



United States  
Department of  
Agriculture

Soil  
Conservation  
Service

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

# Soil Survey of Muscatine County, Iowa





# How To Use This Soil Survey

## General Soil Map

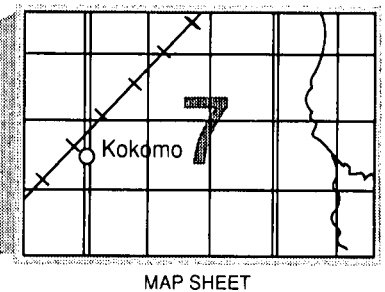
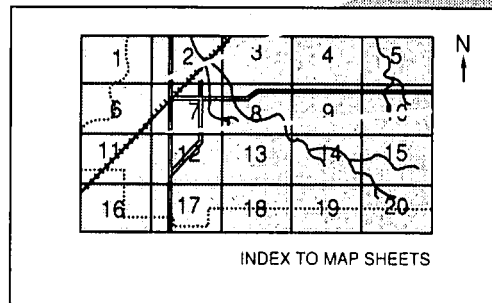
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

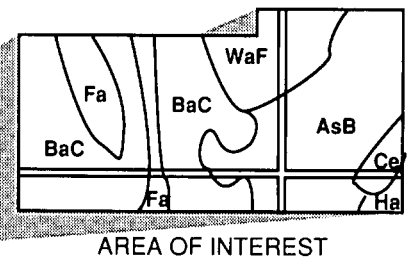
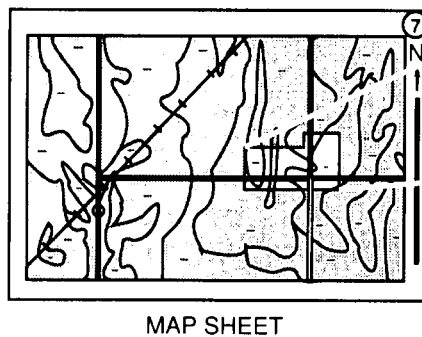
## Detailed Soil Maps

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.



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.



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. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in the period 1980-85. Soil names and descriptions were approved in January. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Muscatine County Soil Conservation District. Funds appropriated by Muscatine 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.

**Cover: Sprinkler irrigation improves soybean yields in an area of Fruitfield soils.**

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# Preface

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This soil survey contains information that can be used in land-planning programs in Muscatine County, Iowa. 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 Muscatine County, Iowa

By Wayne N. Dankert, Soil Conservation Service

Fieldwork by Thomas F. Brantmeier, Wayne N. Dankert, Paul P. Viner, Soil Conservation Service, and Richard Hafner, Iowa State University

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

MUSCATINE COUNTY is in the southeastern part of Iowa. The Mississippi River forms part of the east and south boundary of the county (fig. 1). The total area of the county is 283,200 acres, or 442.5 square miles. Muscatine, the county seat, is on the southeastern edge of the county where the flow of the Mississippi River turns south.

According to the 1980 census, the population of Muscatine County is about 40,435. The population of Muscatine, the biggest town, is about 23,470, that of West Liberty is about 2,725, and that of Wilton is about 2,500. The populations of Atalissa, Conesville, Nichols, and Stockton each range from about 200 to 400.

The landscape varies throughout the county. The western part, except for the extreme northwestern part, is a broad, level to gently undulating terrace. The southeastern part is broad, level to gently undulating bottom land. In both of these areas the surface drainage pattern is poorly defined and has many depressions or low areas. In most of the rest of the county the surface drainage pattern is well defined. Most of the soils are deep, silty or loamy, and nearly level to gently sloping. The elevation ranges from about 815 to 535 feet above sea level.

Farming and manufacturing are the main enterprises in the county. Corn and soybeans are the main crops. Manufacturing, including processing agricultural

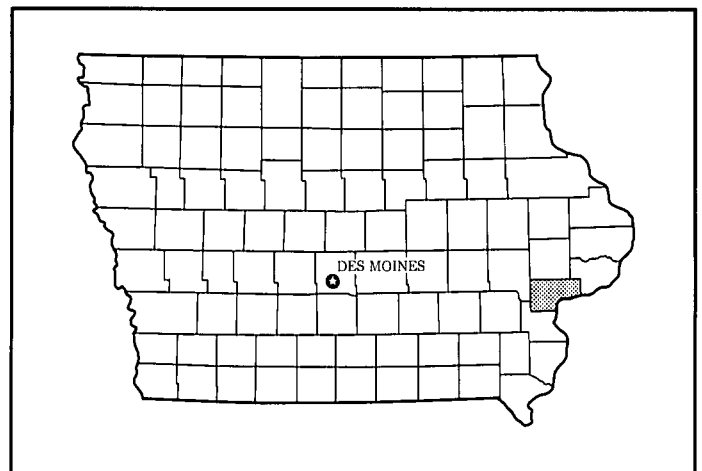


Figure 1.—Location of Muscatine County in Iowa.

products, is located mainly in the vicinity of Muscatine, West Liberty, and Wilton. Transportation and commercial and recreational fishing are the main uses of the Mississippi River.

This survey updates the soil survey of Muscatine County published in 1916 (28). It provides additional information and larger maps which show the soils in greater detail.

## General Nature of the County

This section gives information on the history and development, climate, and transportation facilities of Muscatine County. The climate, the distribution of soils, and the proximity of the Mississippi River have affected the pattern of development in the county and the kinds and locations of cultural features.

## History and Development

Native American Indians lived in the county for many years. Their artifacts and ceremonial mounds are mostly of Middle Woodland and Late Woodland Indian cultures. The Indians used many of the resources of the county in farming, gathering, hunting, and fishing (3).

The county was named for the historic Muscouteau Indians, who lived on what is now called Muscatine Island when the first settlers arrived in 1833. The settlers established a trading post where the city of Muscatine is now located. Early enterprises included lumbering, wood product finishing, and pork processing. Farming was also important, especially in areas with a relatively high proportion of well drained soils, such as Downs, Fayette, and Tama.

Drainage was begun in the late 1800's. Individual and group drainage projects were made to allow row cropping on the poorly drained and very poorly drained soils, which make up about 44 percent of the county. Drainage improvement projects are still in progress, mainly in cultivated areas to improve suitability of the soils for farming. In recent years the acreage used for row crops has increased. Most of this increase has been on soils on bottom land, where flooding is a hazard, and on strongly sloping to steep soils on upland side slopes, where erosion is a severe hazard.

Since Muscatine County was settled, the total acreage in farms has remained fairly constant. In recent years the farms in the county have been increasing in size and decreasing in number. The county had 1,820 farms in 1910 (28). It had 1,643 in 1953, 1,387 in 1963, and 930 in 1983. The average size of a farm was 142 acres in 1910, 162 acres in 1953, 192 acres in 1963, and 270 acres in 1983.

On about 84 percent of the acreage in Muscatine County, the slope is 5 percent or less. Most of the soils on these slopes are well suited to row crops and are commonly used for corn and soybeans. Some of the soils on these slopes are coarse textured and droughty, and some are difficult or costly to artificially drain. Corn is the main crop in the county, but the acreage of soybeans has increased in recent years. In 1962

soybeans were grown on about 9 percent of the farmland. By 1972 they were grown on about 16 percent of the farmland and by 1982 on 20 percent. In 1982 corn was grown on about 106,000 acres, soybeans on 41,000 acres, all varieties of hay on 12,100 acres, and oats on 8,100 acres.

Much of the corn and soybean production is sold to processors or shippers, but some is fed to livestock. In recent years the number of grain-fed cattle sold has slightly decreased and the number of hogs farrowed, raised, and sold has slightly increased. In 1982, about 11,100 fed cattle and 170,000 fed hogs were marketed. In that year beef cattle numbered 11,700, milk cows 1,900, and hogs and pigs 110,000 (27).

## Climate

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Muscatine in the period 1951 to 1981. 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 25 degrees F, and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Muscatine on January 12, 1974, is -21 degrees. In summer the average temperature is 74 degrees, and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Muscatine on July 1, 1956, is 104 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, 23 inches, or about 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 9.5 inches at Muscatine on June 7, 1967. Thunderstorms occur on about 48 days each year, and most occur in summer.

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, 30



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 west-northwest. Average windspeed is highest, 12 miles per hour, in spring.

## Transportation Facilities

Muscatine County is served by a federal highway, three state highways, and numerous all-weather, surfaced county roads. County roads surfaced with crushed limestone rock follow many section lines.

The county is served by two railroad companies and two bus companies. Commercial charter service is available at the Muscatine Airport. Barge loading and unloading facilities on the Mississippi River permit the efficient marketing of the county's grain and other products and reduce the transportation cost of imported products.

## 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 soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the 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 considerable 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, soil 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 interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were 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 were 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 state with a fairly high degree of probability 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.

The soils in the county vary widely in their potential for major land uses. Soil potential ratings are based on the practices commonly used in the county to overcome soil limitations. These ratings reflect the ease of overcoming limitations. They also reflect the problems that will persist even if such practices are used.

Each association is rated for *cultivated crops, specialty crops, woodland, urban uses, and recreation areas*. Cultivated crops are those grown extensively in the survey area. Specialty crops are the vegetables and fruits that generally require intensive management. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

## Soil Descriptions

### 1. Garwin-Muscatine-Tama Association

*Nearly level to moderately sloping, poorly drained,*

*somewhat poorly drained, and well drained, silty soils that formed in loess; on uplands*

This association consists of soils on nearly level and gently sloping broad ridgetops and gently sloping and moderately sloping, relatively undissected side slopes. Slopes range from 0 to 9 percent.

This association makes up about 18 percent of the county. It is about 24 percent Garwin soils, 23 percent Muscatine and similar soils, 19 percent Tama soils, and 34 percent soils of minor extent (fig. 2).

Garwin soils are poorly drained and nearly level and are on broad ridgetops and at the head of some drainageways. Muscatine soils are somewhat poorly drained and nearly level and are on broad ridgetops. Tama soils are well drained, are gently sloping and moderately sloping, and are on convex ridgetops and side slopes.

Typically, the surface layer of Garwin soils is black silty clay loam about 8 inches thick. The subsurface layer is very dark gray silty clay loam about 11 inches thick. It has mottles in the lower part. The subsoil is friable, mottled silty clay loam about 31 inches thick. In the upper part it is dark grayish brown, in the next part it is mottled yellowish brown and gray, and in the lower part it is mottled gray and light olive brown. The substratum to a depth of about 60 inches is gray, mottled silt loam.

Typically, the surface layer of Muscatine soils is very dark brown silty clay loam about 8 inches thick. The subsurface layer is also very dark brown silty clay loam about 6 inches thick. The subsoil is friable and about 34 inches thick. In descending sequence, it is very dark grayish brown silty clay loam; grayish brown, mottled silty clay loam; light brownish gray, mottled silty clay loam; and mottled, light brownish gray and brownish yellow silty clay loam and silt loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam.

Typically, the surface layer of Tama soils is very dark brown silt loam about 8 inches thick. The subsurface layer is also very dark brown silt loam about 7 inches

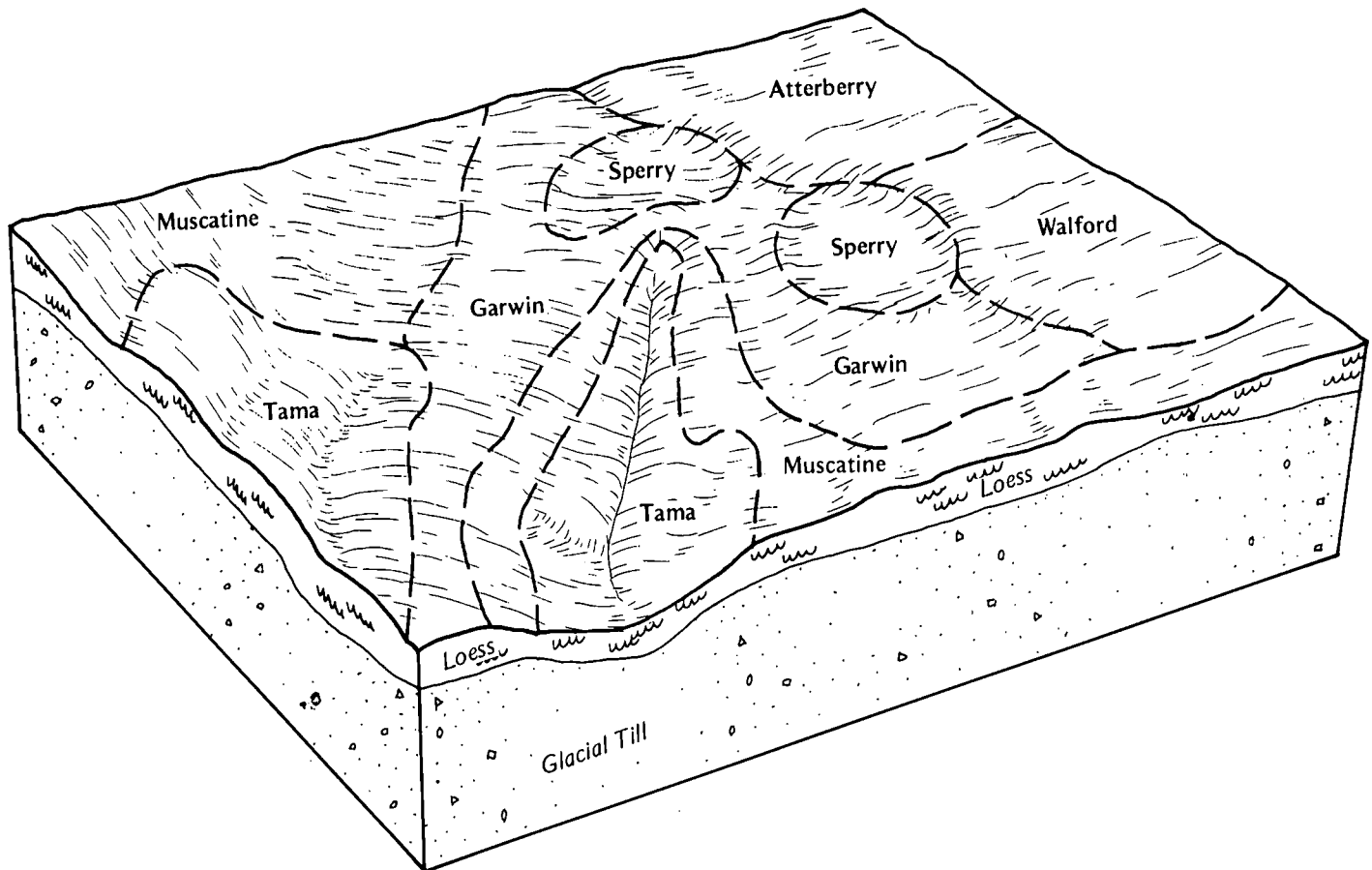


Figure 2.—Typical pattern of soils and parent material in the Garwin-Muscatine-Tama association.

thick. The subsoil is friable silty clay loam about 35 inches thick. In descending sequence, it is very dark grayish brown and brown; brown and yellowish brown; yellowish brown; and mottled, yellowish brown and light brownish gray. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam.

The minor soils in this association are Atterberry, Colo, Downs, Sperry, and Walford soils. Atterberry and Walford soils are somewhat poorly drained and poorly drained, respectively, and have a subsurface layer of light-colored silt loam. These soils are on landscapes similar to those of Garwin soils. Downs soils are well drained, have dark colored soil material to a depth of less than 10 inches, and are on landscapes similar to those of Tama soils. Colo soils formed in silty alluvium, are poorly drained, and are on bottom land and in drainageways. Sperry soils are very poorly drained and are in depressions on uplands.

The major soils of this association are well suited to row crops. Corn and soybeans are grown extensively. The main management concerns are controlling water erosion, providing drainage, and maintaining tilth and fertility.

## 2. Downs-Tama Association

*Gently sloping to strongly sloping, well drained, silty soils that formed in loess; on uplands*

This association consists of soils on gently sloping to strongly sloping, convex ridgetops and side slopes that are dissected by many drainageways. Slopes range from 2 to 14 percent.

This association makes up about 26 percent of the county. It is about 45 percent Downs and similar soils, 21 percent Tama and similar soils, and 34 percent soils of minor extent (fig. 3).

Downs and Tama soils are gently sloping and

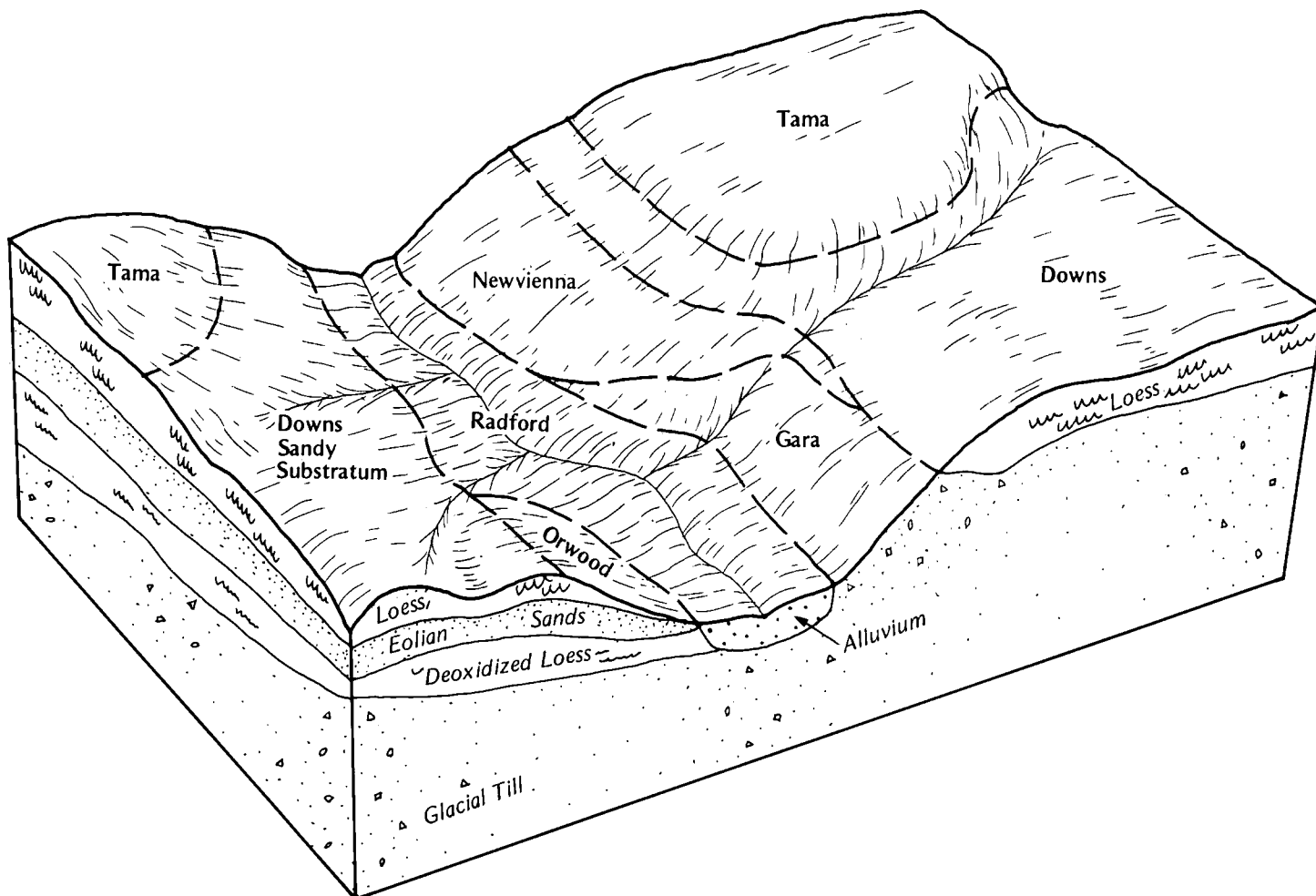


Figure 3.—Typical pattern of soils and parent material in the Downs-Tama association.

moderately sloping on convex ridgetops and moderately sloping and strongly sloping on convex side slopes.

