

### Nordness Series

The Nordness series consists of shallow, well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loess and in a thin layer of clayey residuum over dolomitic limestone bedrock. The depth to bedrock is 8 to 12 inches. The native vegetation was deciduous trees. Slopes range from 5 to 35 percent.

Typical pedon of Nordness silt loam, 5 to 14 percent slopes, in a pasture; 10 feet north and 340 feet west of the center of sec. 10, T. 85 N., R. 1 E.

- A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; common very fine roots; slightly acid; abrupt smooth boundary.
- E—3 to 8 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few distinct very dark gray (10YR 3/1) organic coatings on the faces of peds in the upper part; moderate medium platy structure parting to moderate fine subangular blocky; friable; few very fine roots; slightly acid; clear smooth boundary.
- BE—8 to 11 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and very fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films and pale brown (10YR 6/3 dry) silt coatings on faces of peds; few very fine roots; few distinct very dark gray (10YR 3/1) wormcasts; neutral; clear smooth boundary.
- Bt1—11 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium subangular and angular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films and few common distinct pale brown (10YR 6/3 dry) silt coatings on faces of peds; neutral; gradual smooth boundary.
- 2Bt2—15 to 19 inches; brown (7.5YR 5/4) silty clay;

moderate fine and very fine angular blocky structure; very firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few very fine roots; about 10 percent chert fragments 0.5 centimeter to 3.5 centimeters in size; neutral; abrupt wavy boundary.

2R—19 inches; hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 8 to 20 inches. The A horizon has chroma of 1 or 2. It is 1 to 4 inches thick. The Ap horizon, if it occurs, has value of 4 and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. In cultivated areas it is incorporated into the Ap horizon. The Bt horizon is silt loam, silty clay loam, or loam. The 2Bt horizon has hue of 7.5YR or 5YR. It is silty clay, silty clay loam, or clay loam. It is 3 to 6 inches thick.

### Orion Series

The Orion series consists of somewhat poorly drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in stratified, silty recent sediment 20 to 40 inches deep over an older buried soil. The native vegetation was deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Orion silt loam, 0 to 2 percent slopes, in a permanent pasture; 1,100 feet north and 2,000 feet west of the southeast corner of sec. 19, T. 84 N., R. 1 E.

- A—0 to 4 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silt loam, light brownish gray (10YR 6/2) and very pale brown (10YR 7/3) dry; weak fine and medium granular structure; friable; common very fine roots; mildly alkaline; gradual smooth boundary.
- C1—4 to 16 inches; dark grayish brown (10YR 4/2) silt loam; few thin brown (10YR 5/3) strata; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; appears massive but parts to weak thin and medium platy fragments; friable; common very fine roots; few brown (7.5YR 4/4) accumulations (iron and manganese oxide); mildly alkaline; gradual smooth boundary.
- C2—16 to 29 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; common fine prominent yellowish red (5YR 4/6) mottles; appears massive but parts to weak thin platy fragments; friable; few very fine roots; few dark concretions (iron and manganese oxide); mildly

alkaline; gradual smooth boundary.

C3—29 to 34 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; common thin very dark grayish brown (10YR 3/2) strata; common fine prominent yellowish red (5YR 4/6) and dark reddish brown (2.5YR 3/4) mottles; appears massive but parts to weak medium platy fragments; friable; few very fine roots; few dark concretions (iron and manganese oxide); few black (10YR 2/1) organic fillings in root channels; mildly alkaline; abrupt smooth boundary.

Ab—34 to 60 inches; black (10YR 2/1) silt loam; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; few dark concretions (iron and manganese oxide); few black (N 2/0) krotovinas at a depth of 35 inches; mildly alkaline.

Depth to the Ab horizon ranges from 20 to 40 inches. The content of clay in the 10- to 40-inch control section ranges from 10 to 18 percent.

The A or Ap horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon also has value of 4 or 5 and chroma of 2 or 3. It has mottles with hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 4 to 6. It typically is silt loam. In some pedons, however, it has thin strata of silt or sand. The Ab horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam.

## Orwood Series

The Orwood series consists of well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loamy and silty eolian material more than 60 inches thick. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 25 percent.

Typical pedon of Orwood loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 820 feet north and 660 feet east of the southwest corner of sec. 30, T. 84 N., R. 6 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam, dark grayish brown (10YR 4/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; weak fine subangular blocky structure parting to weak fine granular; friable; common fine and very fine roots; medium acid; abrupt smooth boundary.

BE—8 to 15 inches; dark yellowish brown (10YR 4/4) loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and medium subangular blocky structure parting to

weak fine and very fine granular; friable; few distinct dark brown (10YR 3/3) clay films on faces of peds; common fine and very fine roots; slightly acid; gradual smooth boundary.

Bt1—15 to 22 inches; dark yellowish brown (10YR 4/6) loam; weak medium and fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; neutral; gradual smooth boundary.

Bt2—22 to 32 inches; dark yellowish brown (10YR 4/6) loam; weak medium and fine subangular structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common very fine roots; neutral; gradual smooth boundary.

Bt3—32 to 44 inches; yellowish brown (10YR 5/6) silt loam; weak medium and fine prismatic structure parting to weak medium and fine subangular blocky; friable; common distinct dark yellowish brown (10YR 4/4) clay films and few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; common very fine roots; few dark concretions (iron and manganese oxide); neutral; gradual smooth boundary.

BC—44 to 60 inches; yellowish brown (10YR 5/6) silt loam; few fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) mottles in the lower part; weak medium and fine prismatic structure parting to weak medium and fine subangular blocky; friable; few distinct dark yellowish brown (10YR 4/4) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 40 to 60 inches. The Ap horizon has value and chroma of 2 or 3. It is loam or silt loam. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is loam, silt loam, or clay loam. Some pedons have a C horizon, which is silt loam and has hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

## Otter Series

The Otter series consists of poorly drained, moderately permeable soils on bottom land and in upland drainageways. These soils formed in silty alluvium. The native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Otter silt loam, 0 to 2 percent slopes, in a cultivated field; 610 feet east and 480 feet north of the southwest corner of sec. 18, T. 85 N., R. 6 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; many distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

A—9 to 24 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; many distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine granular structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

Bg—24 to 37 inches; very dark gray (10YR 3/1) silt loam; many distinct black (10YR 2/1) organic coatings on faces of peds; few fine distinct strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; few dark concretions (iron and manganese oxide); slightly acid; gradual smooth boundary.

Cg—37 to 60 inches; dark gray (10YR 4/1) silt loam; few distinct very dark gray (10YR 3/1) organic coatings on cleavage planes; common fine prominent yellowish red (5YR 4/6) mottles; appears massive but has some vertical cleavage planes; friable; few dark concretions (iron and manganese oxide); neutral.

The thickness of the solum ranges from 24 to 50 inches. The Ap and A horizons have value of 2 or 3 and chroma of 1 or 2. The combined thickness of the Ap and A horizons ranges from 24 to 40 inches. The B horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 to 5 and chroma of 0 to 2. It is silt loam or silty clay loam. The C horizon has hue of 2.5Y or 10YR or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It typically is silt loam. In some pedons, however, it has thin strata of loam or sandy loam.

### Perks Series

The Perks series consists of excessively drained, rapidly permeable soils on broad flood plains. These soils formed in stratified, sandy alluvium. The native vegetation was deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Perks sandy loam, in a cultivated area of Chaseburg-Perks complex, 0 to 2 percent slopes; 1,140 feet west and 1,380 feet south of the center of sec. 1, T. 84 N., R. 1 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark grayish brown (10YR 4/2) overwash material; weak fine

granular structure; very friable; common very fine roots; medium acid; clear smooth boundary.

C1—8 to 21 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) loamy sand; appears massive but has some horizontal cleavage planes; very friable; common fine roots; 1-inch stratum of light yellowish brown (10YR 6/4) sand at a depth of 9 inches; medium acid; abrupt wavy boundary.

C2—21 to 29 inches; stratified yellowish brown (10YR 5/4) and pale brown (10YR 6/3) loamy sand; single grain; loose; few very fine roots; 1-inch stratum of very dark grayish brown (10YR 3/2) sandy loam at a depth of about 24 inches; slightly acid; abrupt wavy boundary.