Typically, the surface layer of Downs soils is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown and dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. In the upper part it is yellowish brown, friable silt loam, in the next part it is yellowish brown, mottled, friable silty clay loam, and in the lower part it is mottled yellowish brown and light brownish gray, friable silt loam.

Typically, the surface layer of Tama soils is very dark brown silt loam about 8 inches thick. The subsurface layer is also very dark brown silt loam about 7 inches thick. The subsoil is friable silty clay loam about 35 inches thick. In descending sequence, it is very dark

grayish brown and brown; brown and yellowish brown; yellowish brown; and mottled, yellowish brown and light brownish gray. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam.

The minor soils in this association are Atterberry, Gara, Newvienna, Orwood, Radford, and Waubeek soils. Atterberry soils are grayer in the subsoil than Downs and Tama soils, are somewhat poorly drained, and are on nearly level to gently sloping, upland ridgetops and side slopes and gently sloping head slopes. Radford soils are nearly level and gently sloping, and poorly drained, and are in drainageways. Gara soils are loamy and formed in glacial till. Newvienna soils have mottled colors at a depth of 6 to 15 inches. Orwood soils formed in loess stratified with

sandy, eolian sediments. Waubeek soils formed in 20 to 40 inches of loess over loamy glacial till. Gara, Newvienna, Orwood, and Waubeek soils are on side slopes.

Corn and soybeans are grown extensively on the soils in this association. In the gently sloping areas Tama and Downs soils are well suited to row crops, but in the more sloping areas of these soils erosion is a severe hazard. Generally, Downs and Tama soils are more eroded and contain less organic matter in the more sloping areas than in the gently sloping areas. The main management concerns are controlling water erosion and maintaining tilth and fertility.

### 3. Fayette-Lindley Association

*Gently sloping to very steep, well drained, silty and loamy soils that formed in loess and glacial till; on uplands*

This association consists of soils on gently sloping to strongly sloping, convex ridgetops and moderately sloping to very steep, convex side slopes. It has a well developed network of drainageways. Slopes range from 2 to 50 percent.

This association makes up about 17 percent of the county. It is about 49 percent Fayette soils, 21 percent Lindley soils, and 30 percent soils of minor extent (fig. 4).

Fayette soils are gently sloping to strongly sloping on convex ridgetops and strongly sloping to very steep on side slopes. Lindley soils are moderately sloping to very steep and are on side slopes.

Typically, the surface layer of Fayette soils is dark grayish brown silt loam about 8 inches thick. The subsurface layer is yellowish brown silt loam about 4 inches thick. The subsoil is silty clay loam about 36 inches thick. In the upper part it is yellowish brown and friable. In the next part it is yellowish brown and firm. In the lower part it is yellowish brown, mottled, and friable. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Typically, the surface layer of Lindley soils is dark grayish brown and very dark grayish brown loam about 4 inches thick. The subsurface layer is dark grayish brown and grayish brown loam about 6 inches thick. The subsoil is yellowish brown and about 44 inches thick. In the upper part it is friable loam, in the next part it is firm clay loam, and in the lower part it is mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam that has pockets of loamy sand.

The minor soils in this association are Chelsea,

Exette, Fayette, sandy substratum, Rozetta, and Stronghurst soils, and Radford and Hanlon soils in a complex. Chelsea soils are excessively drained, are sandy throughout, and have a thin surface layer. Exette soils are well drained, and Rozetta soils are moderately well drained. They have mottles in most of the subsoil. Fayette, sandy substratum, soils formed in 48 to 96 inches of loess over sand. Stronghurst soils are somewhat poorly drained and are on ridgetops. Chelsea and Fayette, sandy substratum, soils are on ridgetops and side slopes, and Exette and Rozetta soils are on side slopes. Radford and Hanlon soils in a complex are silty and sandy and are on narrow bottom land.

In most of the gently sloping to strongly sloping areas in this association, the soils are used for cultivated crops. In some of the gently sloping to strongly sloping areas and in most of the moderately steep to very steep areas, the soils are used for permanent pasture. Most of the trees are along drainageways in the more sloping areas and on bottom land.

This association is well suited to poorly suited to cultivated crops. Some areas are too steep for cultivation. The main management concerns are controlling water erosion and maintaining tilth and fertility. Tile drains are needed in some drainageways. On some side slopes gullies are cutting into the cropland on ridgetops.

### 4. Fruitfield-Elrick-Toolesboro Association

*Nearly level to gently sloping, excessively drained, well drained, and poorly drained, sandy and loamy soils that formed in alluvium; on bottom land*

This association consists of soils on high, intermediate, and low bottom lands along the Mississippi River. The lower bottom land is subject to rare flooding when high river levels cause levee protection to fail. Slopes range from 0 to 5 percent.

This association makes up about 4 percent of the county. It is about 55 percent Fruitfield soils, 17 percent Elrick soils, 14 percent Toolesboro soils, and 14 percent soils of minor extent (fig. 5).

Fruitfield soils are excessively drained, are nearly level to gently sloping, and are on high bottom land. Elrick soils are well drained and nearly level and are on intermediate bottom land. Toolesboro soils are poorly drained and nearly level and are on low bottom land.

Typically, the surface layer of Fruitfield soils is very dark brown coarse sand about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown coarse sand about 19 inches thick. The

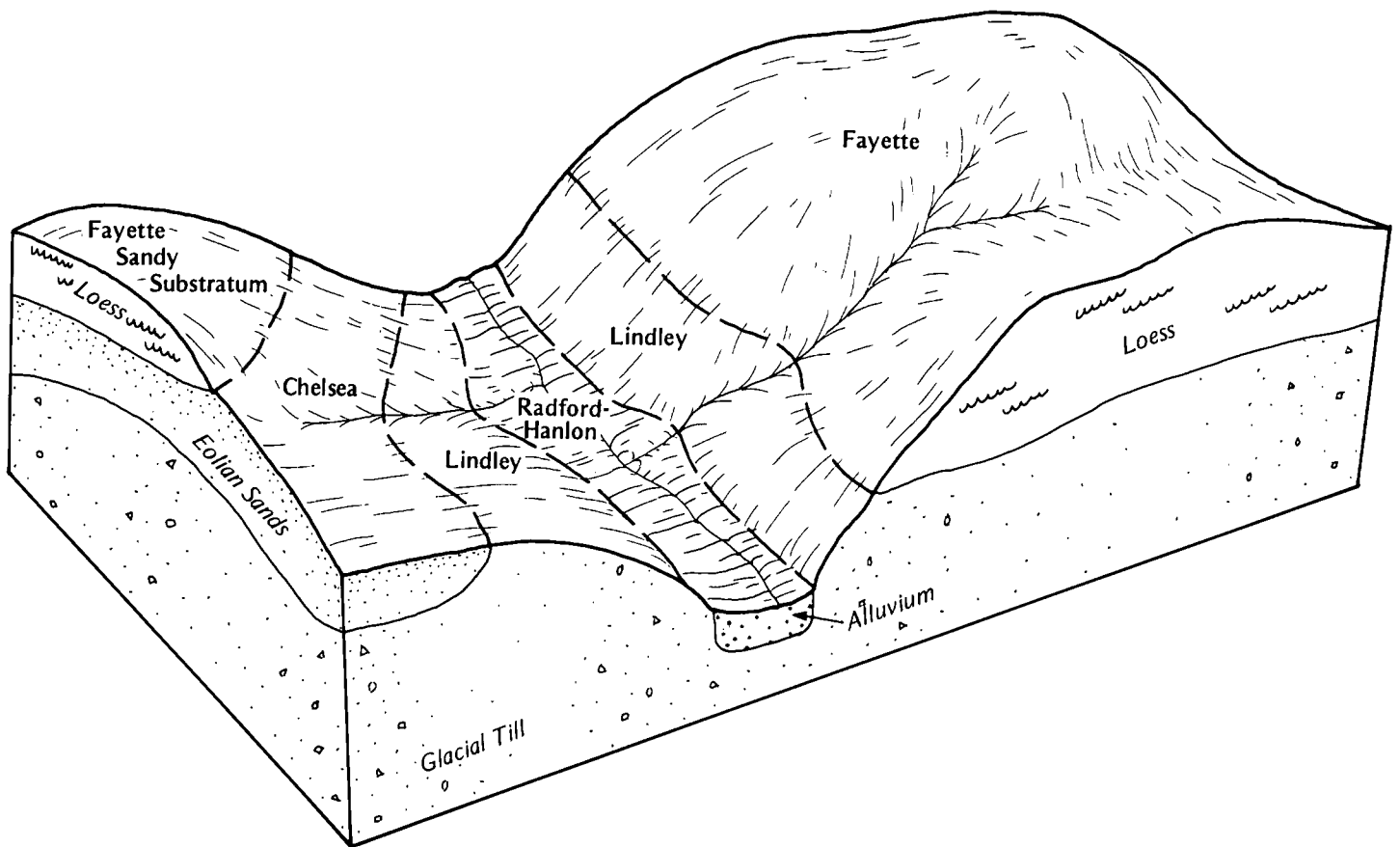


Figure 4.—Typical pattern of soils and parent material in the Fayette-Lindley association.

next layer is dark brown coarse sand about 9 inches thick. The substratum to a depth of about 60 inches is brown and pale brown sand and coarse sand.

Typically, the surface layer of Elrick soils is very dark brown sandy loam about 8 inches thick. The subsurface layer is also very dark brown sandy loam about 5 inches thick. The subsoil is brown, very friable sandy loam about 11 inches thick. The substratum extends to a depth of about 60 inches. It is brown, loose loamy sand in the upper part; brown, mottled, loose sand in the next part; and yellowish brown, loose sand in the lower part.

Typically, the surface layer of Toolesboro soils is black sandy loam about 8 inches thick. The subsurface layer is very dark gray, mottled sandy loam about 4 inches thick. The subsoil is very friable and about 29 inches thick. In the upper part it is mottled, grayish brown and yellowish brown sandy loam. In the next part it is mottled, grayish brown and gray coarse sandy

loam. In the lower part it is mottled, dark gray and strong brown coarse sandy loam. The substratum to a depth of about 60 inches is mottled, dark gray and brown loamy coarse sand in the upper part and brown coarse sand in the lower part.

The minor soils in this association are Ambraw and Shaffton soils. Ambraw soils have a dark colored surface layer that is less than 24 inches thick, are poorly drained, and are on low bottom land. Shaffton soils are loam textured throughout, are somewhat poorly drained, and are on intermediate bottom land.

In most areas the soils in this association are used for irrigated, cultivated crops. They are also used for industrial and residential development. The excessively drained soils are also used as a source of sand and gravel.

Most of the irrigated crops are grown on the excessively drained soils on high bottom land and on the well drained soils on intermediate bottom land. The

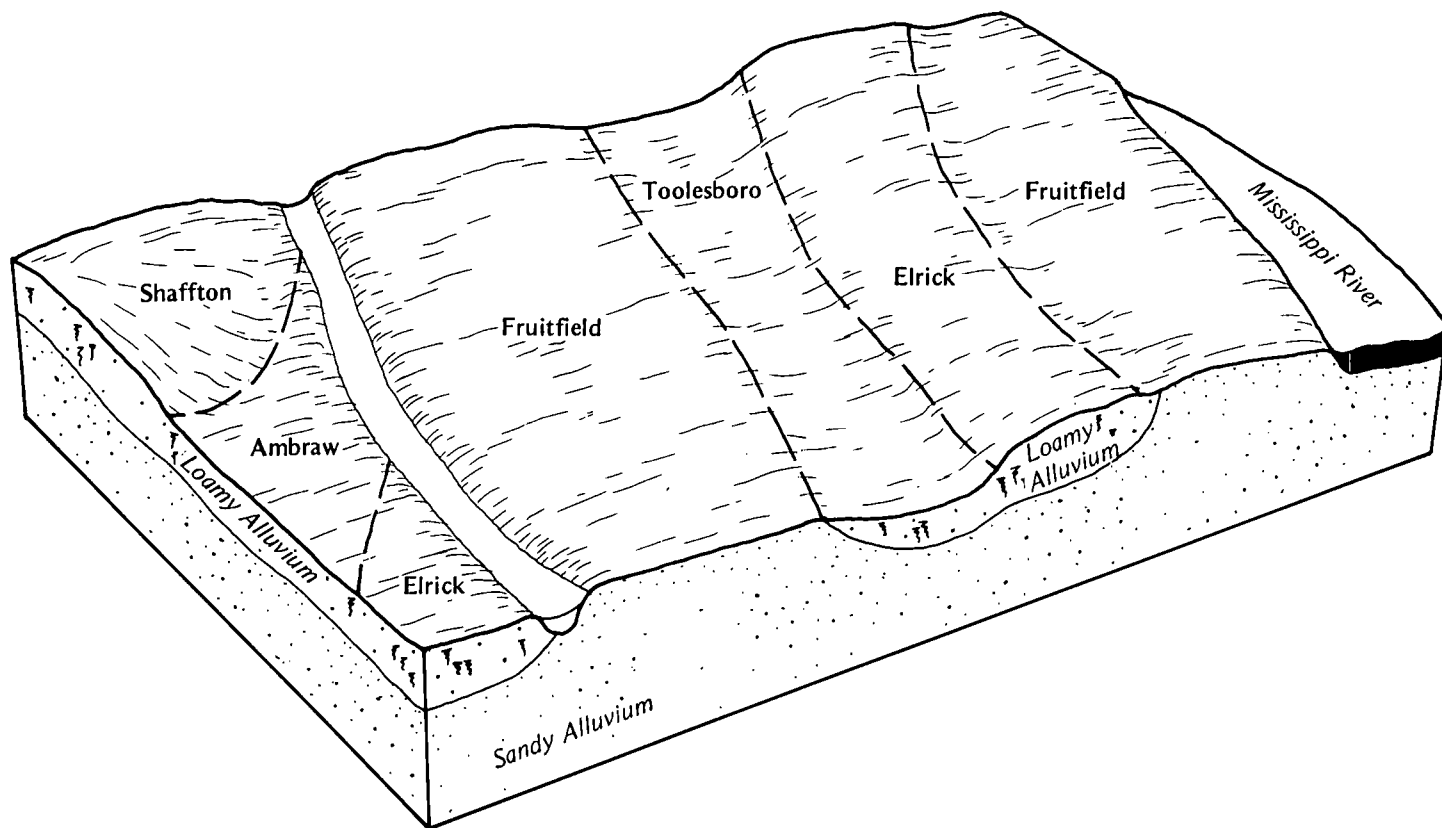


Figure 5.—Typical pattern of soils and parent material in the Fruitfield-Elrick-Toolesboro association.

major irrigated crops are corn, soybeans, potatoes, tomatoes, cantaloups, and watermelons. On some farms retail marketing of the specialty crops is an important source of income. Crops are grown without irrigation on the poorly drained soils of this association. Corn and soybeans are the major nonirrigated crops. Available water capacity ranges from high to very low. Organic matter content is high or moderate. The main management concerns are droughtiness, controlling soil blowing, the seasonal high water table, flooding, and maintaining fertility.

The soils of this association are subject to flooding, but the frequency of flooding is greatly reduced by the Mississippi River levee system. On the poorly drained soils, drainage ditches that lead to a pumping system lower the seasonal high water table.

##### 5. Sparta-Bolan-Dickinson Association

*Nearly level to strongly sloping, well drained to excessively drained, sandy and loamy soils that formed*

*in wind- and water-sorted deposits; on stream terraces and on uplands*

This association consists of soils on nearly level to strongly sloping terraces and terrace side slopes and gently sloping to strongly sloping, sandy, mound-like areas on uplands. Slopes range from 0 to 14 percent.

This association makes up about 11 percent of the county. It is about 39 percent Sparta and similar soils, 21 percent Bolan and similar soils, 11 percent Dickinson soils, and 29 percent soils of minor extent.

Sparta soils are excessively drained and are nearly level to strongly sloping on terraces and eolian mounds and moderately sloping and strongly sloping on terraces and upland side slopes. Bolan soils are well drained and are nearly level and gently sloping on terraces and uplands. Dickinson soils are somewhat excessively drained and are nearly level to moderately sloping on terraces and upland side slopes.

Typically, the surface layer of Sparta soils is very dark grayish brown loamy fine sand about 7 inches



thick. The subsurface layer is very dark grayish brown and dark brown loamy fine sand about 11 inches thick. The subsoil is dark brown and brown, very friable loamy fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand.

Typically, the surface layer of Bolan soils is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown, very dark grayish brown, and dark brown loam about 11 inches thick. The subsoil is about 27 inches thick. In the upper part it is brown, friable loam, in the next part it is brown, friable sandy loam, and in the lower part it is brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown sand.

Typically, the surface layer of Dickinson soils is very dark brown and very dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown and very dark brown fine sandy loam about 12 inches thick. The subsoil is about 23 inches thick. In descending sequence, it is very dark grayish brown and brown, friable fine sandy loam; brown, friable fine sandy loam; brown, very friable sandy loam; and brown, very friable loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand.

The minor soils in this association are Ankeny, Chelsea, Elrin, Hoopeston, and Watseka soils. Ankeny soils have dark colored surface and subsurface layers that are more than 24 inches thick and are in landscape positions similar to those of Bolan soils. Chelsea soils have a dark colored surface layer less than 10 inches thick. Elrin, Hoopeston, and Watseka soils are somewhat poorly drained and are at slightly lower elevations on the landscape.

Most areas of soils in this association are used for cultivated crops. Specialty crops, such as cantaloups and watermelons, are important on some farms. In some moderately sloping and strongly sloping areas the soils are used for pasture. Corn, soybeans, oats, and hay grow moderately well if rainfall is adequate. Available water capacity is moderate or low. Organic matter content is moderate or low. The main management concerns are droughtiness, controlling soil blowing, and maintaining fertility. Where the moderately sloping and strongly sloping soils are cultivated, the main concern is controlling erosion.

## 6. Ambraw-Aquolls-Colo Association

*Nearly level, poorly drained, silty soils that formed in alluvium; on bottom land*

This association consists of soils on bottom land of the Cedar River and major tributary streams. Backwater channels interspersed with ponds meander through the low and intermediate bottom lands. These channels and ponds contain water for varying periods. In some places a levee protects the low bottom land. In most areas, however, the low bottom land is subject to frequent flooding. The intermediate bottom land is subject to occasional flooding, but many places are surrounded by floodwater whenever flooding occurs. Several areas are permanently separated from adjacent bottom land by flowing water in a chute or secondary river channel. Slopes range from 0 to 3 percent.