C3—29 to 41 inches; brown (10YR 4/3) loamy sand; many distinct very dark grayish brown (10YR 3/2) organic coatings on cleavage planes; appears massive but has some horizontal cleavage planes; very friable; few very fine roots; slightly acid; abrupt wavy boundary.

C4—41 to 60 inches; stratified brown (10YR 5/3), pale brown (10YR 6/3), and dark brown (10YR 3/3) sand; single grain; loose; slightly acid.

The thickness of the solum, which is the same as the thickness of the Ap horizon, is less than 10 inches. The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is sandy loam or sand. The C horizon has value of 3 to 6 and chroma of 2 to 6. It typically is loamy sand, sand, or sandy loam. In some pedons, however, it has thin strata of finer textured material.

### Pillot Series

The Pillot series consists of well drained soils on upland ridges, side slopes, and high stream benches. These soils formed in 24 to 40 inches of loess and in the underlying loamy sediment. The native vegetation was prairie grasses. Permeability is moderate in the upper part of the solum and rapid in the lower part. Slopes range from 2 to 9 percent.

Typical pedon of Pillot silt loam, 2 to 5 percent slopes, in a pasture; 2,120 feet north and 480 feet east of the southwest corner of sec. 36, T. 84 N., R. 1 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; common very fine roots; slightly acid; gradual smooth boundary.

A—8 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate fine

granular; friable; common very fine roots; medium acid; gradual smooth boundary.

AB—15 to 22 inches; dark brown (10YR 3/3) silt loam; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine granular; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—22 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; few distinct dark brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; gradual smooth boundary.

Bt2—28 to 35 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium and fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; medium acid; abrupt wavy boundary.

2Bt3—35 to 44 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few very fine roots; slightly acid; gradual smooth boundary.

2C—44 to 60 inches; yellowish brown (10YR 5/4 and 5/6) loamy sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 24 to 45 inches. The Ap and A horizons have chroma of 1 or 2. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. The 2Bt horizon is sandy loam, loam, or loamy sand. The 2C horizon is dominantly loamy sand, sandy loam, or sand. In some pedons, however, it has thin strata of sandy loam.

Pillot silt loam, 5 to 9 percent slopes, moderately eroded, is a taxadjunct to the series because it does not have a mollic epipedon.

## Racine Series

The Racine series consists of well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in 12 to 24 inches of loamy sediment and in the underlying glacial till. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Racine loam, 5 to 9 percent slopes, moderately eroded, in a hayfield; 660 feet east and 1,920 feet south of the northwest corner of sec. 15, T. 86 N., R. 1 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; mixed with some streaks and pockets of

brown (10YR 4/3) subsoil material; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 14 inches; brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; few distinct dark brown (10YR 3/3) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; neutral; clear smooth boundary.

2Bt2—14 to 20 inches; yellowish brown (10YR 5/6 and 5/4) loam; moderate fine and medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; about 5 percent glacial pebbles 2 to 5 millimeters in size; neutral; gradual smooth boundary.

2Bt3—20 to 30 inches; yellowish brown (10YR 5/6 and 5/4) loam; moderate fine and medium subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; about 7 percent glacial pebbles 2 to 10 millimeters in size; strongly acid; gradual smooth boundary.

2Bt4—30 to 46 inches; yellowish brown (10YR 5/6 and 5/4) loam; common fine and medium distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; friable; few distinct dark yellowish brown (10YR 4/4) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; many black (10YR 2/1) concretions (iron and manganese oxide); about 5 percent glacial pebbles 2 to 10 millimeters in size; very strongly acid; gradual smooth boundary.

2Bt5—46 to 60 inches; yellowish brown (10YR 5/4 and 5/6) loam; common fine and medium distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure; firm; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few very fine roots; about 3 percent glacial pebbles 2 to 5 millimeters in size; strongly acid.

The thickness of the solum ranges from 36 to more than 60 inches. The thickness of the loamy erosional sediment over glacial till ranges from 14 to 24 inches. The upper sediment typically does not have coarse fragments. The till contains 2 to 12 percent coarse fragments by volume.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam. The B horizon has value of 4 or 5 and chroma of 3 or 4. It is loam, silt loam, or clay

loam. The 2B horizon has value of 4 or 5 and chroma of 4 to 6. It is loam or clay loam.

### Raddle Series

The Raddle series consists of well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. The native vegetation was prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Raddle silt loam, 1 to 4 percent slopes, in a cultivated field; 1,300 feet south and 840 feet east of the northwest corner of sec. 23, T. 84 N., R. 1 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few very fine roots; medium acid; gradual smooth boundary.

A—7 to 15 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; friable; few very fine roots; medium acid; clear smooth boundary.

BA—15 to 21 inches; very dark grayish brown (10YR 3/2) silt loam; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine and very fine subangular blocky structure parting to weak fine granular; friable; few very fine roots; medium acid; clear smooth boundary.

Bt1—21 to 33 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine and very fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Bt2—33 to 45 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films and few prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Bt3—45 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine and medium prismatic structure parting to weak medium subangular blocky; friable; few distinct brown (10YR 4/3) clay films and few prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The A horizon has value of 2 or 3 and chroma of 1 to 3. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. Some pedons have a C horizon, which is fine sand or sand.

### Rockton Series

The Rockton series consists of moderately deep, well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loamy material and in a thin layer of residuum over dolomitic limestone bedrock. The native vegetation was prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Rockton silt loam, 5 to 9 percent slopes, in a cultivated field; 440 feet east and 720 feet south of the center of sec. 27, T. 84 N., R. 2 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine and medium granular structure; friable; common very fine roots; slightly acid; gradual smooth boundary.

A—9 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; few distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—16 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; slightly acid; clear smooth boundary.

Bt2—24 to 28 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; neutral; abrupt wavy boundary.

R—28 inches; brownish yellow (10YR 6/6), weathered limestone about 1 inch thick over hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The Ap and A horizons have value of 2 or 3 and chroma of 1 or 2. They are silt loam or loam. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam or loam. Some pedons have a 2Bt horizon. This horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. It is clay loam or clay. It is less than 6 inches thick. In some pedons it contains as much as 8 percent gravel-sized coarse fragments.

Rockton silt loam, 5 to 9 percent slopes, moderately

eroded, is a taxadjunct to the series because it does not have a mollic epipedon.

### Rollingstone Series

The Rollingstone series consists of well drained, slowly permeable soils on upland ridgetops and side slopes. These soils formed in 5 to 15 inches of loess and in the underlying cherty residuum. The native vegetation was deciduous trees. Slopes range from 9 to 25 percent.

Typical pedon of Rollingstone silt loam, in a pastured area of Donatus-Rollingstone silt loams, 9 to 14 percent slopes; 220 feet west and 1,220 feet south of the center of sec. 4, T. 85 N., R. 2 E.

- A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.
- E—3 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak thin and medium platy structure parting to weak fine and very fine granular; friable; common fine roots; slightly acid; clear smooth boundary.
- Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine and medium subangular and angular blocky structure; friable; few distinct brown (10YR 4/3) clay films; common fine roots; about 2 percent chert fragments 0.6 centimeter to 1.9 centimeters in size; medium acid; clear smooth boundary.
- 2Bt2—13 to 23 inches; yellowish red (5YR 4/6) cherty clay; strong fine and medium angular blocky structure; very firm; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 30 percent chert fragments 0.6 centimeter to 13 centimeters in size; strongly acid; gradual smooth boundary.
- 2Bt3—23 to 36 inches; yellowish red (5YR 4/6) cherty clay; moderate fine and medium angular and subangular blocky structure; very firm; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 35 percent chert fragments 0.6 centimeter to 13 centimeters in size; strongly acid; gradual smooth boundary.
- 2Bt4—36 to 60 inches; yellowish red (5YR 4/6) cherty clay; moderate medium and coarse subangular blocky structure; very firm; few distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 25 percent chert fragments 0.6 centimeter to 13 centimeters in size; strongly acid.

The thickness of the solum ranges from 60 to 90

inches. The soils have no carbonates within a depth of 60 inches. By volume, the content of chert fragments is less than 5 percent in the loess and is 10 to 35 percent in the residuum.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is 1 to 4 inches thick. The Ap horizon, if it occurs, has value of 4 and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. In cultivated areas it has been incorporated into the Ap horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The 2Bt horizon has hue of 2.5YR to 7.5YR and value and chroma of 4 to 6. In some pedons it is thin and does not have chert fragments.