This association makes up about 10 percent of the county. It is about 26 percent Ambraw and similar soils, 26 percent Aquolls, silty over sandy, 15 percent Colo and similar soils, and 33 percent soils of minor extent (fig. 6).

Ambraw and Colo soils are poorly drained and are on low bottom lands. Aquolls are poorly drained and are on low bottom lands 0 to 2 feet below Ambraw and Colo soils.

Typically, the surface layer of Ambraw soils is black silty clay loam about 5 inches thick. The subsurface layer is very dark gray loam about 8 inches thick. The subsoil is friable and about 28 inches thick. In the upper part it is very dark grayish brown, mottled loam; in the next part it is dark gray, mottled loam; and in the lower part it is gray, mottled, stratified sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is gray, mottled, stratified loamy sand, sand, and coarse sand.

Typically, the surface layer of Aquolls is black silty clay loam about 5 inches thick. The subsurface layer is very dark gray, mottled, silt loam and loam about 13 inches thick. The next layer is mottled, dark gray and grayish brown sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is sand. In the upper part it is mottled, light olive brown and grayish brown, and in the lower part it is mottled, gray and brown.

Typically, the surface layer of Colo soils is very dark gray silty clay loam about 8 inches thick. The subsurface layer is very dark gray, mottled silty clay loam about 22 inches thick. The subsoil is very dark gray, mottled, friable silty clay loam about 25 inches thick. The substratum to a depth of about 60 inches is grayish brown, stratified sand and coarse sand.

The minor soils in this association are Chelsea, Dickinson, Kennebec, Perks, Shaffton, and Sparta soils. Chelsea and Sparta soils are excessively drained, and Dickinson soils are somewhat excessively drained.

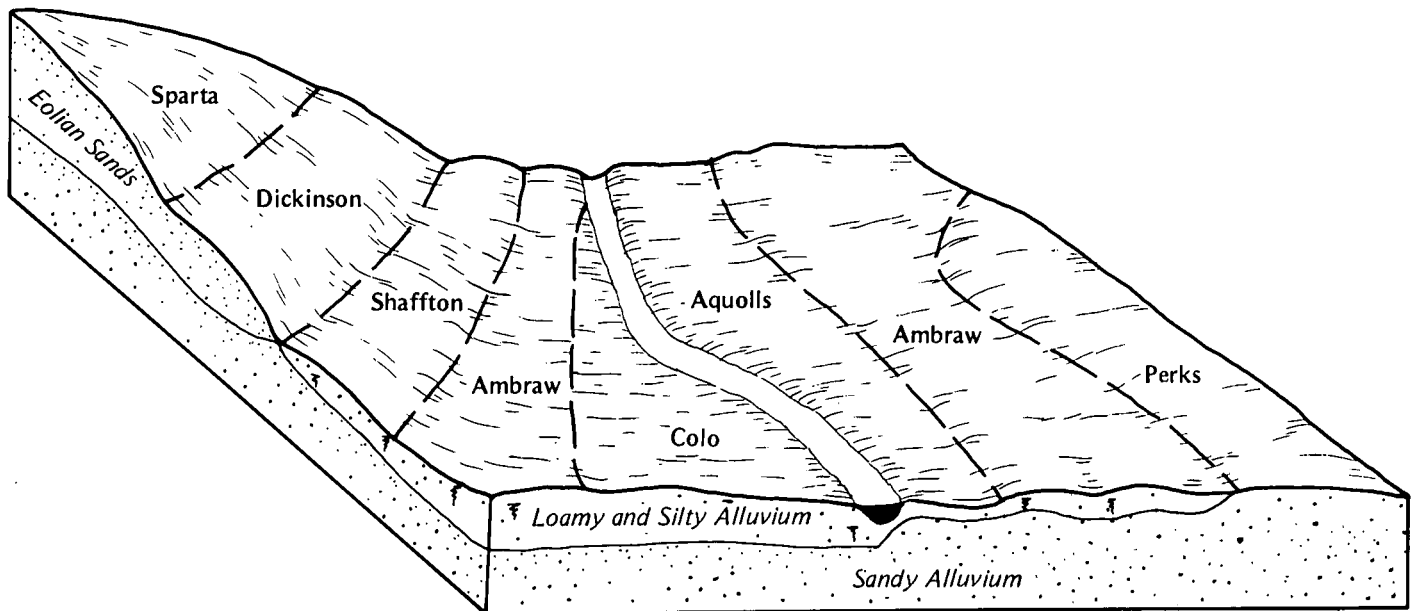


Figure 6.—Typical pattern of soils and parent material in the Ambraw-Aquolls-Colo association.

Chelsea, Dickinson, and Sparta soils are on terraces that are 4 to 6 feet or more above the lower bottom lands. Shaffton soils are somewhat poorly drained and are on intermediate bottom lands. Kennebec soils are moderately well drained and are on bottom lands of tributary streams. Perks soils are excessively drained and are on low to intermediate bottom lands.

The soils of this association are used for cultivated crops, hayland, and pasture. The use of these soils is mainly determined by the degree of protection from flooding and, in areas not protected from flooding, the level of soils relative to normal floodwater levels.

Most areas of soils on bottom lands that are protected from flooding by levees are used for cultivated crops and are suited to this use. Most areas of Aquolls and some low areas of Ambraw and Colo soils are not used for cultivated crops. They are not suited to this use even in areas where they are protected by levees because suitable outlets for surface and subsurface drainage are difficult to find. The main management concerns for cultivated crops are protecting the soils from flooding, providing adequate drainage, maintaining fertility, and deferring tillage when the soils are wet. In some areas channels and ponds have been filled to improve suitability for farming. In other areas channels have been deepened, extended, and straightened to improve drainage.

Most of the soils on bottom lands that are not protected by levees from flooding are not used for cultivated crops and are not suited to this use. Some soils on bottom lands are conditionally suited to cultivated crops if they are accessible when cultural operations are needed. This association is well suited to pasture, and accessible areas are suited to hayland. Most areas not protected from flooding are used for pasture. This association is suited to timber production, and, in some areas, the dominant vegetation is trees.

## 7. Coppock-Rowley-Dolbee Association

*Nearly level, poorly drained and somewhat poorly drained, silty soils that formed in alluvium; on stream terraces*

This association consists of soils on broad terraces. In many areas natural surface drainage is poorly developed. In most areas drainage ditches have been installed to remove excess surface and subsurface water. They also convey runoff water from nearby uplands to a permanent stream. Some lower plane to concave areas are subject to rare flooding from excess runoff from the nearby uplands, especially where siltation has reduced drainage ditch capacity.

This association makes up about 8 percent of the county. It is about 28 percent Coppock and similar soils,

27 percent Rowley and similar soils, 13 percent Dolbee and similar soils, and 32 percent soils of minor extent.

Coppock and Dolbee soils are poorly drained and are on low terraces. Rowley soils are somewhat poorly drained and are on intermediate terraces.

Typically, the surface layer of Coppock soils is very dark gray silt loam about 9 inches thick. The subsurface layer is dark gray and gray silt loam, and is mottled in the lower part. It is about 14 inches thick. The subsoil is mottled, friable silty clay loam about 23 inches thick. In the upper part it is grayish brown, and in the lower part it is light brownish gray. The substratum extends to a depth of about 72 inches. It is light brownish gray, mottled silt loam in the upper part and light gray, brown, and yellowish brown, stratified sand and loamy sand in the lower part.

Typically, the surface layer of Rowley soils is very dark brown silt loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silt loam about 10 inches thick. The subsoil is friable and about 32 inches thick. In descending sequence, it is dark grayish brown silt loam; dark grayish brown and brown, mottled silt loam; mottled, grayish brown and yellowish brown silty clay loam; grayish brown, mottled silt loam; and light brownish gray, mottled loam. The substratum to a depth of about 60 inches is light gray, mottled sand.

Typically, the surface layer of Dolbee soils is very dark gray silt loam about 9 inches thick. The subsurface layer is very dark gray, mottled silty clay loam about 7 inches thick. The subsoil is friable and about 36 inches thick. In the upper part it is very dark gray and dark gray, mottled silty clay loam; in the next part it is gray, mottled silty clay loam; and in the lower part it is gray, mottled silt loam. The substratum to a depth of about 60 inches is gray and light gray, mottled sand.

The minor soils in this association are Bremer, Canoe, Richwood, and Tuskeego soils. Bremer and Tuskeego soils are poorly drained. They have more than 35 percent clay, by weight, in the subsoil and are on low terraces. Canoe soils are somewhat poorly drained and are on low or intermediate terraces. Richwood soils are well drained, have a brown and yellowish brown subsoil, and are on intermediate terraces above Rowley soils.

Most areas of soils in this association are used for row crops. The soils on low terraces are suited to this use, and the soils on intermediate terraces are well suited. The major crops are corn and soybeans. A small proportion is used for small grain, hay, and pasture.

The main management concerns are providing artificial drainage and preventing flooding. Tile drains

and drainage ditches improve soil aeration and allow timely tillage. Drainage ditches also carry runoff water from the nearby uplands to a major stream or river.

## 8. Colo-Coland-Ambraw Association

*Nearly level, poorly drained, silty and loamy soils that formed in alluvium; on bottom land*

This association consists of poorly drained, nearly level soils on bottom land. Natural surface drainage is poorly developed. Drainage ditches have been installed to remove excess surface and subsurface water. They also convey runoff water from nearby uplands to a permanent stream or major drainage ditch. Most areas are subject to rare flooding from excess runoff from nearby uplands, especially where drainage ditch capacity has been reduced by siltation. The bottom land near the Mississippi River is also subject to rare flooding when high flood levels cause levee protection to fail. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 27 percent Colo soils, 25 percent Coland soils, 22 percent Ambraw soils, and 26 percent soils of minor extent.

Typically, the surface layer of Colo soils is very dark gray silty clay loam about 9 inches thick. The subsurface layer is black silty clay loam about 25 inches thick. The subsoil is friable, mottled silty clay loam about 16 inches thick. In the upper part it is very dark gray, and in the lower part it is gray. The substratum to a depth of about 60 inches is light olive gray, mottled silty clay loam.

Typically, the surface layer of Coland soils is black clay loam about 8 inches thick. The subsurface layer is black, mottled clay loam about 20 inches thick. The subsoil is mottled, friable clay loam about 18 inches thick. In the upper part it is very dark gray, and in the lower part it is dark gray and gray. The substratum extends to a depth of about 60 inches. In the upper part it is gray, mottled loam, and in the lower part it is gray and dark gray, mottled, stratified sandy loam and loamy sand.

Typically, the surface layer of Ambraw soils is black loam about 9 inches thick. The subsurface layer is mottled loam about 15 inches thick. It is very dark gray and mottled in the upper part and very dark grayish brown in the lower part. The subsoil is friable and about 24 inches thick. In the upper part it is mottled, dark gray and yellowish brown loam. In the next part it is mottled, gray and yellowish brown sandy clay loam. In the lower part it is dark gray and gray, mottled, stratified loam and sandy loam. The substratum to a depth of about 60

inches is gray, mottled, stratified sand and loamy sand. In some places the dark colored subsurface layer extends below a depth of 24 inches, and in other places as much as 12 inches of silt loam overwash is above the surface layer.

The minor soils in this association are Caneek Variant, Dolbee, Moingona, Moingona Variant, Shaffton, and Zook soils. Dolbee and Zook soils are poorly drained and are on bottom land. They have a silty surface layer and subsoil. Zook soils have a surface layer and subsoil that are dark colored to a depth of 40 inches or more. Dolbee soils have a surface layer and subsoil that are dark colored to a depth of 14 to 24 inches. Caneek Variant, Moingona Variant, and Shaffton soils are somewhat poorly drained. Caneek Variant and Moingona Variant soils are on alluvial fans and foot slopes. In Caneek Variant soils the surface layer and the substratum formed in 40 to 60 inches of recently deposited sandy and silty alluvium and the underlying A horizon. In Moingona Variant soils the

surface layer and the subsoil are loam and dark colored to a depth of 12 to 20 inches. Shaffton soils are on high bottom lands. They have a surface layer and subsurface layer that are dark colored to a depth of 10 to 20 inches. Moingona soils are well drained, are on alluvial fans and foot slopes, and have a loam surface layer and subsoil that are dark colored to a depth of 12 to 20 inches.

Most areas of this association are used for row crops. The soils are suited and well suited to this use. The major crops are corn and soybeans. A small proportion is used for small grain and hay.

The main management concerns are providing drainage and preventing flooding. Tile drains and drainage ditches improve soil aeration and allow timely tillage. The drainage ditches also carry runoff water from adjacent uplands to a major stream or river. Part of this association is protected from flooding by a major levee along the Mississippi River.

## 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, Downs silt loam, 2 to 5 percent slopes, is a phase of the Downs 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. Chelsea-Fayette complex, 25 to 40 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 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

#### **41—Sparta loamy fine sand, 0 to 2 percent slopes.**

This is a nearly level, excessively drained soil on stream terraces. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown loamy fine sand about 8 inches thick. The subsurface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is loose sand about 25 inches thick. In the upper part it is dark brown and brown, and in the lower part it is yellowish brown. The substratum extends to a depth of about 60 inches. In the upper part it is variegated, yellowish brown and pale brown, stratified sand and loamy sand. In the lower part it is variegated, pale brown and light yellowish brown loamy fine sand and fine sand. In some places the subsurface layer is lighter colored and contains less organic matter. In a few places the surface layer is loamy sand or sand that is 5 to 10 percent gravel, by volume.

Included with this soil in mapping are small areas of

somewhat excessively drained Dickinson soils, somewhat poorly drained Watseka soils, and severely eroded Sparta soils. Dickinson soils have more clay in the surface layer, subsurface layer, and the upper part of the subsoil and are on the more concave parts of the landscape. Watseka soils have a grayer or more mottled subsoil than the Sparta soil. They are in concave or lower areas. Sparta soils that are severely wind eroded have a light-colored surface layer and contain less organic matter. They are in slightly convex positions that are more exposed to wind and are also in the same positions as this Sparta soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability of this Sparta soil is rapid. Runoff is slow. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated or used for hay and pasture. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is also suited to vegetable crops. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains damage seedlings on this soil and on adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to improve poor tilth. Cover crops reduce the hazard of soil blowing, especially when vegetable crops are grown (fig. 7). Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce the hazard of soil blowing, and improve the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, but most areas of trees are in small windbreaks and groves around farmsteads. Field windbreaks control soil blowing on some farms. Planted seedlings do not survive well without supplemental water or mulching. Seedlings can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is IVs.

**41B—Sparta loamy fine sand, 2 to 5 percent slopes.** This is a gently sloping, excessively drained soil on stream terraces and in a few places on uplands.

Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loamy fine sand about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown loamy fine sand about 11 inches thick. The subsoil is dark brown and brown, very friable loamy fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the combined surface layer and subsurface layer are less than 10 inches thick because soil blowing or water erosion has removed the former surface layer.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils and severely wind-eroded Sparta soils. Dickinson soils contain more clay in the surface layer, subsurface layer, and the upper part of the subsoil. They are in concave or lower areas. Sparta soils are severely wind eroded and have a surface layer of brown or yellowish brown sand. They are in slightly convex positions and are also in the same positions as this Sparta soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability of this Sparta soil is rapid. Runoff is medium. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

In most areas this soil is cultivated or used for hay and pasture. It is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing and water erosion are hazards. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. Cover crops and a system of conservation tillage that leaves crop residue on the surface help to conserve moisture, to prevent excessive soil loss, and to improve poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce soil blowing, and improve the available water capacity.

A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, but most areas of trees are in small windbreaks and groves around farmsteads. On some farms field windbreaks control soil blowing. Planted seedlings do not survive well without supplemental water or mulching. Seedlings can be spaced closer together when planting. The surviving



Figure 7.—Rye strips protect a crop of watermelon from soil blowing. The soil is Sparta loamy fine sand, 0 to 2 percent slopes.

trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is IVs.

**41D—Sparta loamy fine sand, 5 to 14 percent slopes.** This is a moderately sloping and strongly sloping, excessively drained soil on convex, upland side slopes and on stream terraces. In a few areas it is on

dunelike ridges. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is dark brown loamy fine sand about 10 inches thick. The subsoil is yellowish brown, very friable loamy fine sand about 12 inches thick. The substratum to a depth of about 60 inches is stratified, yellowish brown loamy sand and brownish yellow fine sand. In some places the combined surface and subsurface layers are less than 10 inches thick because soil blowing or water erosion has removed the former surface layer.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils and severely wind-eroded Sparta soils. Dickinson soils contain more clay in the surface layer, subsurface layer, and subsoil than the Sparta soil. They are in slightly concave areas. Severely wind-eroded Sparta soils have a surface layer of brown or yellowish brown sand. They tend to be in slightly convex positions that are more exposed to wind but also are in the same positions as this Sparta soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability of this Sparta soil is rapid. Runoff is medium. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated or used for pasture. This soil is generally not suited to cultivated crops because erosion is a severe hazard. A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, but most areas of trees are limited to small windbreaks and groves around farmsteads. Planted seedlings do not survive well without supplemental water or mulching. Consequently, seedlings can be spaced closer together when planting. The surviving trees can then be thinned later to achieve the desired density. Planting larger seedlings also improves the survival rate.

The land capability classification is Vls.

**51B—Vesser silt loam, 2 to 5 percent slopes.** This is a gently sloping, poorly drained soil on high bottom lands and on foot slopes in the uplands. It is subject to occasional flooding. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is silt loam

about 19 inches thick. In the upper part it is very dark gray, and in the lower part it is dark gray and gray. The subsoil to a depth of 60 inches is gray, mottled, friable silty clay loam. In some places the surface layer and the upper part of the subsurface layer are lighter colored.

Permeability of this Vesser soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. Some areas are used for hay and pasture. If this soil is adequately drained and flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and allow timelier tillage. Diversions and dikes on the local flood plains can help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth and controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is Ilw.

**63B—Chelsea loamy fine sand, 1 to 5 percent slopes.** This is a nearly level and gently sloping, excessively drained soil on stream terraces and, in a few areas, on dunelike, low ridges oriented from northwest to southeast, on uplands. Areas range from 2 to more than 60 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy fine sand about 4 inches thick. The subsurface layer is about 41 inches thick. In the upper part it is dark brown and brown loamy fine sand, and in the lower part it is dark yellowish brown and yellowish brown, loose fine sand. Below this, to a depth of about 60 inches, are light yellowish brown and pale brown, loose fine sand and layers of thin brown sandy loam. In places the surface layer is thicker, and in places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of somewhat poorly drained Watseka soils. These soils have a thicker, dark colored surface layer and a grayer, more mottled subsoil. They are in concave areas and



make up about 2 percent of the map unit.

Permeability of this Chelsea soil is rapid. Runoff is slow or medium. Available water capacity is low. The subsurface layer has very low amounts of available phosphorus and low amounts of available potassium.

Most areas are used for pasture or timber production. A few small areas are cultivated along with larger areas of adjacent soils that are well suited to crops. This soil is poorly suited to corn, soybeans, and small grain. It is better suited to small grain or to grasses and legumes for hay or pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, water erosion and soil blowing are hazards. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to control soil blowing, and to improve poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to control soil blowing, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees, and some areas are in native hardwoods. Planted seedlings do not survive well without supplemental water or mulching, and seedlings can be spaced closer together when planting. The surviving trees can be thinned later to achieve desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is IVs.

**63C—Chelsea loamy fine sand, 5 to 9 percent slopes.** This is a moderately sloping, excessively drained soil on moundlike ridges and on convex side slopes on uplands and on stream terraces. Areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loamy fine sand about 2 inches thick. The subsurface layer is about 33 inches thick. In the upper part it is brown and very dark grayish brown fine sand, and in the lower part it is yellowish brown, loose fine sand. Below this, to a depth of about 60 inches, is yellowish brown and pale brown, loose fine sand that has thin layers of brown loamy fine sand. In some places the surface layer is fine sandy loam.

Permeability of this Chelsea soil is rapid. Runoff is medium. Available water capacity is low. The subsurface layer has very low amounts of available

phosphorus and low amounts of available potassium.

Most areas are used for pasture or timber production. Some areas are cultivated along with larger areas of adjacent soils that are well suited to crops. This soil is poorly suited to corn, soybeans, and small grain. It is better suited to grasses or legumes for hay or pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent excessive soil loss, and to improve poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, increase the available water capacity, and help to control soil blowing.

A cover of pasture or hay plants is effective in controlling erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas are in native hardwoods. Planted seedlings do not survive well without supplemental water or mulching, and seedlings can be spaced closer together when planting. The surviving trees can be thinned later to achieve desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is IVs.

**63D—Chelsea loamy fine sand, 9 to 14 percent slopes.** This is a strongly sloping, excessively drained soil on convex side slopes and on stream terraces. Areas range from 5 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loamy fine sand about 4 inches thick. The subsurface layer is very dark grayish brown, brown, and yellowish brown loamy fine sand and fine sand about 36 inches thick. Below this, to a depth of 60 inches, is yellowish brown and light yellowish brown, loose fine sand that has thin layers of dark brown loamy sand. In places this soil has slopes of less than 9 percent. In places the surface layer is sandy loam.

Included with this soil in mapping are small areas of severely wind-eroded Chelsea soils. The surface layer is yellowish brown sand. These soils are generally in slightly convex positions that are more exposed to wind. They make up about 5 percent of the map unit.

Permeability of this Chelsea soil is rapid. Runoff is rapid. Available water capacity is low. The subsurface layer has very low amounts of available phosphorus

and low amounts of available potassium.

Most areas are used for woodland or permanent pasture, but about one-third of the acreage is used for cultivated crops. This soil is not suited to cultivated crops and is poorly suited to hay and pasture, mainly because of slope, droughtiness, and low fertility. Also, it is subject to soil blowing. As a result, a permanent plant cover is needed. Tilth is poor in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in fairly good condition.

This soil is suited to trees, and many areas are in native hardwoods. Planted seedlings do not survive well without supplemental water or mulching, and seedlings can be spaced closer together when planting. The surviving trees can be thinned later to achieve desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is VIs.

**63E—Chelsea loamy fine sand, 14 to 25 percent slopes.** This is a moderately steep and steep, excessively drained soil on side slopes on uplands and stream terraces. Areas range from 5 to 20 acres in size and are irregularly shaped or elongated.

Typically, the surface layer is very dark gray loamy fine sand about 5 inches thick. The subsurface layer is brown and yellowish brown fine sand about 29 inches thick. Below this, to a depth of 60 inches, is light yellowish brown and pale brown, loose fine sand that has thin layers of brown sandy loam. In some places the surface layer is very dark grayish brown loamy fine sand about 12 inches thick. In some places the subsurface layer is dark brown loamy fine sand about 9 inches thick. In a few places the surface layer is sandy loam.

Included with this soil in mapping are small areas of soils that contain coarse sand and gravel. These soils are on terrace side slopes. They make up less than 5 percent of the map unit.

Permeability of this Chelsea soil is rapid. Runoff is rapid. Available water capacity is low. The subsurface layer has very low amounts of available phosphorus and low amounts of available potassium.

Most areas are used as woodland or permanent pasture. This soil is not suited to cultivated crops because of droughtiness, a severe hazard of water erosion, and slope. Also, it is subject to soil blowing. A permanent plant cover is needed. Tilth is poor in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in fairly good condition. Renovating pastures is difficult because some slopes are too steep for safe operation of ordinary farm machinery.

This soil is suited to trees, and many areas remain in native hardwoods. The slope limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings do not survive or grow well without supplemental water or mulching and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is VIIIs.

**63G—Chelsea loamy fine sand, 25 to 45 percent slopes.** This is a very steep, excessively drained soil on convex side slopes on uplands and on side slopes of stream terraces. Areas range from 10 to 100 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark gray loamy fine sand about 3 inches thick. The subsurface layer is dark grayish brown, brown, and yellowish brown loamy fine sand and sand about 45 inches thick. Below this, to a depth of 60 inches, is a layer of variegated brown and light brownish gray loamy sand.

Included with this soil in mapping are small areas of soils that are underlain by coarse sand and gravel. These soils are on terrace side slopes. Also included are small areas of poorly drained soils near the base of side slopes. They make up less than 5 percent of the map unit.

Permeability of this Chelsea soil is rapid. Runoff is rapid. Available water capacity is low. The subsurface layer has very low amounts of available phosphorus and low amounts of available potassium.

Most areas are used as woodland or permanent pasture. This soil is not suited to cultivated crops or hay because of the slope, the severe hazard of erosion, and droughtiness. Also, it is subject to soil blowing. It is poorly suited to pasture. Ordinary farm machinery cannot be used because of the slope. Tilth is poor in the surface layer.

This soil is suited to trees, and most areas remain in native hardwoods. Tree planting, management, and harvesting operations are difficult and dangerous because of the slope. Much of the work is most safely

done with hand-operated equipment. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion.

Seedlings do not survive or grow well without supplemental water or mulching and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is VII.

**65D2—Lindley loam, 5 to 14 percent slopes, moderately eroded.** This is a moderately sloping and strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 5 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is brown loam about 8 inches thick. Plowing has mixed some streaks and pockets of dark yellowish brown clay loam subsoil material into the surface layer. The subsoil is clay loam about 41 inches thick. In the upper part it is friable and dark yellowish brown, and in the lower part it is brown and yellowish brown, mottled, and firm. The substratum to a depth of 60 inches is brown, mottled clay loam. In a few places that have not been cultivated, the surface layer is dark grayish brown loam about 3 inches thick. In places the surface layer and the upper part of the subsoil are siltier.

Included with this soil in mapping are small areas of severely eroded Lindley soils. These soils have a surface layer of clay loam and a high proportion of subsoil material. They are on the more convex parts of the slope and make up about 5 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Runoff is rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. A few areas are used for pasture. This soil is poorly suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. Some slopes are long enough and uniform enough for contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation

grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

The land capability classification is IVe.

**65E2—Lindley loam, 14 to 18 percent slopes, moderately eroded.** This is a moderately steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark brown loam about 6 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material with the surface layer. The subsoil is friable and about 43 inches thick. In the upper part it is yellowish brown loam, in the middle part it is yellowish brown loam, and in the lower part it is yellowish brown, mottled clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In places this soil is steeply sloping. In a few places that have not been cultivated, the surface layer is very dark grayish brown and dark grayish brown loam about 3 inches thick. In other places the surface layer and the upper part of the subsoil are siltier.

Included with this soil in mapping are small areas of severely eroded Lindley soils that have a clay loam surface layer and a high proportion of subsoil material. They are on the more convex parts of side slopes. They make up about 5 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Runoff is very rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Many areas are cultivated. Some areas are used for pasture but have been cultivated at some time in the past. This soil is generally not suited to cultivated crops because of the slope and the severe hazard of further water erosion. It is moderately suited to grasses and legumes for hay and pasture. Tillage is fair in the surface layer.

This soil is suited to trees. Tree planting, management, and harvesting operations are slightly more difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control water erosion. Seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve desired stand density. Planting

larger seedlings also improves the survival rate.

The land capability classification is VIe.

**65F—Lindley loam, 18 to 25 percent slopes.** This is a steep, well drained soil on short, convex side slopes on uplands. Areas range from 5 to 50 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown loam about 3 inches thick. The subsurface layer is mixed dark grayish brown, brown, and yellowish brown loam about 6 inches thick. The subsoil is yellowish brown and about 24 inches thick. In the upper part it is friable clay loam, in the next part it is mottled, friable clay loam, and in the lower part it is mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam that has a few thin lenses of brown and yellowish brown sandy loam. In places slopes are less than 18 percent.

Included with this soil in mapping are small areas of Gosport and Gale soils. These soils are on the lower part of side slopes. Gosport soils formed mainly in shale bedrock residuum and are seepy during wet seasons. Gale soils formed in silt loam loess over residuum of sandstone bedrock. Included soils make up about 3 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Runoff is very rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for permanent pasture or woodland. This soil is not suited to cultivated crops and hay because of the slope and the severe hazard of water erosion. It is better suited to permanent pasture or woodland. A cover of pasture plants is effective in controlling water erosion.

This soil is suited to trees, and many areas remain in native hardwoods. Tree planting, management, and harvesting operations are difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIIe.

**65G—Lindley loam, 25 to 50 percent slopes.** This is a very steep, well drained soil on convex side slopes on uplands. Areas range from 20 to 100 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown and very dark grayish brown loam about 4 inches thick. The subsurface layer is dark grayish brown and grayish

brown loam about 6 inches thick. The subsoil is yellowish brown and about 44 inches thick. In the upper part it is friable loam, in the next part it is firm clay loam, and in the lower part it is mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam that has pockets of loamy sand.

Included with this soil in mapping are a few areas of Gosport and Gale soils. These soils are on the lower part of side slopes. Gosport soils formed mainly in the residuum of shale bedrock and are seepy during wet seasons. Gale soils formed in silt loam over residuum of sandstone bedrock. Included soils make up 1 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Runoff is very rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used as woodland or permanent pasture. This soil is not suited to cultivated crops or hay because of the slope and the severe hazard of water erosion. It is poorly suited to pasture. Ordinary farm machinery cannot be used because of the slope.

This soil is suited to trees, and areas remain in native hardwoods. Tree planting, management, and harvesting operations are difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIIe.

**118—Garwin silty clay loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on broad, upland ridgetops, in the upper part of concave drainageways, and on high stream terraces. Most areas range from 5 to 100 acres in size and are irregular in shape.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark gray silty clay loam. It is mottled in the lower part. The subsoil is friable, mottled silty clay loam about 31 inches thick. In the upper part it is dark grayish brown; in the next part it is mottled, yellowish brown and gray; and in the lower part it is mottled, gray and light olive brown. The substratum to a depth of 60 inches is gray, mottled silt loam. In places sandy material is at a depth of 48 to 72 inches.

Included with this soil in mapping are small areas of very poorly drained Sperry soils in slight depressions. These soils have less clay in the surface and

subsurface layers, are lighter colored in the subsurface layer, and have more clay in the subsoil. They make up about 2 percent of the map unit.

Permeability of this Garwin soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential of the subsurface layer and subsoil are high. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in improving soil tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**119—Muscatine silty clay loam, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on broad ridgetops or divides on uplands and on high stream terraces. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is also very dark brown silty clay loam about 6 inches thick. The subsoil is friable and about 34 inches thick. In descending sequence, it is very dark grayish brown silty clay loam; grayish brown, mottled silty clay loam; light brownish gray, mottled silty clay loam; and mottled, light brownish gray and brownish yellow silty clay loam and silt loam. The substratum to a depth of 60 inches is light brownish gray, mottled silt loam. In many places the substratum below a depth of 48 to 96 inches is sand.

Included with this soil in mapping are small areas of very poorly drained Sperry soils and well drained Tama soils. Sperry soils are grayer, more mottled, and more clayey in the subsoil than the Muscatine soil. They are in depressions. Tama soils are browner in the subsoil than the Muscatine soil. They are on slight rises. Included soils make up about 1 percent of the map unit.

Permeability of this Muscatine soil is moderate. Runoff is slow. Available water capacity is high. The soil

has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and, in most areas, allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining soil tilth. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is I.

**120B—Tama silt loam, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on broad, plane to convex ridges and side slopes on uplands. Areas range from 5 to 40 acres or more in size and are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is also very dark brown silt loam about 7 inches thick. The subsoil is friable silty clay loam about 35 inches thick. In descending sequence, it is very dark grayish brown and brown; brown and yellowish brown; yellowish brown; and mottled, yellowish brown and light brownish gray. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam. In some places the soil is mottled in the upper part of the subsoil. In other places sandy material is at a depth of 48 to 96 inches. Also, in places the surface layer is lighter colored and has less organic matter.

Permeability of this Tama soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface

crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**120B2—Tama silt loam, 2 to 5 percent slopes, moderately eroded.** This is a gently sloping, well drained soil on broad, convex ridges, on side slopes, and on concave head slopes on uplands. Areas range from 5 to 40 acres or more in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. Plowing has mixed a few streaks and pockets of brown silty clay loam subsoil material with the surface layer. The subsoil is friable and about 40 inches thick. In descending sequence, it is very dark grayish brown and brown silty clay loam; yellowish brown silty clay loam; yellowish brown, mottled silty clay loam; and yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam. In some places the upper part of the subsoil has mottles. In other places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Tama soils. These soils have a surface layer of dark brown and yellowish brown silty clay loam and are on convex side slopes. They make up about 1 percent of the map unit.

Permeability of this Tama soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Water erosion is a hazard on the more convex side slopes. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**120C—Tama silt loam, 5 to 9 percent slopes.** This is a moderately sloping, well drained soil on convex side slopes and ridgetops on uplands. Areas range from 5 to 50 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark brown silt loam about 5 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. In the upper part it is brown and dark yellowish brown, in the next part it is yellowish brown, and in the lower part it is yellowish brown and mottled. In some places the surface layer is lighter colored and contains less organic matter. Also, in some places sandy material is at a depth of 48 to 96 inches.

Permeability of this Tama soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**120C2—Tama silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex side slopes and ridgetops on uplands. Areas range from 5 to 80 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed a few streaks and pockets of brown silty clay loam subsoil material with the surface layer. The subsoil is friable and about 39 inches thick. In the upper part it is brown silty clay loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown silt loam that has light brownish gray mottles.

The substratum to a depth of 60 inches is yellowish brown, mottled silt loam. In places the upper part of the subsoil has mottles. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Tama soils. These soils have a surface layer of dark brown and yellowish brown silty clay loam. They are on convex side slopes. They make up about 2 percent of the map unit.

Permeability of this Tama soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Water erosion is a hazard on the more convex side slopes and in the most eroded areas. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**120C3—Tama silty clay loam, 5 to 9 percent slopes, severely eroded.** This is a moderately sloping, well drained soil on convex side slopes on uplands. Areas range from 5 to 50 acres in size and are elongated.

Typically, the surface layer is dark brown and yellowish brown silty clay loam about 7 inches thick. It is mixed subsoil material and surface soil material. The subsoil is friable and about 31 inches thick. In the upper part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the surface layer is very dark grayish brown silt loam and contains more organic matter. Also, in places sandy material is at a depth of 48 to 96 inches.

Permeability of this Tama soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and

very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IVe.

**120D2—Tama silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on side slopes on uplands. Areas range from 5 to 25 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed a few streaks and pockets of brown silty clay loam subsoil material with the surface layer. The subsoil is friable and about 40 inches thick. In descending sequence, it is brown silty clay loam; yellowish brown silty clay loam; yellowish brown, mottled silty clay loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches is yellowish brown, mottled silt loam. In places the subsoil has mottles throughout.

Included with this soil in mapping are small areas of severely eroded Tama soils. These soils have a surface layer of dark brown and yellowish brown silty clay loam. They are on convex side slopes. They make up about 5 percent of the map unit.

Permeability of this Tama soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform

enough for terraces and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**120D3—Tama silty clay loam, 9 to 14 percent slopes, severely eroded.** This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated.

Typically, the surface layer is yellowish brown and dark brown silty clay loam about 9 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is friable and about 27 inches thick. In the upper part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the subsoil has mottles throughout. Also, in places the surface layer is very dark grayish brown silt loam and contains more organic matter.

Permeability of this Tama soils is moderate, and runoff is rapid. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops in rotation with small grain and to rasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IVe.

**122—Sperry silt loam, 0 to 1 percent slopes.** This is a level, very poorly drained soil in slight depressions on broad, upland divides. It is subject to ponding. Areas

range from 2 to 10 acres or more in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 10 inches thick. The subsurface layer is dark gray, mottled silt loam about 12 inches thick. The subsoil is silty clay loam about 34 inches thick. In the upper part it is dark gray, mottled, and firm. In the next part it is gray, mottled, and firm. In the lower part it is gray, mottled, and friable. The substratum to a depth of 60 inches is gray, mottled silty clay loam. In places the upper part of the subsoil is black or very dark gray.

Permeability of this Sperry soil is slow. Runoff is very slow or ponded. Available water capacity is high. The soil has a seasonal high water table near or above the surface. The shrink-swell potential of the subsoil is high. The subsoil has low amounts of available phosphorus and available potassium.

Most areas are cultivated. If this soil is adequately drained, it is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Cultivated crops are subject to damage by ponding and poor soil aeration where artificial drainage is not adequate. Surface intakes and shallow ditches in addition to tile drains improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring fieldwork when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants reduces damage from ponding. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIIw.

**133—Colo silty clay loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on bottom land. It is subject to frequent flooding. Areas range from 5 to 100 acres in size, but some areas are as large as 300 acres. They are irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is very dark gray, mottled silty clay loam about 22 inches thick. The subsoil is mottled, very dark gray, friable silty clay loam about 25 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam. In some places the depth to sandy textures is less than 48 inches or more than 60 inches. In other places about 12 inches of recently deposited silt loam overlies the surface layer. Also, in places dark colors are less than



36 inches thick, and the surface and subsurface layers are loam or clay loam.

Included with this soil in mapping are small areas of Zook soils. These soils have more clay and are in lower areas in the map unit. Included soils make up about 5 to 7 percent of the map unit.

Permeability of this Colo soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential is moderate. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are in pasture and woodland. This soil is not suited to corn, soybeans, and small grain because of frequent flooding, siltation, and stream channels. It is moderately suited to grasses and legumes for hay and pasture. In some areas drainage ditches are needed to help control local runoff. Other areas need flood protection. Tilth is fair in the surface layer.

A cover of pasture or hay plants is effective in controlling channeling or soil washing by flowing floodwater. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. The seasonal high water table restricts the use of equipment to drier periods or winter, when the soil is frozen. During wet periods special high flotation equipment may be needed for harvesting or management. Planted seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the survival rate.

The land capability classification is Vw.

#### **133B—Colo silty clay loam, 2 to 5 percent slopes.**

This is a gently sloping, poorly drained soil in narrow drainageways on uplands. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 22 inches thick. In the upper part it is very dark gray, and in the lower part it is black. The subsoil is silty clay loam about 12 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The substratum to a depth of 60 inches is gray silty clay loam. In places the depth to dark gray or lighter colors is less than 36 inches.

Included with this soil in mapping are small areas of Radford soils. These soils formed in 20 to 36 inches of recently deposited alluvium over a buried soil. They are on small alluvial fans and are in the same positions as this Colo soil. They make up about 5 percent of the map unit.

Permeability of this Colo soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated, but some are in pasture. If this soil is adequately drained and if flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss and to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility and help to prevent surface crusting.