### Rowley Series

The Rowley series consists of somewhat poorly drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. The native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Rowley silt loam, 0 to 2 percent slopes, in a cultivated field; 1,810 feet west and 720 feet south of the northeast corner of sec. 36, T. 84 N., R. 2 E.

- Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; common very fine roots; slightly acid; gradual smooth boundary.
- A—8 to 17 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; few very fine roots; slightly acid; clear smooth boundary.
- BA—17 to 23 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; few very fine roots; medium acid; clear smooth boundary.
- Btg1—23 to 35 inches; brown (10YR 5/3) silty clay loam; few fine faint grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.
- Btg2—35 to 48 inches; grayish brown (2.5Y 5/2) silt loam; few fine distinct strong brown (7.5YR 5/6 and 4/6) mottles; weak fine and medium subangular blocky structure; friable; common distinct grayish

brown (2.5Y 5/2) clay films on faces of peds; few very fine roots; medium acid; clear smooth boundary.

2BCg—48 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; few fine distinct strong brown (7.5YR 5/6) and common medium distinct strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very friable; few distinct grayish brown (2.5Y 5/2) clay films on faces of peds; 2-inch stratum of loam at a depth of about 58 inches; medium acid.

The thickness of the solum ranges from 45 to more than 60 inches. The Ap and A horizons have value of 2 or 3 and chroma of 1 to 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is silty clay loam or silt loam. The 2BCg horizon is sandy loam, loam, or silt loam. In some pedons it is stratified.

### Rozetta Series

The Rozetta series consists of moderately well drained, moderately permeable soils on ridges and side slopes in the uplands. These soils formed in loess. The native vegetation was deciduous trees. Slopes range from 9 to 25 percent.

Typical pedon of Rozetta silt loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 380 feet north and 315 feet west of the southeast corner of sec. 5, T. 84 N., R. 6 E.

Ap—0 to 7 inches; brown (10YR 4/3) and dark grayish brown (10YR 4/2) silt loam, light yellowish brown (10YR 6/4) and pale brown (10YR 6/3) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine and fine roots; neutral; clear smooth boundary.

Bt1—7 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; common very fine roots; slightly acid; gradual smooth boundary.

Bt2—13 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; common medium prominent light brownish gray (2.5Y 6/2) and strong brown (7.5YR 4/6) mottles; moderate fine and medium angular and subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common very fine roots; few dark concretions

(iron and manganese oxide); strongly acid; gradual smooth boundary.

Bt3—23 to 35 inches; yellowish brown (10YR 5/4) silty clay loam; common fine prominent light brownish gray (2.5Y 6/2) and strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

Bt4—35 to 42 inches; yellowish brown (10YR 5/4) silty clay loam; few medium prominent light brownish gray (2.5Y 6/2) and strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

BCt—42 to 48 inches; yellowish brown (10YR 5/4) silty clay loam; few medium prominent light brownish gray (2.5Y 6/2) and brown (7.5YR 5/4) mottles; weak coarse prismatic structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; few black (10YR 2/1) concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct light brownish gray (2.5Y 6/2) and brown (7.5YR 5/4) mottles; appears massive but has some vertical cleavage planes; friable; few black (10YR 2/1) concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 42 to more than 60 inches. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. The mottles in the middle and lower parts of this horizon have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. Those in the upper part are relict mottles. The content of clay in this horizon ranges from 27 to 35 percent. The C horizon has value of 4 to 6 and chroma of 2 to 6.

### Schapville Series

The Schapville series consists of moderately deep, moderately well drained soils on upland side slopes. These soils formed in 15 to 30 inches of loess and in the underlying material weathered from shale bedrock. The native vegetation was prairie grasses. Permeability is moderate in the upper part of the solum and slow in

the lower part. It is very slow below the solum. Slopes range from 18 to 30 percent.

Typical pedon of Schapville silt loam, 18 to 30 percent slopes, in a permanent pasture; 600 feet south and 1,920 feet east of the northwest corner of sec. 35, T. 86 N., R. 4 E.

- A1—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; moderate medium granular structure; friable; common very fine roots; slightly acid; clear smooth boundary.
- A2—8 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; common distinct very dark brown (10YR 2/2) organic coatings on faces of peds; moderate medium granular structure; friable; common very fine roots; neutral; clear smooth boundary.
- Bt1—14 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; neutral; gradual smooth boundary.
- 2Bt2—24 to 31 inches; pale olive (5Y 6/3) silty clay; common fine distinct olive yellow (2.5Y 6/6) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine prismatic structure parting to strong medium subangular blocky; very firm; common distinct light olive brown (2.5Y 5/4) clay films on faces of peds; few very fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.
- 2Cr—31 to 60 inches; pale olive (5Y 6/3) and greenish gray (5GY 6/1) clay shale; common fine distinct olive yellow (2.5Y 6/6) and common medium prominent strong brown (7.5YR 5/6) mottles; massive; very firm; about 2 percent hard shale fragments 1.0 to 2.5 centimeters in size; moderate effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. The upper part of the B horizon has value of 4 or 5 and chroma of 3 or 4. The lower part has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 or 3. The 2Cr horizon has value of 5 or 6 and chroma of 2 to 4. In some pedons it contains 2 to 10 percent hard shale, limestone, or chert fragments.

### Sparta Series

The Sparta series consists of excessively drained, rapidly permeable soils on upland ridges and side

slopes, high stream benches, and stream terraces. These soils formed dominantly in sandy wind-deposited material. The native vegetation was prairie grasses. Slopes range from 2 to 14 percent.

Typical pedon of Sparta loamy sand, 2 to 5 percent slopes, in a cultivated field; 860 feet north and 200 feet west of the center of sec. 7, T. 86 N., R. 1 E.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; very friable; few very fine roots; neutral; gradual smooth boundary.
- A—8 to 17 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark brown (10YR 3/3) subsurface material; weak fine and very fine granular structure; very friable; few very fine roots; neutral; clear smooth boundary.
- Bw1—17 to 34 inches; brown (10YR 4/3) sand; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and medium subangular blocky structure parting to single grain; very friable; few fine and very fine roots; dark brown (7.5YR 3/2) krotovina at a depth of 26 inches; neutral; clear smooth boundary.
- Bw2—34 to 45 inches; yellowish brown (10YR 5/4) sand; weak fine and medium subangular blocky structure parting to single grain; very friable; few very fine roots; dark brown (7.5YR 3/2) krotovina at a depth of 38 inches; neutral; gradual smooth boundary.
- C—45 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; few very fine roots; brown (7.5YR 4/4) lamellae, 0.25 inch thick, at depths of 58 and 60 inches; dark brown (7.5YR 3/2) krotovina at a depth of 55 inches; neutral.

The thickness of the solum ranges from 24 to 45 inches. The Ap and A horizons have value of 2 or 3. They are loamy sand, loamy fine sand, or sand. The combined thickness of the Ap and A horizons ranges from 10 to 24 inches. The Bw horizon has hue of 10YR or 7.5YR and value and chroma of 3 to 6. It is sand, fine sand, or loamy fine sand. The C horizon is sand or fine sand.

### Tama Series

The Tama series consists of well drained, moderately permeable soils on upland ridges and side slopes and on high stream benches. These soils formed in loess. The native vegetation was prairie grasses. Slopes range from 1 to 14 percent.

Typical pedon of Tama silt loam, 2 to 5 percent

slopes, in a cultivated field; 185 feet west and 390 feet south of the northeast corner of sec. 33, T. 86 N., R. 3 E.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; common very fine roots; slightly acid; gradual smooth boundary.
- A—9 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; common very fine roots; slightly acid; gradual smooth boundary.
- BA—18 to 24 inches; dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; slightly acid; clear smooth boundary.
- Bt1—24 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and very fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.
- Bt2—35 to 45 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct grayish brown (2.5Y 5/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak fine and medium prismatic structure parting to weak medium and fine subangular blocky; friable; few distinct brown (10YR 4/3) clay films and common prominent light gray (10YR 7/2 dry) silt coatings on faces of peds; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.
- BC—45 to 60 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 4/6) and common fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; medium acid.