A cover of pasture or hay plants is effective in preventing excessive soil loss and in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

#### **135B—Coland clay loam, 2 to 5 percent slopes.**

This is a gently sloping, poorly drained soil in narrow drainageways on uplands or on foot slopes and alluvial fans. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are long and narrow.

Typically, the surface layer is very dark gray clay loam about 9 inches thick. The subsurface layer is black and very dark gray, mottled, friable clay loam about 26 inches thick. The subsoil is very dark gray, mottled, friable loam and clay loam about 13 inches thick. The substratum extends to a depth of about 60 inches. It is light olive gray and light olive brown, mottled loam in the upper part and gray, mottled sandy loam in the lower part. In places recently deposited silty clay loam and silt loam overlies the surface layer. In other places the subsurface layer is not as thick. In some places this soil is silty clay loam throughout.

Permeability of this Coland soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated, but some are in pasture. If this soil is adequately drained and if flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss and to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility and help to maintain tilth.

A cover of pasture or hay plants is effective in preventing excessive soil loss and in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**136—Ankeny sandy loam, 0 to 3 percent slopes.**

This is a nearly level and very gently sloping, well drained soil on broad stream terraces. Areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 17 inches thick. The subsoil is about 21 inches thick. In the upper part it is very dark grayish brown and brown, friable sandy loam. In the lower part it is yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is pale brown sand. In some places the surface layer is loamy sand. Also, in places the subsoil is gray. In a few places on foot slopes, the slope is as much as 5 percent.

Permeability of this Ankeny soil is moderately rapid. Runoff is slow. Available water capacity is moderate. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and on adjacent soils. This soil receives runoff where it is adjacent to side slopes. A system of conservation tillage that leaves crop residue on the surface reduces runoff from the adjacent side slopes and helps to conserve moisture, prevent soil blowing, and to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is too dry improve fertility, help to reduce the hazard of soil blowing, and increase available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

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

**139—Perks loamy sand, 0 to 3 percent slopes.** This is a nearly level and very gently sloping, excessively drained soil on bottom lands. This soil is subject to frequent flooding. Most areas range from 5 to 80 acres in size and are irregular in shape.

Typically, the surface layer is very dark grayish brown loamy sand about 4 inches thick. The substratum to a depth of about 60 inches is brown and pale brown sand that is stratified with coarse sand in the lower part. In some places the surface layer is sandy loam or loam.

Permeability of this Perks soil is rapid. Surface runoff is slow. Available water capacity is very low. The substratum has very low amounts of available phosphorus and available potassium.

Most areas of this soil are used as woodland and permanent pasture. Other areas have been cleared and are cultivated. This soil is generally not suited to corn, soybeans, and small grain, but is suited to grasses and legumes for hay and pasture if flooding is controlled. Plant growth depends on a good distribution of rainfall.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Seedlings do not survive well without supplemental water or mulching and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings also improves the survival rate.

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

**141—Watseka loamy fine sand, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on stream terraces. Areas range from 2 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is also very dark grayish brown loamy fine sand about 6 inches thick. The subsoil is about 15 inches thick. In the upper part it is very dark grayish brown and dark grayish brown, very friable loamy fine sand, and in the lower part it is dark grayish brown and

brown, mottled, loose fine sand. The substratum to a depth of about 60 inches is multicolored, mottled fine sand and sand. In some places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils, excessively drained Sparta soils, and poorly drained, fine sandy loam soils. Dickinson soils are fine sandy loam in the surface layer, the subsurface layer, and the upper part of the subsoil. Sparta soils have a brown or yellowish brown subsoil. Dickinson and Sparta soils are on slight rises. Poorly drained, fine sandy loam soils have a grayer and more mottled subsoil. These soils are in lower areas in the map unit. Included soils make up about 6 percent of the map unit.

Permeability of this Watseka soil is rapid. Runoff is slow. Available water capacity is low. The soil has a seasonal high water table. The subsoil has very low amounts of available phosphorus and available potassium.

Many areas are cultivated. Most small areas of this soil are cropped along with larger areas of adjacent soils that are well suited to crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is also suited to vegetable crops. Plant growth depends on a good distribution of rainfall because of the low available water capacity. The water table is high in spring but drops rapidly during the growing season. In some areas installing tile is difficult because of the substratum of loose, water-bearing sand. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to maintain fair tilth. Cover crops reduce the hazard of soil blowing especially when vegetable crops are grown. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce the hazard of soil blowing, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIs.

**152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on stream terraces. Areas range from 5 to more than 80 acres in size and are irregularly shaped.

Typically, the surface layer is black clay loam about 7 inches thick. The subsurface layer is black and very dark gray clay loam about 15 inches thick. It is mottled in the lower part. The subsoil is about 15 inches thick. In the upper part it is dark gray and gray, mottled firm clay loam, and in the lower part it is gray and olive gray, mottled, friable clay loam. The substratum to a depth of about 60 inches is dark gray and light brownish gray sand. In places the subsoil extends to a depth of about 24 inches. Also, in places the surface layer, the subsurface layer, and the subsoil are loam.

Included with this soil in mapping are small areas of somewhat poorly drained Watseka soils and very poorly drained soils in depressions that pond water. Watseka soils are loamy sand or sand in the surface layer, the subsurface layer, and the upper part of the subsoil. They are in higher landscape positions than Marshan soils. Included soils make up about 3 percent of the map unit.

Permeability of this Marshan soil is moderate in the surface layer, the subsurface layer, and the subsoil, and is rapid in the substratum. Runoff is slow. Available water capacity is moderate. The soil has a seasonal high water table. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Drainage ditches and, in some places, tile drains improve soil aeration and allow timelier tillage. Because of the relatively low position of this soil, in some places establishing adequate drainage outlets is difficult. Installing drainage tile is difficult in some areas because of the underlying, loose, water-bearing sand. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet help to prevent surface crusting and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**160—Walford silt loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on broad, upland ridgetops in the upper part of concave drainageways. Most areas range from 5 to 80 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 dark grayish brown silt loam about 7 inches thick. The subsoil is mottled, friable silty clay loam about 28 inches thick. In the upper part it is gray, in the next part it is grayish brown, and in the lower part it is light olive gray. The substratum to a depth of 60 inches is light olive gray, mottled silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of very poorly drained Sperry soils. This soil has a thicker silt loam surface layer and subsurface layer and has more clay in the subsoil. They are in slight depressions. They make up about 2 percent of the map unit.

Permeability of this Walford soil is moderately slow. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential of the subsoil is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration, and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIw.

**162B—Downs silt loam, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on broad, convex ridges and side slopes on uplands. 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 brown and dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. In the upper part it is yellowish brown, friable silt loam; in the next part it is yellowish brown, mottled, friable silty clay loam; and in the lower part it is mottled, yellowish brown and light brownish gray, friable

silt loam. In some places plowing has mixed streaks and pockets of yellowish brown subsoil material with the surface layer. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Atterberry soils. These soils have a grayer and more mottled subsoil. They are in more nearly level areas and on concave head slopes. They make up about 2 percent of the map unit.

Permeability of this Downs soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**162C—Downs silt loam, 5 to 9 percent slopes.** This is a moderately sloping, well drained soil on convex ridges and side slopes on uplands. 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 dark grayish brown and brown silt loam about 3 inches thick. The subsoil is friable and about 44 inches thick. In the upper part it is brown and yellowish brown silt loam, in the next part it is yellowish brown silty clay loam, and in the lower part it is mottled, yellowish brown and light brownish gray silt loam. The substratum to a depth of about 60 inches is light yellowish brown, mottled silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Downs soils. These soils have a surface layer of brown and dark brown silty clay loam

and contain less organic matter. They are on convex side slopes. They make up about 2 percent of the map unit.

Permeability of this Downs soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridges and side slopes on uplands. Areas range from 5 to more than 80 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material with the surface layer. The subsoil is friable and about 46 inches thick. In the upper part it is yellowish brown silty clay loam. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches is mottled, yellowish brown and light brownish gray silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Downs soils. These soils have a surface layer of brown and dark brown silty clay loam and contain less organic matter. They are on convex side slopes. They make up about 2 percent of the map unit.

Permeability of this Downs soil is moderate. Runoff is medium. Available water capacity is high. The subsoil

has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Water erosion is a hazard on the more convex side slopes, where prior erosion is greatest (fig. 8). A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**162C3—Downs silty clay loam, 5 to 9 percent slopes, severely eroded.** This is a moderately sloping, well drained soil on side slopes on uplands. Areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark brown silty clay loam about 8 inches thick. It is mixed subsoil material and surface soil material. The subsoil is friable and about 46 inches thick. In the upper part it is yellowish brown silty clay loam; in the next part it is yellowish brown, mottled silty clay loam; and in the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In places sandy material is at a depth of 48 to 96 inches.

Permeability of this Downs soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to improve poor tilth. In



Figure 8.—Water erosion in an area of Downs silt loam, 5 to 9 percent slopes, moderately eroded, has damaged both the soil and the crop of soybeans.

most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the

pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas

range from 10 to 30 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material with the surface layer. The subsoil is yellowish brown, friable, and about 38 inches thick. In the upper part it is silt loam, in the next part it is silty clay loam, and in the lower part it is mottled silty clay loam and silt loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Downs soils. These soils have a surface layer of brown and dark brown silty clay loam. They are on convex side slopes and contain less organic matter. They make up about 2 percent of the map unit.

Permeability of this Downs soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**162D3—Downs silty clay loam, 9 to 14 percent slopes, severely eroded.** This is a strongly sloping, well drained soil on side slopes on uplands. Areas range from 3 to more than 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark brown silty clay loam about 7 inches thick. It is mixed subsoil material and surface soil material. The subsoil is friable and about 39 inches thick. In the upper part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown silt loam that has light brownish gray

mottles. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam. In places sandy material is at a depth of 48 to 96 inches.

Permeability of this Downs soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to improve poor tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

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

This is a gently sloping, well drained soil on broad, convex ridges and side slopes on uplands. Areas range from 5 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is yellowish brown silt loam about 4 inches thick. The subsoil is silty clay loam about 36 inches thick. In the upper part it is yellowish brown and friable; in the next part it is yellowish brown and firm; and in the lower part it is yellowish brown, mottled, and friable. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places sand is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Stronghurst soils. These soils are grayer and more mottled in the subsoil. They are in less sloping areas and on slightly concave head slopes. They make up about 5 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

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

This is a moderately sloping, well drained soil on narrow ridges and convex side slopes on uplands. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is yellowish brown silt loam about 4 inches thick. The subsoil is friable and about 40 inches thick. In the upper part it is yellowish brown silty clay loam. In the next part it is yellowish brown, mottled silty clay loam. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the subsoil has mottles throughout. Also, in places sandy material is at a depth of 48 to 96 inches.

Permeability of this Fayette soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface

crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on narrow ridges and convex side slopes. Areas range from 5 to 30 acres or more in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. Some streaks and pockets of yellowish brown silty clay loam subsoil material are mixed with the surface layer. The subsoil is friable and about 39 inches thick. In the upper part it is yellowish brown silty clay loam. In the next part it is yellowish brown, mottled silty clay loam. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In places this soil has a subsurface layer of silt loam. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Fayette soils. These soils have a surface layer of brown or yellowish brown silty clay loam and contain less organic matter. They are in more convex positions and make up about 5 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. The hazard of water erosion is greatest on the more convex side slopes. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in



controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

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

This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 10 to 20 acres in size and are elongated.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 5 inches thick. The subsoil is friable and about 49 inches thick. In the upper part it is brown silt loam, in the next part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown silt loam. In places sandy material is at a depth of 48 to 96 inches.

Permeability of this Fayette soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are used for pasture or woodland. A few areas have been cleared of trees and are cultivated. This soil is suited to corn and soybeans grown in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**163D2—Fayette silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown and

brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown silty clay loam subsoil material with the surface layer. The subsoil is yellowish brown and about 45 inches thick. In descending sequence, it is friable silty clay loam; firm silty clay loam; mottled, friable silty clay loam; and mottled, friable silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In places the subsurface layer is silt loam. In some places the subsoil is mottled throughout. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of severely eroded Fayette soils. These soils have a surface layer of brown or yellowish brown silty clay loam and contain less organic matter. They are in the same positions as the moderately eroded Fayette soil and are in the more convex positions. They make up about 3 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. A few areas are used for pasture. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. The hazard of water erosion is greatest on the more convex side slopes. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

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

This is a moderately steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is yellowish brown, friable, and about 47 inches thick. In

the upper part it is silt loam, in the next part it is silty clay loam, and in the lower part it is mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the surface layer is very dark gray silt loam about 4 inches thick. In a few places the subsoil is mottled throughout. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of Lindley soils. These soils have a subsoil and substratum of loam or clay loam and are on the lower part of side slopes. They make up about 5 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are used for pasture or woodland. This soil is poorly suited to occasional row crops in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, water erosion is a serious hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and contour stripcropping help to prevent excessive soil loss and to maintain fair tilth. Terracing is not as effective or as practical as on less sloping areas of Fayette soils. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and areas remain in native hardwoods. Tree planting, management, and harvesting operations are more difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**163E2—Fayette soil loam, 14 to 18 percent slopes, moderately eroded.** This is a moderately steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated.

Typically, the surface layer is dark grayish brown and dark brown silt loam about 6 inches thick. Plowing has mixed some streaks and pockets of subsoil material into the surface layer. The subsoil is yellowish brown and

about 44 inches thick. In the upper part it is friable silty clay loam. In the next part it is firm silty clay loam. In the lower part it is mottled, friable silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some places the subsoil is mottled throughout. Also, in places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of Lindley soils and severely eroded Fayette soils. Lindley soils have a subsoil and substratum of loam or clay loam and are on the lower part of side slopes. Severely eroded Fayette soils have a surface layer of brown or yellowish brown silty clay loam and are on the more convex side slopes. Included soils make up about 10 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Many areas are cultivated. A few are used for pasture. This soil is poorly suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. Water erosion is a hazard on the more convex side slopes and where prior erosion is greatest. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and contour stripcropping help to prevent excessive soil loss and to maintain fair tilth. Terracing is not as effective or as practical as on less sloping Fayette soils. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Tree planting, management, and harvesting operations are more difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**163F—Fayette silt loam, 18 to 25 percent slopes.** This is a steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 120 acres in size and are elongated and irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is yellowish brown, friable, and about 44 inches thick. In the upper part it is silt loam, in the next part it is silty clay loam, and in the lower part it is silt loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. In some places the subsoil is mottled throughout.

Included with this soil in mapping are small areas of Gale and Lindley soils. Gale soils have sandstone bedrock within a depth of 18 to 36 inches. Lindley soils have a subsoil and substratum of loam or clay loam. Gale and Lindley soils are on the lower part of side slopes and make up about 3 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is very rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are used as woodland or permanent pasture. This soil is moderately suited to pasture and trees. This soil is not suited to cultivated crops because of the slope and the severe hazard of erosion. Tilth is fair in the surface layer.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition. Renovating pastures is difficult because some slopes are too steep for the safe operation of ordinary farm machinery.

This soil is suited to trees, and many areas remain in native hardwoods. Tree planting, management, and harvesting operations are difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control water erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIe.

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

This is a very steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 50 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is grayish brown silt loam about 6 inches thick. The subsoil is friable to a depth of 60 inches. In the upper part it is yellowish brown silt loam, in the next part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown, mottled silt loam. In places the subsoil is mottled throughout.

Included with this soil in mapping are small areas of

Gosport, Lindley, and Gale soils. In Gosport soils material weathered from shale is at a depth of less than 15 inches. Lindley soils formed in loam and clay loam glacial till. In Gale soils sandstone bedrock is at a depth of 18 to 36 inches. Gosport, Lindley, and Gale soils are on the lower part of side slopes and make up less than 5 percent of the map unit.

Permeability of this Fayette soil is moderate. Runoff is very rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are used as woodland or permanent pasture. This soil is not suited to cultivated crops or to hay because of slope and the severe hazard of water erosion. It is poorly suited to pasture. Ordinary farm machinery cannot be used for pasture renovation because of the slope. Tilth is fair in the surface layer.

This soil is suited to trees, and most areas remain in native hardwoods. Tree planting, management, and harvesting operations are difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control water erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIIe.

**164—Traer silt loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on broad ridgetops and divides on uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark gray silt loam about 11 inches thick. The subsurface layer is about 6 inches thick. It is light brownish gray silt loam that has yellowish brown mottles. The subsoil is silty clay loam about 37 inches thick. In descending sequence, it is grayish brown and friable and has yellowish brown mottles; mottled, grayish brown and yellowish brown, and firm; mottled, grayish brown and yellowish brown, and friable; mottled, grayish brown, and friable; and mottled, light brownish gray, brownish yellow, and yellowish brown, and friable. The substratum to a depth of 60 inches is mottled, brownish yellow and light brownish gray silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Stronghurst soils and very poorly drained soils in depressions. Stronghurst soils have a browner or less mottled subsoil and are on slight rises in the map unit. The soils in depressions are ponded during wet periods and are scattered throughout the map unit. Included soils make up about 3 percent of the map unit.

Permeability of this Traer soil is slow. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential of the subsoil is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Tile drains improve aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in improving soil tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few areas remain in native hardwoods. This soil is poorly drained. The seasonal high water table restricts the use of equipment to drier periods or winter, when the ground is frozen. During wet periods special high flotation equipment may also be needed for harvesting or management. Planted seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the seedling survival rate.

The land capability classification is IIIw.

**165—Stronghurst silt loam, 0 to 3 percent slopes.**

This is a very gently sloping, somewhat poorly drained soil on broad ridgetops and divides on uplands. Areas range from 3 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam about 5 inches thick. The subsoil is about 35 inches thick. In the upper part it is brown, mottled, friable silty clay loam. In the next part it is mottled, light gray and yellowish brown, firm silty clay loam. In the lower part it is light gray, mottled, friable silty clay loam. The substratum to a depth of 60 inches is light gray, mottled silt loam. In places sandy material is at a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of poorly drained Traer soils. These soils have a grayer or more mottled subsoil. They are in slightly lower or less

convex areas. They make up about 5 percent of the map unit.

Permeability of this Stronghurst soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the surface, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining good tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIw.

**173—Hoopeston sandy loam, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on stream terraces. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown, mottled sandy loam about 8 inches thick. The subsoil is friable sandy loam about 15 inches thick. In descending sequence, it is mottled, dark grayish brown and dark yellowish brown; dark yellowish brown and mottled; and mottled, dark yellowish brown and grayish brown. The substratum extends to a depth of 60 inches. It is yellowish brown, mottled sand in the upper part and light brownish gray sand in the lower part.

Included with this soil in mapping are small areas of poorly drained soils. These soils have a grayer and more mottled subsoil. They are in slightly lower concave positions, and make up about 5 percent of the map unit.

Permeability of this Hoopeston soil is moderately rapid. Runoff is slow. Available water capacity is low. The soil has a seasonal high water table. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is suited to corn,

soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. The water table is moderately high in spring but drops rapidly during the growing season. In some areas installing tile is difficult because of the substratum of loose, water-bearing sand. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and adjacent soils. A system of conservation tillage that leaves crop residue on the surface and cover crops help to conserve moisture, to prevent soil blowing, and to maintain fair tilth. Returning crop residue to the surface and regularly adding other organic material improve fertility, help to reduce surface crusting and to control soil blowing, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIs.

**174—Bolan loam, 0 to 2 percent slopes.** This is a nearly level, well drained soil on uplands and stream terraces. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown, very dark grayish brown, and dark brown loam about 11 inches thick. The subsoil is about 27 inches thick. In the upper part it is brown, friable loam. In the next part it is brown, friable sandy loam. In the lower part it is brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown sand. In places, the surface layer and the upper part of the subsoil are sandy loam.

Included with this soil in mapping are small areas of somewhat poorly drained Elrin and Hoopeston soils. These soils are scattered throughout the map unit. Elrin soils have a dark grayish brown and grayish brown subsoil. Hoopeston soils have more sand and a mottled subsoil that has grayer colors. Elrin and Hoopeston soils are in slightly lower or concave areas. Included soils make up about 6 percent of the map unit.

Permeability of this Bolan soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow. Available water capacity is moderate. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Because of the moderate

available water capacity, plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to control soil blowing, and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce surface crusting, and increase available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIs.

**174B—Bolan loam, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on uplands and on stream terraces. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 12 inches thick. The subsoil is about 25 inches thick. In the upper part it is dark brown and brown, friable loam. In the next part it is brown, friable sandy loam. In the lower part it is dark yellowish brown, very friable loamy sand. The substratum to a depth of about 60 inches is brown and pale brown sand.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils. Dickinson soils are sandy loam in the surface layer, the subsurface layer, and the upper part of the subsoil. They are scattered throughout the unit and make up about 5 percent of the map unit.

Permeability of this Bolan soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is moderate. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion and soil blowing are hazards. Plant growth depends on a good distribution of rainfall. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent excessive soil loss, and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, reduce surface crusting, and increase available water capacity.

A cover of pasture or hay plants is effective in

controlling erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**175—Dickinson fine sandy loam, 0 to 2 percent slopes.** This is a nearly level, somewhat excessively drained soil on stream terraces. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown and very dark brown fine sandy loam about 12 inches thick. The subsoil is about 23 inches thick. In descending sequence, it is very dark grayish brown and brown, friable fine sandy loam; brown, friable fine sandy loam; brown, very friable sandy loam; and brown, very friable loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand. In places the surface layer is loamy sand.

Included with this soil in mapping are small areas of well drained Bolan soils and somewhat poorly drained Hoopeston soils. Bolan soils are loam in the surface layer, the subsurface layer, and the upper part of the subsoil. Hoopeston soils are gray and mottled in the subsoil and are in slightly lower or more concave positions. Bolan and Sparta soils are scattered throughout the map unit. Included soils make up about 5 percent of the map unit.

Permeability of this Dickinson soil is moderately rapid. Runoff is slow. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses or legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. Blowing sand grains can damage seedlings on this soil and adjacent soils. A system of conservation tillage that leaves crop residue on the surface and cover crops help to conserve moisture, to prevent soil blowing, and to maintain fair tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, reduce surface crusting, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIs.

**175B—Dickinson fine sandy loam, 2 to 5 percent slopes.** This is a gently sloping, somewhat excessively drained soil on uplands and stream terraces. Areas range from 3 to 40 acres in size and are irregularly shaped or oval.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is about 25 inches thick. In the upper part it is dark brown and brown, very friable fine sandy loam; in the next part it is brown, very friable fine sandy loam; and in the lower part it is yellowish brown, very friable loamy fine sand. The substratum to a depth of about 60 inches is brown and yellowish brown sand. In places the upper part of the solum contains more clay.

Permeability of this Dickinson soil is moderately rapid. Runoff is medium. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses or legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, erosion and soil blowing are hazards. Blowing sand grains can damage seedlings on this soil and adjacent soils. A system of conservation tillage that leaves crop residue on the surface and cover crops help to conserve moisture, to prevent excessive soil loss, and to maintain fair tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, reduce surface crusting, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**175C—Dickinson fine sandy loam, 5 to 9 percent slopes.** This is a moderately sloping, somewhat excessively drained soil on convex, upland side slopes and on wind-deposited dunes on stream terraces. Areas range from 4 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is dark brown fine sandy loam about 7 inches thick. The subsoil is about 27 inches thick. In the upper part it is dark brown and yellowish brown, very friable fine sandy loam, and in the lower part it is

yellowish brown, brown, and brownish yellow, very friable loamy sand. The substratum to a depth of about 60 inches is pale yellow and brownish yellow sand. In some places the surface layer is loam.

Permeability of this Dickinson soil is moderately rapid. Runoff is medium. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated or are used for hay and pasture. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, erosion and soil blowing are hazards. Blowing sand grains can damage seedlings on this soil and adjacent soils. A system of conservation tillage that leaves crop residue on the surface, cover crops, grassed waterways, and stripcropping help to conserve moisture, to prevent excessive soil loss, and to maintain fair tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce surface crusting, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**179D2—Gara loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown loam about 6 inches thick. Plowing has mixed streaks and pockets of yellowish brown clay loam subsoil material into the surface layer. The subsoil is about 42 inches thick. In the upper part it is yellowish brown, friable clay loam. In the next part it is yellowish brown, mottled, firm clay loam. In the lower part it is mottled, yellowish brown and pale brown, friable clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In some places the surface layer is brown or yellowish brown clay loam. Also, in places slopes are less than 9 percent.

Included with this soil in mapping are small areas of Orwood soils and soils that are sandy and gravelly in the surface layer and the subsoil. Orwood soils are silty and have sandy and loamy layers in the subsoil. Sandy and gravelly soils and Orwood soils are scattered

throughout the map unit. Included soils make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Runoff is rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Many areas are cultivated. Some are used for pasture or hay but were cultivated at some time in the past. This soil is suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to reduce both runoff and surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**179F—Gara loam, 14 to 25 percent slopes.** This is a moderately steep and steep, well drained soil on convex side slopes on uplands. Areas range from 5 to 20 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is yellowish brown about 33 inches thick. It is friable loam in the upper part and firm clay loam in the lower part. The substratum extends to a depth of about 60 inches. It is light olive brown mottled clay loam in the upper part and light brownish gray mottled clay loam in the lower part. In most places that have been cultivated, the surface layer is lighter in color and contains less organic matter.

Included with this soil in mapping are small areas of Orwood soils and soils that are sandy and gravelly in the surface layer and the subsoil. Orwood soils are silty and have sandy and loamy layers in the subsoil, and they are on the upper part of slopes. Sandy and gravelly soils are scattered throughout the map unit. Included soils make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow.

Runoff is rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for hay and pasture. Some areas are cultivated presently or have been cultivated at some time in the past. This soil generally is not suitable for cultivated crops because of the slope and the severe hazard of erosion. It is suited to grasses and legumes for hay and pasture. Tillth is good in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Tree planting, management, and harvesting operations are more difficult because of the slope. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIe.

**212—Kennebec silt loam, 0 to 2 percent slopes.**

This is a nearly level, moderately well drained soil on bottom land. It is subject to occasional flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is silt loam about 32 inches thick. In the upper part it is black, and in the lower part it is very dark gray. The subsoil extends to a depth of about 60 inches. It is dark grayish brown and dark brown silt loam in the upper part and brown, mottled silt loam in the lower part. In places about 12 inches of recently deposited silt loam overlies the surface layer. In other places the combined thickness of the surface layer and the subsurface layer is about 20 inches, and the subsoil is brown silt loam. Also, in places the solum contains more sand.

Permeability of this Kennebec soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsurface layer has low amounts of available phosphorus and moderate amounts of available potassium.

Most areas are cultivated. If flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Diversions and dikes on the local flood plains can help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. A system of conservation tillage that leaves crop residue on the surface helps to conserve

moisture and to maintain good tillth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling soil washing or channeling by floodwater. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is I.

**249B—Zwingle silt loam, 2 to 9 percent slopes.**

This is a gently sloping and moderately sloping, poorly drained soil on stream terraces along tributaries of the Mississippi River. Areas range from 5 to 40 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 grayish brown and dark grayish brown, mottled silt loam about 4 inches thick. The subsoil to a depth of 60 inches is mottled, firm silty clay loam. In descending sequence, it is brown; grayish brown and yellowish brown; brown and light brownish gray; and reddish brown and brown. In places, silt loam overwash is as much as 12 inches thick.

Permeability of this Zwingle soil is very slow. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential of the subsoil is high. The subsoil has very low amounts of available phosphorus and low amounts of available potassium.

Most areas are used for woodland or permanent pasture. Some are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. Tile drains do not function well because of the clayey subsoil. A system of conservation tillage that leaves crop residue on the surface, contouring, and stripcropping help to prevent excessive soil loss and to maintain fair tillth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep pasture and the soil in good condition.

This soil is poorly suited to trees, but many areas remain in native hardwoods. The seasonal high water table restricts the use of equipment to drier periods or winter, when the ground is frozen. During wet periods



special high flotation equipment may be needed for harvesting or management. Planted seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the seedling survival rate.

The land capability classification is IIIe.

**291—Atterberry silt loam, 0 to 2 percent slopes.**

This is a nearly level, somewhat poorly drained soil on broad ridgetops in the uplands. 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 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is mottled, friable silty clay loam about 33 inches thick. In descending sequence, it is brown; light olive brown; mottled, light brownish gray and light olive brown; and mottled, light brownish gray and brownish yellow. The substratum to a depth of about 60 inches is mottled, light gray, brownish yellow, and gray loam and silt loam. In places sand is below a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of well drained Downs soils and poorly drained Walford soils. Downs soils have a brown and yellowish brown subsoil. They are on slight rises in the map unit. Walford soils are grayer and more mottled in the subsoil than the Atterberry soil. They are in lower or more concave positions in the map unit. Included soils make up about 5 percent of the map unit.

Permeability of this Atterberry soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most areas tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining good tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is I.

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

This is a gently sloping, somewhat poorly drained soil on convex ridgetops, on plane to concave side slopes, and on head slopes on uplands. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is friable and about 42 inches thick. In the upper part it is yellowish brown, mottled silty clay loam. In the next part it is light brownish gray, mottled silty clay loam. In the lower part it is light brownish gray, mottled silt loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam. In places sand is below a depth of 48 to 96 inches.

Included with this soil in mapping are areas of well drained Downs soils. These soils are brown and yellowish brown in the subsoil. They are on convex side slopes adjacent to and above the concave side slopes and make up about 5 percent of the map unit.

Permeability of this Atterberry soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most areas tile drains improve soil aeration and allow timelier tillage. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**293G—Chelsea-Fayette complex, 25 to 40 percent slopes.** This map unit consists of very steep soils on side slopes in the uplands. The Chelsea soil is excessively drained, and the Fayette soil is well drained. It is 50 percent Chelsea soil, 35 percent Fayette soil, and 15 percent other soils. These soils are in areas so intricately mixed or so small in size that they could not be separated at the scale used for mapping. Most areas range from 20 to 35 acres in size and are irregularly shaped.

Typically, the surface layer of the Chelsea soil is very dark gray loamy fine sand about 3 inches thick. The subsurface layer is dark grayish brown, brown, and yellowish brown loamy fine sand and fine sand about 45 inches thick. Below this to a depth of 60 inches is variegated, brown and light brownish gray loamy sand.

Typically, the surface layer of the Fayette soil is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of 60 inches and is friable. In the upper part it is yellowish brown silt loam, in the next part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown, mottled silt loam. In places the subsoil is mottled throughout.

Permeability is rapid in the Chelsea soil and moderate in the Fayette soil. Surface runoff is rapid. Available water capacity is low for the Chelsea soil and high for the Fayette soil. In the Chelsea soil the subsurface layer has very low amounts of available phosphorus and low amounts of available potassium. In the Fayette soil the subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are used for woodland or permanent pasture. These soils are not suited to cultivated crops or to hay because of the slope and the severe hazard of erosion. They are poorly suited to pasture. Slope prevents use of ordinary farm machinery on these soils for pasture renovation. Plant growth on the Chelsea soil depends on a good distribution of rainfall. Tillage is fair in the surface layer.

These soils are suited to trees, and most areas remain in native hardwoods. The slope limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below these soils helps to control erosion. On the Fayette soil seedlings survive and grow well. On the Chelsea soil seedlings do not survive and grow well without supplemental water or mulching. On this soil seedlings can be spaced closer together and thinned later to achieve desired stand density. Planting

larger seedlings and controlling competing vegetation improve the survival rate.

The Chelsea and Fayette soils are in capability subclass VIIe.

**313G—Gosport silty clay loam, 18 to 40 percent slopes.** This is a steep and very steep, moderately well drained soil on side slopes in the uplands. Areas range from 10 to 100 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 27 inches thick. In descending sequence, it is light olive brown, mottled, friable silty clay loam; light olive brown, mottled, firm silty clay; mottled, light olive brown and light brownish gray, firm silty clay; and gray, mottled, firm silty clay. The substratum to a depth of 60 inches is very dark gray and dark gray clay shale and some sandstone fragments.

Included with this soil in mapping are small areas of Gale and Lindley soils. Gale soils have weathered sandstone residuum underlying 20 to 40 inches of silty loess. Lindley soils are loam or clay loam in the subsoil and the substratum. Gale and Lindley soils are on the upper part of the slope and make up about 5 percent of the map unit.

Permeability of the Gosport soil is very slow. Runoff is very rapid. Available water capacity is moderate. Shrink-swell potential in the subsoil is high. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are used for woodland or permanent pasture. This soil is not suited to cultivated crops or to hay because of the slope and the severe hazard of erosion. It is poorly suited to pasture. Slope prohibits use of ordinary farm machinery for pasture renovation. Tillage is fair in the surface layer.

This soil is suited to trees, and most areas remain in native hardwoods. The slope limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings do not survive well and can be spaced closer together and thinned later to achieve desired stand density. Planting larger seedlings and controlling competing vegetation improve the survival rate.

The land capability classification is VIIe.

**315—Aquolls, 0 to 2 percent slopes.** These are nearly level, poorly drained soils on bottom lands along streams and rivers. They are subject to frequent flooding except where they are protected by levees.

Areas range from 10 to several hundred acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 5 inches thick. The subsurface layer is very dark gray, mottled silt loam and loam about 13 inches thick. The next layer is mottled, dark gray and grayish brown sandy loam about 4 inches thick. The substratum to a depth of 60 inches is sand. It is mottled, light olive brown and grayish brown in the upper part and mottled, gray and brown in the lower part.

Included with these soils in mapping are small areas of somewhat excessively drained Perks sandy loam soils and loamy sand soils. Perks sandy loam soils are sandy loam in the surface layer and the subsurface layer and are on the higher bottom lands 3 to 4 feet above these soils. Perks loamy sand soils are loamy sand in the surface layer and are 0 to 2 feet above these soils. Together, these Perks soils make up about 10 percent of the map unit.

Permeability of Aquolls differs from place to place. It generally is moderate in the surface layer, subsurface layer, and next layer and rapid in the substratum. Runoff is slow. Available water capacity is moderate. The subsurface layer and the next layer have low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for pasture or woodland. These soils are not suited to corn, soybeans, and small grain because of frequent flooding, siltation, and stream channels. Some areas that have flood protection are used for cultivated crops. These soils are moderately suited to grasses and legumes for hay and pasture. Even when levees provide flood protection, some areas are ponded when the water level remains high (fig. 9). Tillth is fair in the surface layer.

These soils are suited to trees, and many areas remain in native hardwoods. The seasonal high water table restricts the use of equipment to drier periods or winter, when the ground is frozen. During wet periods special high flotation equipment may be needed for harvesting or management. Seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the survival rate.

The land capability classification is Vw.

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

This is a gently sloping, well drained soil on convex ridges and side slopes on uplands and stream terraces.

Areas range from 3 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 subsoil is yellowish brown, friable, and about 31 inches thick. In the upper part it is silty clay loam. In the next part it is silt loam. In the lower part it is loam that has loamy sand and sand lenses. The substratum to a depth of 60 inches is pale brown and brown stratified sand and loamy sand, and loam and sandy loam iron bands (fig. 10). In a few places the surface layer is loam.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils. These soils are sandy loam in the surface layer, the subsurface layer, and the upper part of the subsoil. These included soils are scattered throughout and make up about 7 percent of the map unit.

Permeability of this Whittier soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain good tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

Land capability classification is IIe.

### **352C—Whittier silt loam, 5 to 9 percent slopes.**

This is a moderately sloping, well drained soil on convex side slopes on uplands. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is friable and about 22



Figure 9.—The elevated vacation cottages on Aquolls, 0 to 2 percent slopes, usually are not damaged by the frequent flooding.

inches thick. In the upper part it is yellowish brown silty clay loam. In the lower part it is yellowish brown and brownish yellow, stratified loam and sandy loam. The substratum to a depth of 60 inches is light yellowish brown and yellowish brown, stratified sand and loamy sand. In a few places the surface layer is loam. In

places depth to sand is more than 40 inches.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils and severely eroded Whittier soils. Dickinson soils have a sandy loam texture. Severely eroded Whittier soils have a surface layer of brown or yellowish brown silty clay

loam. These included soils are scattered throughout and make up about 8 percent of the map unit.

Permeability of this Whittier soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain good tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**352C2—Whittier silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex side slopes on uplands. Areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 9 inches thick. Plowing has mixed streaks and pockets of yellowish brown silty clay loam subsoil material into the surface layer. The subsoil is about 33 inches thick. In the upper part it is yellowish brown, friable silty clay loam. In the next part it is yellowish brown, friable loam. In the lower part it is yellowish brown and brownish yellow, very friable loamy sand. The substratum to a depth of 60 inches is yellowish brown and brownish yellow sand. In some places the surface layer of very dark grayish brown silt loam is not mixed with subsoil material of yellowish brown silty clay loam. In a few places the surface layer is loam. In places depth to sand is more than 40 inches.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded

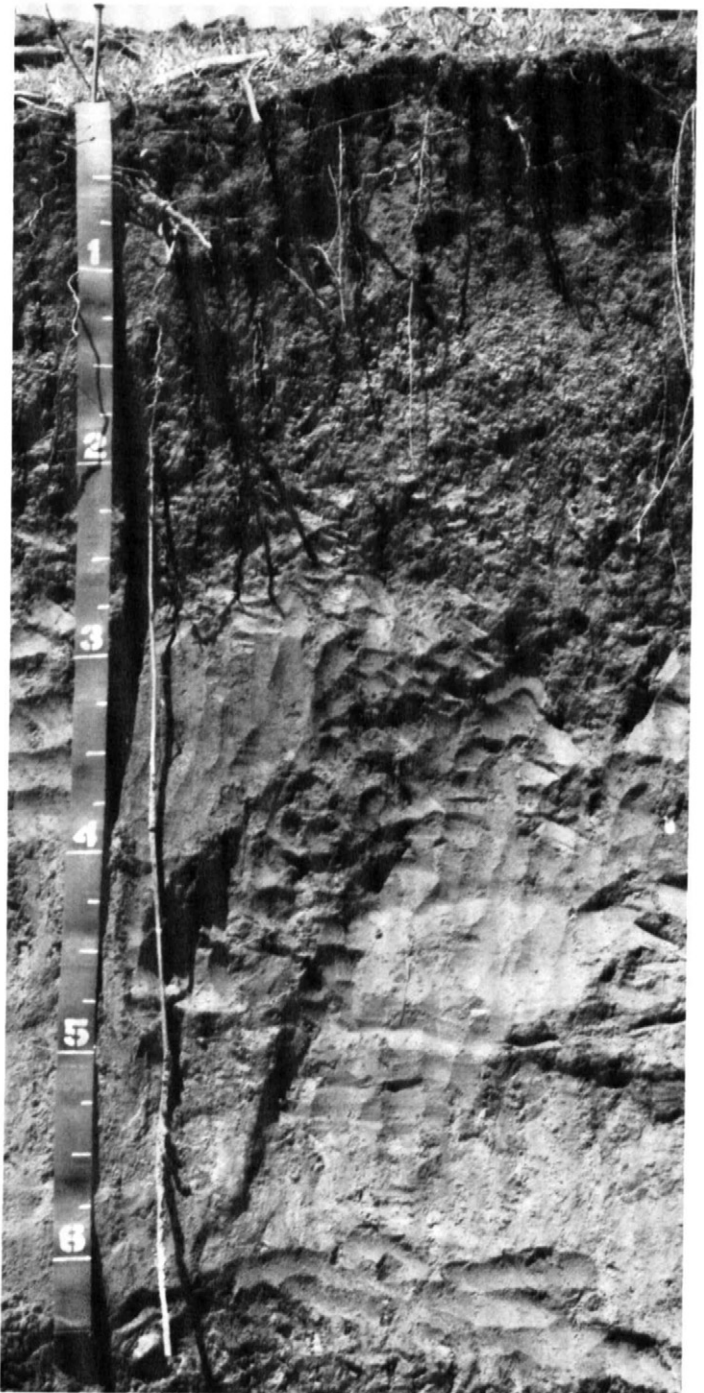


Figure 10.—Profile of Whittier silt loam, 2 to 5 percent slopes. The light-colored, sandy substratum is at a depth of 36 to 78 inches. In this location glacial till is below a depth of 78 inches.