The thickness of the solum ranges from 40 to more than 60 inches. The Ap and A horizons have value of 2 or 3 and chroma of 1 or 2. They are silt loam or silty clay loam. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. The content of clay in this horizon ranges from 27 to 34 percent. Some pedons have a C

horizon, which is silt loam and has hue of 10YR, value of 4 or 5, and chroma of 3 to 6.

The moderately eroded Tama soils in this county are taxadjuncts to the series because they do not have a mollic epipedon.

## Terril Series

The Terril series consists of moderately well drained, moderately permeable soils on foot slopes, on alluvial fans, and in upland drainageways. These soils formed in loamy colluvium and alluvium. The native vegetation was prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Terril loam, 2 to 5 percent slopes, in a cultivated field; 940 feet south and 60 feet east of the northwest corner of sec. 20, T. 84 N., R. 3 E.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; weak medium subangular blocky structure parting to weak fine granular; friable; few fine roots; neutral; gradual smooth boundary.
- A1—8 to 22 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; common distinct black (10YR 2/1) organic coatings on faces of peds; weak medium and fine subangular blocky structure parting to weak fine granular; friable; few fine roots; mildly alkaline; gradual smooth boundary.
- A2—22 to 33 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; medium distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak very fine granular; friable; few very fine roots; mildly alkaline; gradual smooth boundary.
- BA—33 to 41 inches; very dark grayish brown (10YR 3/2) loam; common distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.
- Bw—41 to 52 inches; brown (10YR 4/3) sandy loam; common distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.
- BC—52 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; neutral.

The thickness of the solum ranges from 36 to more than 60 inches. The Ap and A horizons have value of 2 or 3. They are loam or silt loam. The Bw horizon has chroma of 3 or 4. Some pedons have a C horizon, which is loamy sand or sand.

## Volney Series

The Volney series consists of well drained soils on alluvial fans and in narrow upland drainageways. These soils formed in silty alluvium having varying amounts of limestone and chert fragments (fig. 17). The native vegetation was prairie grasses. Permeability is moderately rapid in the upper part of the solum and very rapid in the lower part and in the substratum. Slopes range from 1 to 7 percent.

Typical pedon of Volney silt loam, in a permanently pastured area of Volney-Dorchester silt loams, 1 to 7 percent slopes; 740 feet west and 60 feet south of the northeast corner of sec. 21, T. 87 N., R. 3 E.

- A1—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine granular structure; friable; common very fine roots; about 2 percent limestone fragments 0.6 centimeter to 7.6 centimeters in size and about 2 percent chert fragments 2 to 10 millimeters in size; very slight effervescence; moderately alkaline; gradual wavy boundary.
- A2—9 to 33 inches; very dark grayish brown (10YR 3/2) very gravelly silt loam, grayish brown (10YR 5/2) dry; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine granular structure; friable; common very fine roots; few dark red (2.5YR 3/6) and few strong brown (7.5YR 5/8) iron accumulations; about 60 percent limestone and chert fragments (10 percent 0.2 centimeter to 0.6 centimeter, 40 percent 0.6 centimeter to 7.6 centimeters, and 10 percent larger than 7.6 centimeters); very slight effervescence; moderately alkaline; gradual wavy boundary.
- C—33 to 60 inches; very dark grayish brown (10YR 3/2) very gravelly silt loam; massive; friable; few very fine roots; few dark red (2/5YR 3/6) and few strong brown (7.5YR 5/8) iron accumulations; about 60 percent limestone and chert fragments (10 percent 0.2 centimeter to 0.6 centimeter, 40 percent 0.6 centimeter to 7.6 centimeters, and 10 percent larger than 7.6 centimeters); slight effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches. Typically, the original A horizon is covered by overwash as much as 18 inches thick. The overwash has value of 3 or 4. Some pedons have no overwash. The original A horizon has value of 2 or 3 and chroma of 1 or 2. By volume, the content of limestone and chert



Figure 17.—Profile of a Volney silt loam in an upland drainageway. The upper 9 inches is recent overwash.

fragments ranges from 0 to 10 percent in the overwash and from 20 to 60 percent in the original A horizon. The C horizon has value of 2 to 4 and chroma of 2 or 3. It contains 35 to 60 percent limestone and chert

fragments by volume. In some pedons the limestone fragments are channers.

### Walford Series

The Walford series consists of poorly drained, moderately slowly permeable soils on high stream benches. These soils formed in loess. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Walford silt loam, benches, 0 to 2 percent slopes, in a cultivated field; 2,200 feet north and 170 feet west of the southeast corner of sec. 30, T. 84 N., R. 5 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

E—9 to 15 inches; gray (10YR 5/1) silt loam, light gray (10YR 7/1) dry; few fine prominent strong brown (7.5YR 4/6) mottles; moderate thin and medium platy structure; friable; few very fine roots; slightly acid; clear smooth boundary.

Btg1—15 to 21 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; moderate fine subangular blocky structure; friable; common distinct dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; medium acid; clear smooth boundary.

Btg2—21 to 28 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; common distinct gray (10YR 5/1) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Btg3—28 to 38 inches; light olive gray (5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

Btg4—38 to 48 inches; light gray (5Y 6/1) silty clay loam; few distinct dark gray (10YR 4/1) organic coatings in root channels; few fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide);

strongly acid; gradual smooth boundary.

Btg5—48 to 60 inches; light olive gray (5Y 6/2) and light gray (5Y 6/1) silty clay loam; common fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; few distinct gray (10YR 5/1) clay films on faces of peds; few dark reddish brown (2.5YR 3/4 and 5YR 3/3) iron accumulations; strongly acid.

The thickness of the solum ranges from 42 to more than 60 inches. The Ap horizon has chroma of 1 or 2. It is 6 to 9 inches thick. The E horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The Btg horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. The content of clay in this horizon ranges from 27 to 35 percent.

### Whittier Series

The Whittier series consists of well drained soils on upland ridges and high stream benches. These soils formed in 24 to 40 inches of loess and in the underlying sandy sediment. The native vegetation was mixed prairie grasses and deciduous trees. Permeability is moderate in the upper part of the solum and rapid in the lower part. Slopes range from 2 to 5 percent.

Typical pedon of Whittier silt loam, 2 to 5 percent slopes, in a cultivated field; 1,460 feet west and 100 feet south of the northeast corner of sec. 19, T. 84 N., R. 5 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak fine subangular blocky structure parting to weak medium granular; friable; common very fine roots; slightly acid; clear smooth boundary.

E—9 to 15 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; common distinct dark brown (10YR 3/3) organic coatings on faces of peds and few distinct very dark grayish brown (10YR 3/2) organic coatings in root channels; weak medium platy structure parting to weak fine subangular blocky; friable; few very fine roots; slightly acid; clear smooth boundary.

EB—15 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; slightly acid; gradual smooth boundary.

Bt1—20 to 30 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium and fine subangular

blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; slightly acid; gradual smooth boundary.

Bt2—30 to 35 inches; yellowish brown (10YR 5/4) loam; moderate medium and fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

2Bt3—35 to 44 inches; yellowish brown (10YR 5/4) loamy sand; weak fine prismatic structure parting to weak medium subangular blocky; very friable; few distinct dark yellowish brown (10YR 5/4) clay films on faces of peds; few prominent strong brown (7.5YR 4/6) and yellowish red (5YR 5/8) iron accumulations; strongly acid; gradual smooth boundary.

2C—44 to 60 inches; yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) loamy sand; single grain; loose; strongly acid.

The thickness of the solum ranges from 30 to 48 inches. The Ap or A horizon has chroma of 2 or 3. It is 6 to 9 inches thick. The E horizon has chroma of 2 or 3. The Bt and 2Bt horizons have value of 4 or 5 and chroma of 3 or 4. Some pedons have a 2BC horizon, which has value of 4 or 5 and chroma of 4 to 6. The 2C horizon has value of 4 or 5 and chroma of 4 to 6. It is loamy sand or fine sand.

### Winneshiek Series

The Winneshiek series consists of moderately deep, well drained, moderately permeable soils on upland ridges and side slopes. These soils formed in loamy material and a thin layer of residuum over dolomitic limestone bedrock. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 14 percent.

Typical pedon of Winneshiek loam, 9 to 14 percent slopes, moderately eroded, in a pasture; 2,180 feet west and 200 feet south of the northeast corner of sec. 8, T. 84 N., R. 3 E.

Ap—0 to 7 inches; very dark brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; few streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; moderate medium subangular blocky structure; friable; common very fine roots; neutral; clear smooth boundary.

BE—7 to 12 inches; dark yellowish brown (10YR 4/4) loam; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; weak medium platy structure parting to moderate medium subangular blocky; friable; few distinct brown (10YR 4/3) clay

films on faces of peds; common very fine roots; neutral; clear smooth boundary.

Bt1—12 to 18 inches; dark yellowish brown (10YR 4/4) loam; moderate medium and fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; common very fine roots; neutral; gradual smooth boundary.

Bt2—18 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine prismatic structure parting to strong medium subangular blocky; firm; many distinct brown (7.5YR 4/4) clay films on faces of peds; few very fine roots; neutral; clear smooth boundary.

2Bt3—24 to 29 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/6) clay; moderate fine subangular blocky structure parting to strong fine angular blocky; very firm; many distinct dark brown (7.5YR 4/4) clay films on faces of peds; few very fine roots; neutral; abrupt wavy boundary.

2R—29 inches; yellow (10YR 7/6), weathered bedrock about 1 inch thick over hard, fractured dolomitic limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The Ap horizon has value of 2 or 3. It is loam or silt loam. It is 6 to 9 inches thick. The BE and Bt horizons have chroma of 3 or 4. They are loam or clay loam. The 2Bt horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 8. It is silty clay or clay. It is 1 to 5 inches thick.

### Worthen Series

The Worthen series consists of well drained, moderately permeable soils on foot slopes, on alluvial fans, and on foot slopes adjacent to upland drainageways. These soils formed in more than 60 inches of silty colluvium and alluvium. The native vegetation was prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Worthen silt loam, 2 to 5 percent slopes, in a cultivated field; 1,230 feet west and 60 feet south of the northeast corner of sec. 31, T. 84 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate medium and fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

A—9 to 18 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; few

distinct black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate medium and fine granular; friable; few very fine roots; neutral; gradual smooth boundary.

AB—18 to 26 inches; very dark grayish brown (10YR 3/2) silt loam; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

Bw1—26 to 35 inches; brown (10YR 4/3) silt loam; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; medium acid; gradual smooth boundary.

Bw2—35 to 46 inches; yellowish brown (10YR 5/4) silt loam; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; weak medium prismatic structure parting to moderate medium and fine subangular blocky; friable; few distinct dark grayish brown (10YR 4/2) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; medium acid; gradual smooth boundary.

BC—46 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct strong brown (7.5YR 5/8) and common fine distinct light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure; friable; few distinct light gray (10YR 7/2 dry) silt coatings on faces of peds; few very fine roots; few reddish brown (5YR 4/4) iron accumulations; medium acid.

The thickness of the solum ranges from 30 to 60 inches. The combined thickness of the Ap and A horizons is 16 to 24 inches. These horizons have value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 or 5 and chroma of 3 or 4.

## Zwingle Series

The Zwingle series consists of poorly drained, very slowly permeable soils on stream terraces. These soils formed in clayey lacustrine sediment. The native vegetation was deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Zwingle silt loam, 0 to 2 percent slopes, in a pasture; 1,000 feet east and 100 feet north of the center of sec. 24, T. 87 N., R. 4 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; mixed with some streaks and pockets of brown (10YR 4/3 and 5/3) subsurface material; weak thin platy

structure parting to weak fine granular; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 13 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films and few distinct very pale brown (10YR 8/3 dry) silt coatings on faces of peds; common very fine roots; few dark concretions (iron and manganese oxide); medium acid; gradual smooth boundary.

Bt2—13 to 20 inches; brown (7.5YR 5/4) clay; strong fine subangular blocky structure; very firm; many distinct reddish brown (5YR 4/3) clay films on faces of peds; common very fine roots; strongly acid; gradual smooth boundary.

Bt3—20 to 32 inches; yellowish brown (10YR 5/4) clay; few fine faint light brownish gray (10YR 6/2) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to strong medium subangular blocky; very firm; many distinct brown (7.5YR 4/4) clay films on faces of peds; few very fine roots; very strongly acid; gradual smooth boundary.

Bt4—32 to 40 inches; brown (7.5YR 5/4) clay; few fine distinct light brownish gray (10YR 6/2) and common fine distinct yellowish red (5YR 4/6) mottles; moderate fine prismatic structure parting to strong medium subangular blocky; very firm; many distinct reddish brown (5YR 4/4) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); very strongly acid; gradual smooth boundary.

Bt5—40 to 50 inches; brown (7.5YR 5/4) silty clay; few fine distinct light brownish gray (10YR 6/2) and common fine faint strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; very firm; common distinct reddish brown (5YR 4/4) clay films and few distinct white (10YR 8/1 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

BC—50 to 60 inches; brown (7.5YR 5/4 and 4/4) silty clay; few fine distinct light brownish gray (10YR 6/2) and common fine distinct yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; very firm; common distinct light gray (10YR 7/1 dry) silt coatings on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); strongly acid.

The thickness of the solum ranges from 36 to 60 inches. The Ap horizon has value of 4 or 5 and chroma

of 1 or 2. It is silt loam or silty clay loam. Some pedons have an A horizon and some have an E horizon. These horizons are silt loam. The A horizon has value of 3 and chroma of 1 or 2. It is less than 5 inches thick. The E horizon has value of 5 or 6 and chroma of 2. The Bt horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. The content of clay in this horizon typically ranges from 50 to 60 percent. In some pedons, however, it is as much as 70 percent.

### Zwingle Variant

The Zwingle Variant consists of poorly drained, very slowly permeable soils on high stream terraces. These soils formed in clayey lacustrine sediment. The native vegetation was deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Zwingle Variant silty clay, 0 to 2 percent slopes, in a wooded pasture; 1,900 feet south and 150 feet east of the northwest corner of sec. 1, T. 84 N., R. 6 E.

A—0 to 4 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) dry; moderate fine and medium granular structure; firm; many very fine and fine roots; very strongly acid; clear smooth boundary.

Bt1—4 to 14 inches; grayish brown (2.5Y 5/2) clay; few fine prominent strong brown (7.5YR 5/6) mottles; strong fine and medium subangular blocky structure; very firm; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); extremely acid; gradual smooth boundary.

Bt2—14 to 26 inches; grayish brown (2.5Y 5/2) clay; common fine prominent strong brown (7.5YR 5/6) mottles; strong fine and very fine angular and subangular blocky structure; very firm; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); extremely acid; gradual smooth boundary.

Bt3—26 to 38 inches; yellowish brown (10YR 5/4) clay; few fine distinct strong brown (7.5YR 5/6) mottles; strong fine and very fine angular and subangular blocky structure; very firm; few distinct light brownish gray (10YR 6/2) clay films on faces of peds; few very fine roots; few dark concretions (iron and manganese oxide); 0.5-inch stratum of reddish brown (5YR 4/3) material at a depth of about 33 inches; extremely acid; clear smooth boundary.

Bt4—38 to 48 inches; reddish brown (2.5YR 4/4) clay; few medium distinct reddish brown (5YR 4/4) mottles; moderate fine prismatic structure parting to strong fine and medium subangular blocky; very firm; few distinct reddish brown (5YR 4/3) clay films on faces of peds; few dark concretions (iron and manganese oxide); few dark reddish brown (5YR 3/3) iron accumulations; few soft accumulations (calcium carbonate); neutral; gradual smooth boundary.

BC—48 to 60 inches; brown (7.5YR 4/4) silty clay; common medium distinct strong brown (7.5YR 5/6) and few fine distinct reddish brown (5YR 4/4) mottles; weak fine prismatic structure parting to moderate fine and medium subangular blocky; very firm; few distinct dark brown (7.5YR 4/2) clay films on faces of peds; few dark concretions (iron and manganese oxide); few soft accumulations (calcium carbonate); mild effervescence; mildly alkaline.