Whittier soils. Chelsea soils are loamy sand and sand throughout. Severely eroded Whittier soils have a

surface layer of brown or yellowish brown silty clay loam. These included soils are scattered throughout and make up about 8 percent of the map unit.

Permeability of this Whittier soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**352D2—Whittier silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes on uplands. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of yellowish brown silty clay loam subsoil material into the surface layer. The subsoil is friable and about 25 inches thick. In the upper part it is yellowish brown silty clay loam. In the lower part it is yellowish brown, stratified loam and sandy loam. The substratum to a depth of 60 inches is yellowish brown and light yellowish brown, stratified sand and loamy sand. In a few places the surface layer is loam.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded Whittier soils. Chelsea soils are loamy sand and sand. Severely eroded Whittier soils have a surface layer of brown or yellowish brown silty clay loam. These included

soils are scattered throughout and make up about 10 percent of the map unit.

Permeability of the Whittier soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is rapid. Available water capacity is moderate. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to occasional row crops in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**450B—Pillot silt loam, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on convex ridgetops and side slopes on uplands and on stream terraces. Areas range from 3 to 20 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 brown and very dark grayish brown silt loam about 8 inches thick. The subsoil is friable and about 25 inches thick. In the upper part it is brown silty clay loam. In the next part it is yellowish brown and brown silty clay loam. In the lower part it is yellowish brown loamy sand. The substratum to a depth of 60 inches is banded brown and pale brown sand. In a few places the surface layer is loam. In places the depth to sandy texture is more than 40 inches.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils. These soils have a surface layer and subsoil of sandy loam. They are scattered throughout and make up about 7 percent of the map unit.

Permeability of this Pillot soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain good tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**450C2—Pillot silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridgetops and side slopes on uplands and on stream terraces. Areas range from 3 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 brown silty clay loam subsoil material into the surface layer. The subsoil is about 32 inches thick. In descending sequence, it is brown, friable silty clay loam; yellowish brown and brown, friable silty clay loam; yellowish brown, friable loam; and yellowish brown, very friable, stratified loamy sand and sand. The substratum to a depth of 60 inches is light yellowish brown sand and bands of yellowish brown loamy sand. In some places the surface layer is loam.

Included with this soil in mapping are small areas of somewhat excessively drained Dickinson soils and severely eroded Pillot soils. Dickinson soils have a surface layer and subsoil of sandy loam. Severely eroded Pillot soils have a surface layer of brown silty clay loam. Included soils are scattered throughout and make up about 10 percent of the map unit.

Permeability of this Pillot soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity

is moderate. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain good tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**467—Radford silt loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on moderately wide bottom lands. It is subject to occasional flooding of brief duration. Areas range from 10 to 200 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The substratum is about 20 inches thick. It is very dark grayish brown, stratified silt loam and thin, dark grayish brown layers. The buried surface layer is black and very dark gray silty clay loam about 18 inches thick. The buried subsoil to a depth of 60 inches is very dark gray and dark gray, mottled, friable silty clay loam. In some places the surface layer and the stratified substratum are less than 20 inches thick, and in other places they are more than 40 inches thick.

Permeability of this Radford soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The substratum has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated, but some are used as pasture or hayland. If this soil is adequately drained and if flooding is controlled, the soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Diversions and dikes on the local flood plains help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. Tile drains improve soil aeration and allow timelier tillage. A system

of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling channeling or soil washing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the soil in good condition.

The land capability classification is 1lw.

**467B—Radford silt loam, 2 to 5 percent slopes.**

This is a gently sloping, poorly drained soil in the lower parts of upland drainageways. It is subject to occasional flooding of brief duration. Areas range from 50 to several hundred acres in size and are elongated or irregularly shaped.

Typically, the surface layer is black silt loam about 10 inches thick. The substratum is about 20 inches thick. It is very dark gray and very dark grayish brown silt loam stratified with dark grayish brown and grayish brown layers. The buried surface layer is black silty clay loam about 10 inches thick. The buried subsoil to a depth of 60 inches is mottled, very dark gray, olive gray, and strong brown, friable silty clay loam. In some places the surface layer and the stratified substratum are less than 20 inches thick.

Permeability of this Radford soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The substratum has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated, but some are used for pasture or hayland. If this soil is adequately drained and flooding is controlled, the soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Diversions and dikes on the local flood plains help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. Tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to prevent soil washing and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling channeling or soil washing. Proper stocking rates, rotation grazing, and timely deferred grazing

especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is 1le.

**479G—Gale silt loam, 18 to 40 percent slopes.** This is a steep and very steep, well drained soil on side slopes on uplands. Areas range from 10 to more than 100 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is yellowish brown, friable, and about 23 inches thick. In the upper part it is silt loam. In the next part it is silty clay loam. In the lower part it is sandy loam that has sandstone fragments. The substratum to a depth of 39 inches is yellowish brown loamy sand. Light yellowish brown, brownish yellow, very pale brown, and strong brown weakly cemented sandstone is at a depth of 39 inches. In some places the surface layer and the subsurface layer contain more sand.

Included with this soil in mapping are small areas of Fayette and Gosport soils. Fayette soils are upslope from Gale soils and are silt loam and silty clay loam throughout. Gosport soils are downslope from Gale soils and have material weathered from shale at a depth of less than 15 inches. Fayette and Gosport soils make up about 7 percent of the map unit.

Permeability of this Gale soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is rapid. Available water capacity is moderate. The subsoil has very low amounts of available phosphorus and very low amounts of potassium.

Most areas are used as pasture or woodland. This soil is not suited to cultivated crops or hay because of slope and the severe hazard of erosion. It is poorly suited to pasture. Ordinary farm machinery cannot be used to renovate the pasture because of the slope. Tilth is fair in the surface layer.

This soil is suited to trees, and most areas remain in native hardwoods. The slope limits tree planting, management, and harvesting operations. Much of the work is most safely done with hand-operated equipment. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIIe.

**480C2—Orwood silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well



drained soil on convex side slopes in the uplands. 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 9 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is more than 51 inches thick. In the upper part it is yellowish brown, friable loam. In the next part it is yellowish brown, friable sandy loam and very friable loamy sand. In the lower part it is light brownish gray, mottled silt loam. In some places the surface layer is loam.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and moderately well drained Newvienna soils. Chelsea soils are loamy sand and sand throughout. Newvienna soils have mottles in the upper part of the subsoil and are silty clay loam and silt loam throughout. Chelsea and Newvienna soils are scattered throughout and make up about 5 percent of the map unit.

Permeability of this Orwood soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some areas slopes are long enough and uniform enough for terracing and contour farming. In places cuts made to construct terraces will expose sandy loam or loamy sand layers. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**480D2—Orwood silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes in the uplands. Areas range from 5 to 15 acres in size and are elongated.

Typically, the surface layer is very dark grayish

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 friable and about 49 inches thick. In the upper part it is yellowish brown loam, in the next part it is yellowish brown clay loam, and in the lower part it is mottled, light brownish gray and brownish yellow sandy loam and silt loam. The substratum to a depth of about 60 inches is mottled, light brownish gray and yellowish brown silt loam. In places the subsoil is sandy loam throughout.

Included with the soil in mapping are small areas of excessively drained Chelsea soils, moderately well drained Newvienna soils, and severely eroded Orwood soils. Chelsea soils are loamy sand or sand throughout and are scattered throughout the map unit. Newvienna soils have mottles in the upper part of the subsoil and are on concave head slopes. Severely eroded Orwood soils have a surface layer of yellowish brown loam and are in more convex areas. Chelsea, Newvienna, and severely eroded Orwood soils make up about 10 percent of the map unit.

Permeability of this Orwood soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans grown in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss and to maintain fair tilth. In some areas slopes are long enough and uniform enough for terracing and contour farming. In places cuts made to construct terraces will expose layers of sandy loam or loamy sand. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**480F2—Orwood silt loam, 14 to 25 percent slopes, moderately eroded.** This is a moderately steep and steep, well drained soil on convex side slopes in the uplands. Areas range from 5 to 10 acres in size and are elongated.

Typically, the surface layer is dark brown silt loam about 8 inches thick. It is high in sand content. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is yellowish brown, friable, and about 47 inches thick. In the upper part it is silty clay loam, in the next part it is silt loam, and in the lower part it is sandy loam. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam. In places the subsoil is sandy loam throughout. In places the surface layer is very dark grayish brown and does not have streaks and pockets of subsoil material.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded Orwood soils. Chelsea soils are loamy sand and sand throughout and are scattered throughout the map unit. Severely eroded Orwood soils have a surface layer of yellowish brown loam or silty clay loam and are in more convex, sloping areas. Chelsea and severely eroded Orwood soils make up about 10 percent of the map unit.

Permeability of this Orwood soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Many areas are cultivated. Some areas have not been cultivated and are used for pasture. This soil is not suited to cultivated crops because of the slope and the severe hazard of erosion. In moderately steep areas it is suited to hay. It is best suited to pasture and trees. Tilth is fair in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition. In steep areas renovating the pasture is difficult.

This soil is suited to trees. The slope somewhat limits tree planting, management, and harvesting operations. Most areas of this soil are narrow enough so that laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIe.

**481D2—Russell silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes in the uplands. Areas range from 3 to 40 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 subsoil material of yellowish brown silty clay loam into the surface layer. The subsoil is yellowish brown and about 36 inches thick. In the upper part it is friable silty clay loam, in the next part it is friable silt loam, and in the lower part it is firm, mottled loam. The substratum to a depth of 60 inches is yellowish brown, mottled loam. In places a sand or loamy sand layer is in the lower part of the subsoil above a substratum of loam or clay loam. In places the surface layer is very dark gray and 2 to 4 inches thick and the subsurface layer is light-colored silt loam. Also, in places this soil is moderately sloping.

Included with this soil in mapping are small areas of Lindley soils. Lindley soils are loam or clay loam throughout and are below Russell soils on the steeper side slopes. They make up about 5 percent of the map unit.

Permeability of this Russell soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and to legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Deep cuts made to construct terraces will expose glacial material with poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**481E2—Russell silt loam, 14 to 18 percent slopes, moderately eroded.** This is a moderately steep, well drained soil on convex side slopes on uplands. Areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown and brown silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil

material into the surface layer. The subsoil is friable and about 39 inches thick. In the upper part it is yellowish brown silt loam. In the next part it is yellowish brown silty clay loam and silt loam. In the lower part it is yellowish brown, mottled loam. The substratum to a depth of 60 inches is yellowish brown loam. In places the surface layer is very dark gray and is 2 to 4 inches thick. In places the depth to loam material is more than 40 inches.

Included with this soil in mapping are small areas of Lindley soils. Lindley soils are loam or clay loam throughout and are below Russell soils on steeper side slopes. They make up about 5 percent of the map unit.

Permeability of this Russell soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are in pasture but have been cultivated in the past. Some areas are cultivated. This soil is marginally suited to occasional row crops in rotation with small grain, grasses, and legumes. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a serious hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and strip cropping help to prevent excessive soil loss and to maintain fair tilth. Some slopes are long enough and uniform enough for terraces and contour farming. Deep cuts made to construct terraces will expose glacial material with poor tilth. Returning crop residue to the soil and regularly adding other organic matter improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. The slope somewhat limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive well if competing vegetation is controlled.

The land capability classification is IVe.

**485—Spillville loam, 0 to 2 percent slopes.** This is a nearly level, moderately well drained soil on bottom lands. Unless protected, this soil is subject to occasional flooding. Areas range from 4 to about 35 acres in size and are long and narrow or irregular.

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

brown and very dark grayish brown loam about 42 inches thick. The substratum is dark grayish brown, mottled loam to a depth of 60 inches. In some places the surface layer is sandy loam. Also, in places the surface layer and the subsurface layer are thinner, and in some places the subsurface layer is mottled.

Permeability of this Spillville soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsurface layer has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. Where this soil is protected from flooding, it is well suited to corn, soybeans, and small grain and to grasses or legumes for hay or pasture. Diversions and dikes on the local flood plains can help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. In some areas drainage ditches improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling channeling or soil washing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**485B—Spillville loam, 2 to 5 percent slopes.** This is a gently sloping, moderately well drained soil on foot slopes and on bottom lands along intermittent streams. Areas range from 4 to about 20 acres in size and are long and narrow.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is loam about 37 inches thick. In the upper part it is black, and in the lower part it is very dark grayish brown. The substratum to a depth of 60 inches is dark grayish brown, mottled loam. In some places the subsurface layer is mottled. In other places the surface layer and the subsurface layer are sandy loam.

Permeability of this Spillville soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsurface layer has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses for hay

or pasture. If cultivated crops are grown, erosion is a hazard. This soil receives runoff from the adjacent uplands. A system of conservation tillage that leaves crop residue on the surface helps to reduce runoff from the adjacent side slopes, to prevent excessive soil loss, and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion and channeling. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**488C2—Newvienna silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, moderately well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 3 to 40 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark grayish brown and yellowish brown silt loam about 9 inches thick. Some streaks and pockets of brown subsoil material have been mixed by plowing with the surface layer. The subsoil is friable silty clay loam about 37 inches thick. In descending sequence, it is brown; brown and mottled; mottled, brown and light brownish gray; and light brownish gray and mottled. The substratum to a depth of 60 inches is mottled, light brownish gray and yellowish brown silt loam. In some places the substratum is loamy sand or sand below a depth of 48 to 96 inches.

Included with this soil in mapping are small areas of Orwood soils and severely eroded Newvienna soils. Orwood soils formed in loess and stratified sandy and loamy sediments and are scattered throughout the map unit. Severely eroded Newvienna soils have a surface layer of dark brown and brown silty clay loam. In most places they are more sloping or more convex than moderately eroded Newvienna soils. Included soils make up about 5 percent of the map unit.

Permeability of this Newvienna soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. In

some areas tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**488C3—Newvienna silty clay loam, 5 to 9 percent slopes, severely eroded.** This is a moderately sloping, moderately well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 3 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 7 inches thick. It contains about 15 percent, by volume, streaks and pockets of very dark grayish brown surface soil material. The subsoil is friable and about 35 inches thick. In descending sequence, it is yellowish brown, mottled silty clay loam; yellowish brown, mottled silty clay loam; mottled, light brownish gray and yellowish brown silty clay loam; and mottled, light brownish gray and yellowish brown silt loam. The substratum to a depth of 60 inches is mottled, light brownish gray and yellowish brown silt loam. In some places the surface layer is mostly very dark grayish brown and dark brown silt loam and has more organic matter. In some places the substratum is loamy sand or sand below a depth of 48 to 96 inches.

Permeability of this Newvienna soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. In some areas tile drains improve soil aeration and allow timelier tillage. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to

improve poor tilth. In some places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**488D2—Newvienna silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, moderately well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 5 to 40 acres in size and are elongated.

Typically, the surface layer is very dark grayish brown and dark brown silt loam about 9 inches thick. Some streaks and pockets of yellowish brown subsoil material have been mixed by plowing into the surface layer. The subsoil is friable and about 31 inches thick. In descending sequence, it is yellowish brown silty clay loam; yellowish brown, mottled silty clay loam; and mottled, yellowish brown and light brownish gray silty clay loam and silt loam. The substratum to a depth of about 60 inches is mottled, light brownish gray and yellowish brown silt loam. In some places the substratum is loam, loamy sand, or sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Orwood soils and severely eroded Newvienna soils. Orwood soils formed in loess and stratified sandy and loamy sediments. They are scattered throughout the map unit. Severely eroded Newvienna soils have a surface layer of dark brown and brown silty clay loam, have less organic matter, and, in most places, are more sloping or more convex than moderately eroded Newvienna soils. Orwood soils and severely eroded Newvienna soils make up about 5 percent of the map unit.

Permeability of this Newvienna soil is moderate. Runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. In some areas tile drains improve soil aeration and allow timelier

tillage. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for terracing and contour farming (fig. 11). Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**488D3—Newvienna silty clay loam, 9 to 14 percent slopes, severely eroded.** This is a strongly sloping, moderately well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 8 inches thick. It contains about 15 percent, by volume, streaks and pockets of very dark grayish brown surface soil material. The subsoil is mottled, yellowish brown and light brownish gray silty clay loam in the upper part and light brownish gray, mottled silty clay loam and silt loam in the lower part. It is about 30 inches thick. The substratum to a depth of 60 inches is mottled, light brownish gray and yellowish brown silt loam. In places the surface layer is very dark grayish brown silt loam. In a few places the substratum is loam, loamy sand, or sand below a depth of 40 inches.