The thickness of the solum ranges from 48 to more than 60 inches. The A horizon has value of 2 or 3 and chroma of 1 to 3. It is 3 to 10 inches thick. It is silty clay or silty clay loam. The upper part of the Bt horizon has value of 4 to 6 and chroma of 1 or 2. The lower part has hue of 2.5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. Mottles in the Bt horizon have hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 to 8. The content of clay in this horizon typically ranges from 60 to 90 percent. In some pedons, however, this horizon is silty clay and has a content of clay that ranges from 40 to 60 percent.

# Formation of the Soils

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This section describes the factors that have affected soil formation in Jackson County. It also describes the processes of soil formation.

## Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material (10).

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

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

## Parent Material

The accumulation of parent material is the first step in the formation of a soil. Most of the soils in the county formed in material that was transported from the site of the parent rock and redeposited at a new location through the action of glacial ice, water, wind, and gravity. A few soils, however, formed partially in material weathered from bedrock. The principal kinds of parent material in Jackson county are loess, alluvium,

lacustrine material, residuum, sandy eolian material, and glacial drift (fig. 18).

*Loess*, or silty material deposited by wind, covers about 80 percent of the county. It is about 15 to 20 feet thick on the more stable ridges and less than 2 feet to 10 feet thick on side slopes. It is underlain by glacial drift, limestone bedrock, or shale. The base of the Wisconsin-age loess in Iowa is 16,500 to 29,000 years old (16). Loess consists mostly of silt particles and some clay particles. It does not contain coarse sand and gravel, which are too large to be moved by the wind, but it does contain small amounts, generally less than 10 percent, of fine sand and very fine sand.

Downs, Fayette, Rozetta, and Tama soils formed in a layer of loess more than 60 inches thick. Dubuque, Frankville, and NewGlarus soils formed in loess less than 40 inches deep over limestone bedrock. Dinsdale soils formed in loess 20 to 40 inches deep over glacial till. Derinda and Schapville soils formed in loess underlain by shale.

*Alluvium* is material deposited by water along rivers and streams. Alluvial material of Late Wisconsin age or younger has been deposited on flood plains and stream terraces in the county. About 14 percent of the soils in the county formed in this material. These soils are mainly along the North Fork of the Maquoketa River, the Maquoketa and Mississippi Rivers, and their tributaries. Large flood plains are along the Mississippi and Maquoketa Rivers. A stream terrace about 1,200 acres in size is in an area along the Mississippi River near the town of Bellevue.

Much of the alluvium in Jackson County washed from soils on loess-covered slopes in the uplands. This alluvial sediment is silty and has a low content of sand. Arenzville, Chaseburg, Orion, Lawson, and Otter are examples of silty soils that formed in alluvium. Perks and Terril soils also formed in alluvium. They have a higher content of sand than the silty soils.

The alluvial soils may be characterized by chemical and mineralogical differences. Caneek, Dorchester, and Volney are examples of calcareous soils that formed in recently deposited alluvium. The other soils derived

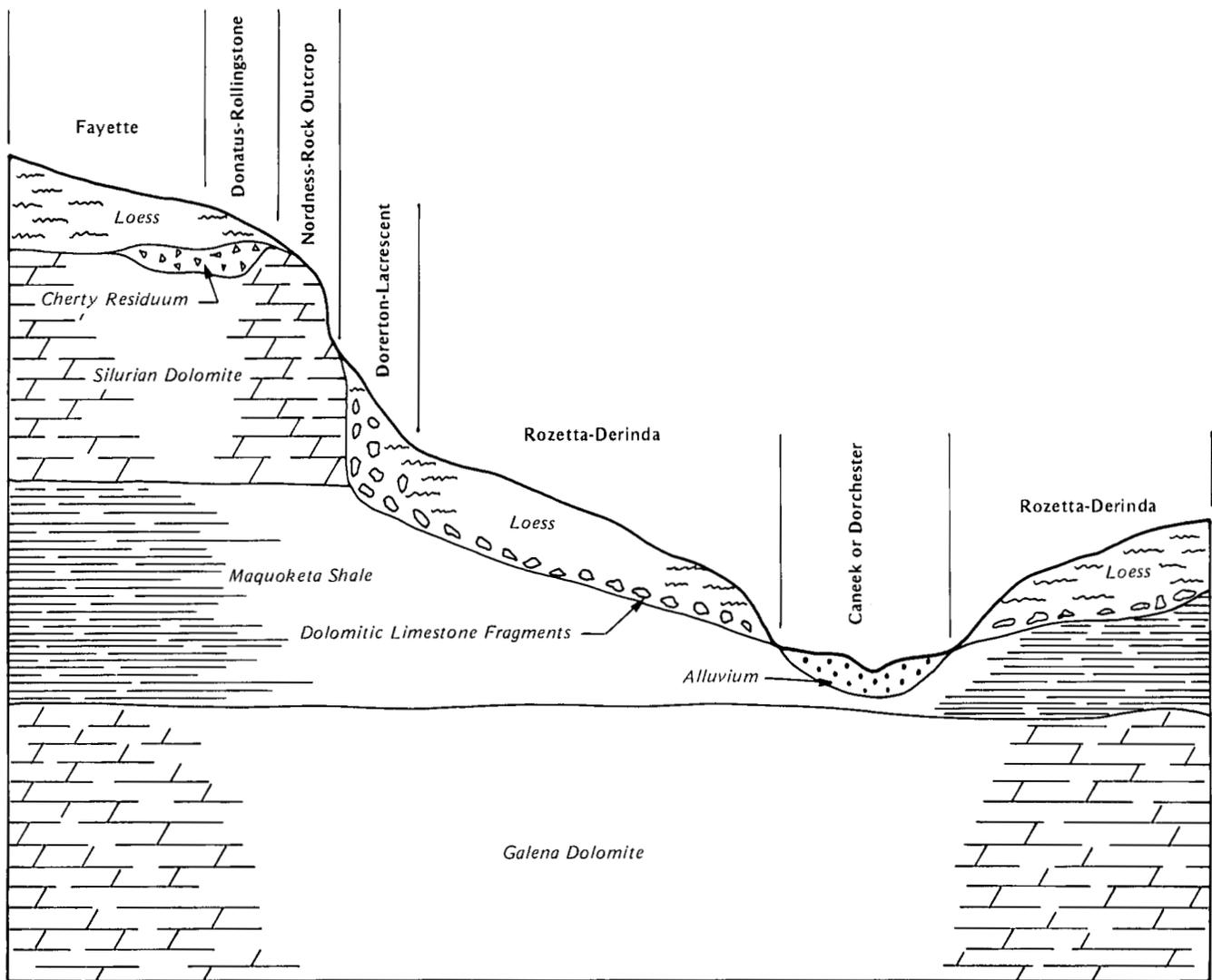


Figure 18.—A cross section indicating the major kinds of parent material in Jackson County.

from alluvium on flood plains are free of carbonates and are neutral to medium acid.

Some alluvial material has been transported only a short distance and has accumulated at the foot of the slope on which it originated. It retains many of the characteristics of the soil from which it was eroded. Worthen and Ely are examples of soils that formed in this type of material.

The soils on stream terraces or second bottoms also formed in alluvium. They are above the present flood plains and generally are not flooded. They vary in texture. Most of these soils are underlain by coarser textured material at a depth of 4 to 6 feet. Festina and Richwood are examples of soils that formed in silty alluvium.

*Lacustrine material* is a unique form of alluvial sediment in Jackson County. It is along the Mississippi River and its tributaries. It consists of 3 to 5 feet of clayey lacustrine sediment with a content of clay that ranges from 40 to 90 percent. The clayey sediment is underlain by stratified silty to sandy alluvial sediment.

According to some studies, the source of the lacustrine material was the preexisting glacial lake at the headwaters of the Mississippi River (13). The sediment was carried down the channel of the river while being held in suspension by turbulent water. As the water inundated the tributaries, the turbulence diminished. As the water evaporated, gently receded, or soaked into the soil mantle, sediment having a high content of clay was left behind. Later, when the river cut

its channel deeper, these deposits were left on high terraces. This sediment is relatively recent. It was deposited after the deposition of loess ceased, about 14,000 years ago. Medary Variant, Zwingle, and Zwingle Variant soils formed on these stream terraces.

*Residuum* is material that weathered in place from sedimentary rocks. Dolomitic limestone and shale are the primary types of sedimentary rocks in Jackson County. The bedrock formations in the county are part of the Ordovician and Silurian Systems (7). The rocks of the Ordovician System were deposited about 425 to 475 million years ago. They make up the Maquoketa Shale and Galena Limestone Formations (5). These formations crop out in an area in the northeast corner of the county designated as the Paleozoic Plateau (14). The rest of the county is underlain by rocks of the Silurian System, which are 410 to 425 million years old. These rocks make up the Edgewood, Kankakee, and Hopkinton Dolomitic Limestone Formations (5).

Emeline and Nordness soils are underlain by limestone bedrock at a depth of 20 inches or less. Nordness soils formed in loess and residuum. They are underlain by dolomitic limestone bedrock of the Ordovician or Silurian System. Emeline soils formed in loamy material or limestone residuum. They are underlain by bedrock only of the Silurian System. Dontaus soils formed in loess and 10 to 20 inches of residuum having a high content of chert. The bedrock underlying these soils generally is in the Kankakee Formation of the Silurian System. Derinda and Schapville soils formed in loess and in material weathered from shale of the Maquoketa Formation.

In Jackson County the thickness of the layer of residuum over unweathered limestone bedrock ranges from less than 5 inches to about 20 inches. The residuum commonly is silty clay or clay. It generally has a reddish hue. A deposit of loess overlies a thin layer of residuum in Dubuque soils and a thicker layer of residuum in NewGlarus soils. A layer of loamy material overlies a thin layer of residuum in Winnesheik soils.

*Sandy eolian material* is not extensive in Jackson County. Generally, it is deposited along the valley of the major streams. It is much higher in content of sand than the deposits of loess. It occurs as low mounds or dunes in some areas of glacial till. In these areas it is underlain by till at various depths.

Wind-deposited sand is mainly fine and very fine quartz that is highly resistant to weathering. It has not been altered appreciably since it was deposited. Chelsea and Sparta soils formed mainly in wind-deposited loamy sand and sand. Orwood soils formed in wind-deposited loamy material.

*Glacial drift* is rock material transported and deposited by glaciers. It includes glacial outwash and glacial till. Glacial outwash is material deposited by bodies of glacial meltwater. Glacial till is unsorted sediment that ranges in size from boulders to clay-sized particles. At least twice during the glacial period, continental ice or glaciers moved over the county. The record of these ice invasions is contained in the unconsolidated rock material that was deposited by the melting ice and meltwater streams. The older ice sheet, known as the Nebraskan Glaciation, occurred about 750,000 years ago (14). It was followed by the Aftonian interglacial period. The Kansan Glaciation is thought to have started about 500,000 years ago. A third period of glaciation, the lowan substage of the Wisconsin Glaciation, formerly was recognized (11) but is now considered questionable. Intensive geomorphic and stratigraphic studies indicate that the landscape is actually a multilevel sequence of erosion surfaces. Many of the levels are cut into the Kansan and Nebraskan Till (17).

At one time the northeastern part of Jackson County was considered by geologists to be part of an unglaciated area referred to as the "Driftless Area" (12). Thin, isolated patches of drift, probably of Nebraskan age, however, are in the Iowa part of this area (14). In the northeastern part of Jackson County, the influence of glacial drift on the landscape is minimal and the terrain is dominated by the Silurian and Ordovician rock formations.

Glacial drift is not extensive in Jackson County. Racine and Floyd soils formed in loamy or silty sediment and in the underlying glacial till on the lowan erosion surface. Floyd soils, which are on the lower concave slopes and along drainageways, are deeper to glacial till than Racine soils. A stone line or pebble band commonly separates the friable, loamy surficial sediment from the firm, loamy glacial till.

Some soils in Jackson County formed in glacial till in areas on uplands where geologic erosion has removed loess from many steep side slopes and exposed the glacial till. Lindley soils are an example.

## Climate

The soils in Jackson County probably formed under the influence of a midcontinental, subhumid climate for at least 5,000 years. From 5,000 to 16,000 years ago, the climate favored the growth of forest vegetation (15). The morphology of most of the soils in the county indicates that the climate under which they formed was similar to the present one. The climate generally is uniform throughout the county but is marked by wide

seasonal extremes in temperature. Precipitation is distributed throughout the year.

Climate is a major factor in determining what soils form in the various kinds of parent material. It affects the rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions in the soil. Temperature, rainfall, relative humidity, and length of the frost-free period affect the kind of vegetation on the soil.

The influence of the general climate of the region is somewhat modified by local conditions. For example, soils on south-facing slopes formed under a microclimate that is warmer and drier than the average climate in nearby areas. Poorly drained soils in low areas formed under a climate that is wetter and colder than that in most of the surrounding areas. These local conditions account for some of the differences between soils that are within the same general climatic region.

### **Plant and Animal Life**

Plant and animal life is an important factor of soil formation. Plants are especially significant. Soil formation really begins with the growth of vegetation. As plants grow and die, they add organic matter to the upper layers of the soil material. Native grasses have myriad fibrous roots that penetrate the soil to a depth of 10 to 20 inches and add large amounts of organic matter to the surface layer. Trees commonly feed on plant nutrients deep in the subsoil. Consequently, they add little organic matter to the surface layer other than that added by falling leaves and dead trees. Much of the organic matter from dead trees remains on the surface or is lost through decomposition.

Pillot and Tama are examples of soils that formed under prairie grasses. Garwin and Dolbee are examples of soils that formed under grasses and water-tolerant plants. Dubuque, Fayette, and Lindley are examples of soils that formed under trees. Atterberry, Downs, and Racine soils have properties that are intermediate between those of the soils that formed entirely under forest vegetation and those that formed entirely under prairie grasses. Soils that formed under trees have a dark surface layer that generally is less than 5 inches thick. They have a lighter colored E horizon directly below the surface layer. In contrast, soils that formed under prairie vegetation contain a large amount of organic matter derived from roots and have a thick, dark surface layer.

Tama, Downs, and Fayette soils are members of a biosequence, which is a group of soils that formed in the same kind of parent material and in a similar environment but that supported different kinds of native vegetation. Variations in the native vegetation caused

the main morphological differences among the soils in this group.

The activities of burrowing animals and insects have some effect on soil formation. They loosen and aerate the upper few feet of the soils.

### **Relief**

Relief can cause important differences among soils. Indirectly, it influences soil formation through its effect on drainage. The soils in Jackson County range from nearly level to very steep. Many nearly level soils are frequently flooded and have a seasonal high water table. Water soaks into the nearly level soils that are not flooded. Much of the rainfall runs off the surface of the more sloping soils, and less of it penetrates the surface.

Garwin and Dolbee soils formed under the influence of a seasonal high water table and have a dominantly olive gray subsoil. Soils that formed in areas where the water table was below the subsoil have a yellowish brown subsoil. Examples are Downs, Fayette, Festina, and Tama soils. Atterberry, Canoe, Muscatine, Rowley, and other soils that formed in areas where natural drainage was intermediate have a grayish brown, mottled subsoil. Of the soils that formed under prairie vegetation, those that have a high water table generally have more organic matter in the surface layer than those that are characterized by good natural drainage.

Aspect and gradient significantly influence soil formation. South-facing slopes generally are warmer and drier than north-facing slopes and consequently support a different type and amount of vegetation.

The influence of porous, rapidly permeable parent material can prevail over the influence of topography. For example, Finchford soils are level to gently sloping, but they are excessively drained because they have a very rapidly permeable subsoil and substratum.

The nearly level Walford and Atterberry and gently sloping Downs soils are examples of soils that formed in the same kind of parent material and under similar vegetation but that differ from each other because of slight variations in topographic position. Their microrelief affects runoff and the depth to a water table. Walford soils, which are in level or slightly depressional areas on high stream benches, are poorly drained. Atterberry soils, which are on slight rises, are somewhat poorly drained. Downs soils, which are in the higher areas on the stream benches, are well drained.

Topography also affected the formation of Worthen and Nordness soils. Worthen soils are on foot slopes, alluvial fans, and in some upland drainageways. They have properties similar to those of the higher lying soils

from which they received sediments. In many areas Nordness soils are steep or very steep. Because most of the rainfall in these areas runs off the surface and does not enter the soils, the effects of soil formation are minimized.

### Time

Time is necessary for the various processes of soil formation. The amount of time necessary ranges from a few years for the formation of a thin A horizon in fresh alluvial deposits, such as that in Caneek silt loam, channeled, 0 to 2 percent slopes, to a thousand years or more for the formation of the subsoil in many of the older soils on uplands. The older soils have well defined genetic horizons. Downs and Fayette soils are examples. The younger soils have weakly expressed horizons. Some of the soils that formed in alluvium, for example, show little or no evidence of profile development because they periodically receive fresh material when they are flooded. The material has not been in place long enough for the formation of well defined genetic horizons.

If other factors are favorable, the texture of the subsoil in most soils becomes finer and a greater amount of soluble material is leached out as the soils continue to weather. Exceptions are Sparta and other soils that formed in quartz sand or in other material that is resistant to weathering. These soils do not change much over a long period. Another exception is the steep Nordness soils, which form more slowly than the less sloping soils in stable areas because only a small amount of water penetrates the surface and a large amount runs off.

Where organic material has been buried by later deposition through the action of ice, water, or wind, the age of a landscape can be determined by radiocarbon dating. The loess in which Downs, Fayette, and Tama soils formed is probably about 14,000 to 20,000 years old. Recent studies show that the Iowa erosion surface formed during the time of loess deposition. Radiocarbon dating indicates that this was 14,000 to 20,000 years ago. In areas where the lowan surface is covered by loamy surficial sediment, it is less than 14,000 years old (16). The soils on the side slopes of this landscape, such as the Racine soils, are probably much younger. Floyd soils are even younger. They are cut in and below the Racine soils. They formed in the erosional sediment derived from these higher lying soils and in the underlying glacial till.

### Human Activities

Important changes took place when Jackson County was settled. Some changes had little effect on soil

productivity; others had drastic effects. The most apparent effects are those caused by water erosion. Breaking the prairie sod and clearing the timber removed and changed the protective plant cover.

Cultivation increases the susceptibility of the more sloping areas to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is the most prevalent kind of erosion in this county, removes a few inches of topsoil at a time, but cultivation generally destroys all evidence of this loss. In some areas, shallow and deep gullies have formed and the material removed through erosion has been deposited on the lower part of the slopes. As the land was brought under cultivation, the runoff rate increased and the rate at which water moved into the soil decreased. As a result, accelerated erosion has removed part or all of the original surface layer from many of the more sloping soils.

Erosion has changed not only the thickness of the surface layer but also its structure and consistence. In severely eroded areas the plow layer commonly includes the upper part of the subsoil, which is less friable and finer textured than the surface layer.

Erosion and cultivation also affect the soil by reducing the organic matter content and the level of fertility. Even in areas not subject to erosion, compaction caused by heavy machinery reduces the thickness of the surface layer and changes the soil structure. Granular structure, which is so apparent on natural grassland, breaks down under intensive cropping. The surface soil tends to bake and become hard when dry. Fine textured soils that have been plowed year after year during wet periods tend to puddle and are less permeable than similar soils in undisturbed areas.

Arenzville, Caneek, and Dorchester soils show the influence of human activities. They have layers of light and dark material washed from the hillsides and deposited by floodwater. This erosion began when the hillsides were first cultivated.

Some human activities have increased the productivity of the soils, decreased soil loss, and reclaimed areas not suitable for crops or pasture. For example, terraces and other measures have helped to control runoff and erosion. Diversions at the base of slopes and drainage ditches have helped to control flooding and deposition and thus have made large areas of bottom land suitable for cultivation. Applications of commercial fertilizer and lime have made many soils more productive now than they were in their natural state.

Water erosion is responsible for most of the loss of organic matter in soils. As much as one-third of the

organic matter, however, can be lost through other means (20). Maintaining as high a reserve of organic matter as was originally present under native grasses is not economically feasible. Measures that maintain a level that is adequate for crops, however, are needed.

## Processes of Horizon Differentiation

Horizon differentiation is caused by four basic kinds of change. These are additions, removals, transfers, and transformations (19). Each of these kinds of change affects many of the substances that make up soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay minerals. In general, these processes tend to promote horizon differentiation, but some tend to offset or retard it. The processes and the resulting changes proceed simultaneously in soils, and the ultimate nature of the profile is governed by the balance of these changes.

The accumulation of organic matter is an early step in the process of horizon differentiation in most soils. The content of organic matter ranges from very high to very low in the A horizon of the soils in Jackson County. The A horizon in Fayette soils is lower in organic matter content than the A horizon in Garwin soils. In some soils the content formerly was quite high but is now low because of erosion.

The removal of substances from parts of the soil profile is important in the differentiation of soil horizons. The downward movement of calcium carbonates and bases is an example. The upper part of all the soils in the county, except for Caneek and Dorchester soils, has been leached of calcium carbonates. The subsoil of some soils has been so strongly leached that it is strongly acid or very strongly acid.

The transfer of substances from one horizon to another is evident in the soils of the county. Phosphorus is removed from the subsoil by plant roots and transferred to parts of the plant growing above the ground. It is then added to the surface layer in the plant

residue. This process affects the form and distribution of phosphorus in the profile.

The translocation of silicate clay minerals is an important process of horizon differentiation. The clay minerals are carried downward in suspension in percolating water from the A horizon. They accumulate in the B horizon in pores and root channels as clay films on faces of peds. This process has influenced many of the soils in Jackson County. In other soils, the content of clay in the A horizon is not markedly different from that in the B horizon and other evidence of clay movement is minimal.

Another kind of transfer that occurs to some extent in very clayey soils is that brought about by shrinking and swelling. Cracks form as the soils shrink and swell. As a result, some material from the surface layer is transferred to the lower part of the profile. Zwingle Variant and Zwingle are examples of soils in which this kind of physical transfer can take place.

Transformations are physical or chemical. The weathering of soil particles to smaller sizes is an example of a physical transformation. Gleying, or the reduction of iron, is an example of a chemical transformation. This process occurs when poorly drained soils, such as Otter soils, are saturated for long periods. These soils have enough organic matter for biological activity to take place during the periods of saturation. Gleying is evidenced by the presence of ferrous iron and gray colors. Reductive extractable iron, or free iron, is normally lower in the profile in somewhat poorly drained soils such as Lawson soils, than in more poorly drained soils.

Another kind of transformation is the weathering of primary apatite minerals in the parent material to secondary phosphorus compounds. At a pH near 7, apatite is weathered to secondary phosphorus compounds. Thus, soils that have a pH of more than 7, such as Dorchester soils, have less available phosphorus than soils that have a pH near 7, such as Otter soils.

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# Glossary

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**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low .....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High .....	9 to 12
Very high.....	more than 12

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Benches (geologic).** Higher, older terraces (old alluvial plains) that are now a part of the erosion surface of the valley. In Iowa, the benches are of pre-Wisconsin age and are covered with loess.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

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

**Channery soil.** A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

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

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

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

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

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

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

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

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

*Cemented*.—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Crop rotation.** A planned sequence of crops, including grasses and legumes, growing in a regularly recurring succession in the same area, as contrasted to growing the same crop year after year or growing crops in a haphazard order.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Dense layer** (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial

saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained*.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained*.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious.

Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained*.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained*.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained*.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained*.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained*.—Water is removed from the

soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

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

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion (geologic).* Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion (accelerated).* Erosion much more rapid than geologic erosion, mainly as a result of human or other animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Fine textured soil.** Sandy clay, silty clay, or clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial outwash** (geology). Gravel, sand, and silt,

commonly stratified, deposited by glacial meltwater.

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

**Grade stabilization structure.** A structure used to control and stabilize the grade and control erosion in natural or artificial channels. It helps to prevent the formation of gullies.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the

underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon.*—Soft, consolidated bedrock beneath the soil.

*R layer.*—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Lacustrine deposit** (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil

passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to

permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percolates slowly** (in tables). The slow movement of water through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile.

Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow .....	less than 0.06 inch
Slow .....	0.06 to 0.2 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

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

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in

composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Sinkhole.** A depression in the landscape where limestone has been dissolved.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

**Stone line.** A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

**Stratified.** Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff

so that water soaks into the soil or flows slowly to a prepared outlet.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). Otherwise suitable soil material too thin for the specified use.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Variant, soil.** A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