Permeability of this Newvienna soil is moderate. Runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops in rotation with small grain and to grasses and legumes for hay and pasture. It is better suited to hay and pasture. In some areas tile drains improve soil aeration and allow timelier tillage. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to improve poor tilth. In some places slopes are long enough and uniform enough for terracing and contour

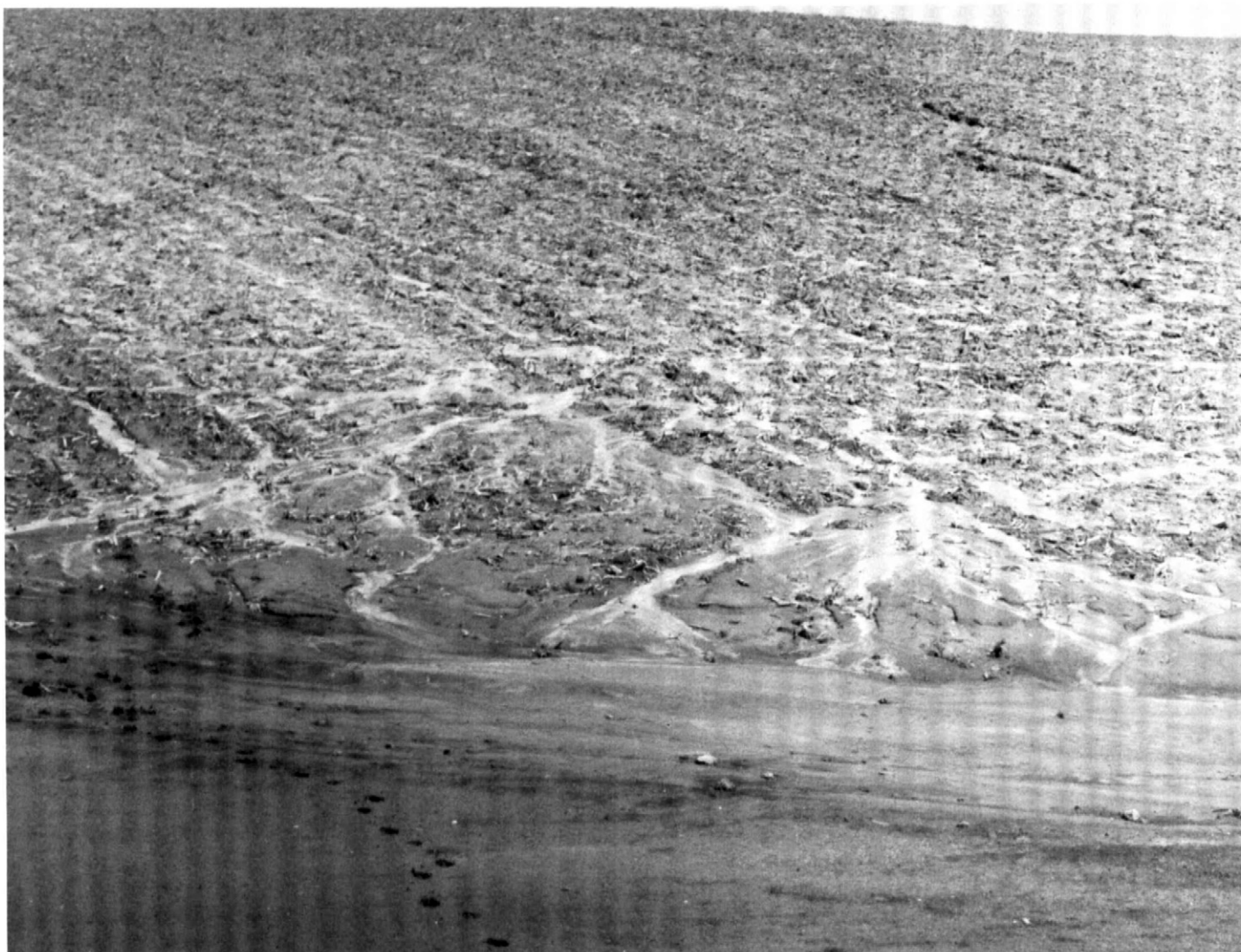


Figure 11.—Rill erosion in an area of Newvienna silt loam, 9 to 14 percent slopes, moderately eroded. The emerging soybean plants have been washed out on the upper side slope and have been covered by sediment on the lower side slope.

farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**490—Caneek silt loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on alluvial fans and bottom lands along major streams. It is subject to rare flooding. Areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, mottled silt loam about 7 inches thick. The substratum is stratified, dark grayish brown and grayish brown, mottled silt loam to a depth of about 31 inches. Below this are older, buried surface and subsurface layers of black, friable silty clay loam 23 inches thick. Below that

is a buried subsoil of very dark gray, mottled silty clay loam to a depth of about 60 inches. In some places the stratified, silty sediments are more than 40 inches thick.

Included with this soil in mapping are small areas of Caneek Variant loamy sand soils. They have a loamy sand surface layer and a sand and loamy sand substratum. They are scattered throughout and make up about 3 percent of the map unit.

Permeability of this Caneek soil is moderate. Runoff is slow. Available water capacity is very high. The soil has a seasonal high water table. The substratum has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for cultivated crops. A few areas are used for pasture. If this soil is adequately drained and if flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Diversions and dikes on the local flood plains can help to protect this soil from overflow. Constructing flood control structures in the upper watershed helps to control flooding. This soil is subject to runoff from adjacent uplands. Drainage ditches and levees help to protect this soil from flooding. Tile drains improve soil aeration and allow timelier tillage where this soil is cultivated. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling channeling and soil washing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**539—Perks sandy loam, 0 to 2 percent slopes.** This is a nearly level, somewhat excessively drained soil on bottom lands. This soil is subject to occasional flooding. Areas range from 5 to 50 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray sandy loam about 7 inches thick. The subsurface layer is very dark gray sandy loam about 4 inches thick. The next layer is very dark grayish brown, friable sandy loam in the upper part and brown, very friable loamy sand in the lower part. It is about 11 inches thick. The substratum to a depth of 60 inches is brown sand and brown and pale brown, stratified sand and coarse sand. In some

places the surface layer and the subsurface layer are loam or silt loam.

Included with this soil in mapping are small areas of poorly drained Ambraw soils. These soils have mottles throughout the subsoil and are in old channels and in low areas that are subject to frequent flooding. They make up about 7 percent of the map unit.

Permeability of this Perks soil is rapid. Runoff is slow. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

A few areas are cultivated. Most areas are permanent pasture or woodland. If flooding is controlled, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Diversions and dikes on the local flood plains help to protect this soil from overflow. Constructing flood control structures in the upper watershed helps to control flooding. Plant growth depends on a good distribution of rainfall because of low available water capacity. If cultivated crops are grown, soil blowing is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIs.

**566B—Moingona loam, 2 to 5 percent slopes.** This is a gently sloping, moderately well drained soil on foot slopes and alluvial fans. Areas range from 5 to 40 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown loam about 4 inches thick. The subsoil to a depth of about 60 inches is friable loam. It is very dark grayish brown and brown in the upper part and brown in the lower part. In some places the combined thickness of the surface layer and the subsurface layer is more than 24 inches. In places part or all of this soil is sandy loam.

Included with this soil in mapping are small areas of

somewhat poorly drained Moingona Variant soils. Moingona Variant soils are grayer and more mottled in the subsoil and are slightly lower or more concave than this Moingona soil. They make up about 7 percent of the map unit.

Permeability of this Moingona soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. This soil receives runoff from adjacent uplands. Diversion terraces help to protect the soil from excessive runoff. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**566C—Moingona loam, 5 to 9 percent slopes.** This is a moderately sloping, moderately well drained soil on foot slopes. Areas range from 5 to 30 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown loam about 7 inches thick. The subsoil to a depth of 60 inches is friable loam. In the upper part it is brown loam, in the next part it is yellowish brown and mottled, and in the lower part it is brown loam. In some places the combined thickness of the surface layer and the subsurface layer is more than 24 inches, and in places part or all of this soil is sandy loam.

Included with this soil in mapping are small areas of somewhat poorly drained Moingona Variant soils. Moingona Variant soils are grayer in the subsoil and are slightly lower or more concave than this Moingona soil. They make up about 3 percent of the map unit.

Permeability of this Moingona soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in a rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. This soil receives runoff from the adjacent uplands. Diversion terraces help to protect the soil from excessive runoff. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**567B—Moingona Variant loam, 2 to 5 percent slopes.** This is a gently sloping, somewhat poorly drained soil on foot slopes. Areas range from 5 to 40 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsurface layer is very dark gray loam about 8 inches thick. The subsoil is friable loam about 31 inches thick. In the upper part it is very dark grayish brown and dark grayish brown. In the next part it is light olive brown and mottled. In the lower part it is mottled, light olive brown and light brownish gray. The substratum to a depth of 60 inches is light olive brown and mottled. In some places the combined thickness of the surface layer and the subsurface layer is more than 24 inches, and in places part or all of this soil is sandy loam.

Included with this soil in mapping are small areas of moderately well drained Moingona soils. Moingona soils have a brown or yellowish brown subsoil and are slightly higher or more convex than this Moingona Variant soil. They make up about 5 percent of the map unit.

Permeability of this Moingona Variant soil is moderate. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to



corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. This soil receives runoff from the adjacent uplands. Diversion terraces help to protect the soil from excessive runoff. In some years tile drains improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface help to prevent excessive soil loss and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**623C2—Rozetta silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, moderately well drained soil on convex side slopes, low ridgetops, and concave head slopes on uplands. Areas range from 5 to 20 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of silty clay loam subsoil material into the surface layer. The subsoil is friable and about 44 inches thick. In the upper part it is brown silty clay loam. In the next part it is brown, mottled silty clay loam. In the lower part it is mottled, brown, yellowish brown, and light brownish gray silt loam. The substratum to a depth of 60 inches is mottled, light brownish gray and yellowish brown silt loam. In some places a subsurface layer of silt loam is between the surface layer and the subsoil.

Included with this soil in mapping are small areas of severely eroded Rozetta soils. These Rozetta soils have a surface layer of silty clay loam and, in most places, are more sloping or more convex than this Rozetta soil. They make up about 5 percent of the map unit.

Permeability of this Rozetta soil is moderate. Runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to

grasses and legumes for hay and pasture (fig. 12). If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for terracing and contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**623D2—Rozetta silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, moderately well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 5 to 40 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is friable and about 36 inches thick. In the upper part it is brown silty clay loam. In the next part it is brown, mottled silty clay loam. In the lower part it is mottled, yellowish brown and light brownish gray silt loam. The substratum to a depth of 60 inches is mottled, light brownish gray and yellowish brown silt loam. In some places a subsurface layer of silt loam is between the surface layer and the subsoil.

Permeability of this Rozetta soil is moderate. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to occasional row crops in rotation with small grain and to grasses and legumes for hay or pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for contour farming. Returning crop residue to the soil and regularly adding other organic material



**Figure 12.**—An area of Rozetta silt loam, 5 to 9 percent slopes, moderately eroded, is protected from further erosion by pasture grasses. In the partially wooded background is an area of Fayette silt loam, 25 to 40 percent slopes.

improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IVe.

**653—Tuskeego silt loam, sandy substratum, 0 to 2 percent slopes.** This is a nearly level, poorly drained

soil on stream terraces. It is subject to rare flooding. Areas range from 3 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 gray silt loam about 12 inches thick. It is mottled in the lower part. The subsoil is gray, mottled, and about 34 inches thick. In the upper part it is firm silty clay loam, and in the lower part it is friable silt loam. The substratum to a depth of 60 inches is strata of gray, mottled loamy sand and silt loam. In some places the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of Coppock and Vesser soils. They have a less clayey subsoil and are moderately permeable. Coppock soils are slightly higher or more convex than this Tuskeego soil. Vesser soils have dark colors below a depth of 10 inches, and are on foot slopes above Tuskeego soils. Included soils make up about 10 percent of the map unit.

Permeability of this Tuskeego soil is slow in the surface layer, the subsurface layer, and the subsoil and rapid in the substratum. Runoff is slow to ponded. Available water capacity is high. The soil has a seasonal high water table. Shrink-swell potential of the subsoil is moderate. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained and if flooding is controlled, the soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Drainage ditches and, in some places, tile drains improve soil aeration and allow timely tillage. In some areas tile installation requires special equipment or procedures because of the underlying loose, water-bearing, sandy material. A conservation tillage system that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining good tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few areas remain in native hardwoods. The seasonal high water table restricts the use of large equipment to drier periods or winter, when the soil is frozen. During wet periods special high flotation equipment may be needed for

harvesting or management. Planted seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation improve the survival rate.

The land capability classification is IIIw.

**680G—Lindley-Douds-Orwood silt loams, 18 to 40 percent slopes.** This map unit consists of steep and very steep soils on side slopes of uplands and high terraces. The Lindley and Orwood soils are well drained, and the Douds soil is moderately well drained. In most areas on upland side slopes, the Douds soil is on the upper part of the slope and the Lindley soil is on the lower part of the slope. On many side slopes of high terraces, the Orwood soil is on the upper part of the slope and the Douds soil is on the lower part of the slope. The entire slope is Orwood soil in some areas or Douds soil in other areas. Areas range from 50 to several hundred acres in size and are elongated or irregularly shaped. They are 50 percent Lindley soil, 20 percent Douds soil, 20 percent Orwood soil, and 10 percent other soils.

Typically, the surface layer of the Lindley soil is dark grayish brown and very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown and grayish brown loam about 6 inches thick. The subsoil is yellowish brown and about 44 inches thick. In the upper part it is friable loam, in the next part it is firm clay loam, and in the lower part it is mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam with pockets of loamy sand.

Typically, the surface layer of the Douds soil is very dark grayish brown and dark grayish brown silt loam about 3 inches thick. The subsurface layer is brown and dark grayish brown silt loam about 4 inches thick. The subsoil is about 39 inches thick. In the upper part it is yellowish brown, friable loam. In the next part it is yellowish brown, very friable, stratified loamy sand and sand. In the lower part it is mottled, yellowish brown and grayish brown, friable, stratified silty clay loam and bands of loam and sandy loam. The substratum to a depth of 60 inches is mottled, yellowish brown and grayish brown silt loam.

Typically, the surface layer of the Orwood soil is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 35 inches thick. In the upper part it is brown and yellowish brown, friable loam. In the next part it is yellowish brown, very friable sandy loam. In the lower part it is light yellowish brown and strong

brown, loose loamy sand. The substratum to a depth of about 60 inches is mottled, gray and light yellowish brown and strong brown silt loam.

Included with these soils in mapping are soils that have a surface layer of sandy loam or loamy sand and a subsurface layer and substratum of stratified loamy sand and sand. These soils are droughty. Also included in mapping are soils that have a subsoil of silty clay or clay. These soils remain wet for long periods because of seepage. Included soils make up about 10 percent of the map unit.

Permeability is moderately slow in the Lindley soil and moderate in the Douds and Orwood soils. Surface runoff is rapid. Available water capacity is high for the Lindley and Orwood soils and moderate for the Douds soil. The Douds soil has a seasonal high water table. The subsoil of the Lindley, Douds, and Orwood soils have low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for woodland or permanent pasture. These soils are not suited to cultivated crops because of the slope and the severe hazard of erosion. These soils are poorly suited to pasture. Ordinary farm machinery cannot be used for pasture renovation on the very steep slopes. Tillth is fair in the surface layer.

A cover of pasture plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the soil and the pasture in good condition.

These soils are suited to trees, and most areas remain in native hardwoods. The slope limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below this soil help to control erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIIe.

**684—Elrick sandy loam, 0 to 2 percent slopes.** This is a nearly level, well drained soil on wide bottom lands. It is subject to rare flooding and is protected by levees. Areas range from 10 to 500 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is also very dark brown sandy loam about 5 inches thick. The subsoil is brown, very friable sandy loam about 11 inches thick. The substratum extends to a depth of 60 inches. It is brown, loose loamy sand in the upper part; brown, mottled, loose sand in the middle part; and yellowish brown, loose sand in the lower part. In some

places the surface layer and the subsurface layer are loam.

Included with this soil in mapping are small areas of excessively drained Fruitfield soils and poorly drained Toolesboro soils. Fruitfield soils have a surface layer and a subsurface layer of loamy sand or sand. These soils are scattered throughout the map unit. Toolesboro soils are grayer and mottled in the subsoil and are in lower or more concave positions. Included soils make up about 5 percent of the map unit.

Permeability of this Elrick soil is moderately rapid in the upper part of the profile and very rapid in the lower part. Runoff is slow. Available water capacity is low. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, potatoes, tomatoes, cantaloup, watermelon, and small grain and to grasses and legumes for hay and pasture. Plant growth depends on irrigation or a good distribution of rainfall. Cultivated areas are subject to damage by soil blowing. Blowing sand can damage newly seeded or transplanted crops on this soil and on adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to maintain fair tillth. Small grain is also planted after vegetable crops are harvested to prevent soil blowing in winter and early spring. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to reduce surface crusting, and increases the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIIs.

**727—Udolpho loam, 32 to 40 inches to sand, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on stream terraces and uplands. It is subject to rare flooding. Areas range from 3 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is grayish brown, mottled loam about 5 inches thick. The subsoil is about 18 inches thick. In the upper part it is grayish brown, mottled, friable clay loam. In the middle part it is gray, friable clay loam. In the lower part it is gray, mottled, friable sandy loam. The substratum to a depth of about 60 inches is gray, mottled, stratified loamy

sand and sand. In some places the depth to the sandy substratum is 24 to 32 inches. In other places the surface layer, the subsurface layer, and the subsoil are silt loam, and the depth to sandy material is more than 40 inches.

Permeability is moderate in the upper part of the profile and rapid in the lower part. Available water capacity is moderate. Surface runoff is slow. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas of this soil are cultivated. If this soil is adequately drained, it is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where this soil is cultivated, tile drains and drainage ditches improve soil aeration and allow timely tillage. In some areas establishing adequate drainage outlets and installing drainage tile is difficult because of the underlying, loose, water-bearing, sandy material. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in improving tilth. Timely deferred grazing especially during wet periods helps to keep the pasture and the soil in good condition.

This soil is suited to trees. The seasonal high water table restricts the use of large equipment to drier periods or to winter when the soil is frozen. During wet periods special high flotation equipment may be needed for harvesting or management. Planted seedlings do not survive well and seedlings can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation improve the survival rate.

This soil is in capability classification IIw.

#### **753B—Thebes silt loam, 2 to 5 percent slopes.**

This is a gently sloping, well drained soil on convex ridgetops on uplands and on stream terraces. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsurface material into the surface layer. The subsurface layer is yellowish brown silt loam about 2 inches thick. The subsoil is yellowish brown, friable, and about 31 inches

thick. In the upper part it is silt loam, in the next part it is silty clay loam, and in the lower part it is sandy loam. The substratum to a depth of 60 inches is stratified sand and loamy sand.

Included with this soil in mapping are small areas of excessively drained Chelsea soils. Chelsea soils are loamy sand and sand. Chelsea soils are scattered throughout the map unit and make up about 6 percent of the map unit.

Permeability of this Thebes soil is moderate in the solum and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Many areas are cultivated, but some are used for pasture and woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

#### **753C—Thebes silt loam, 5 to 9 percent slopes.**

This is a moderately sloping, well drained soil on convex ridgetops and side slopes on uplands and on stream terraces. 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 3 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 5 inches thick. The subsoil is friable and about 27 inches thick. In the upper part it is yellowish brown silt loam. In the next layer it is yellowish brown silty clay loam. In the lower part it is yellowish brown loam. The substratum to a depth of 60 inches is stratified, light yellowish brown sand and brown and strong brown loamy sand. Some places are strongly sloping. In other

places the depth to sandy texture is more than 40 inches.

Included with this soil in mapping are small areas of excessively drained Chelsea soils. These soils are loamy sand and sand. They are scattered throughout the map unit and make up about 6 percent of the map unit.

Permeability of this Thebes soil is moderate in the solum and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Some areas are cultivated, but most are used for pasture and woodland. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and some areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**753C2—Thebes silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridgetops and side slopes on uplands and on stream terraces. Areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. Plowing has mixed streaks and pockets of yellowish brown silty clay loam subsoil material into the surface layer. The subsoil is yellowish brown, friable, and about 26 inches thick. In the upper part it is silty clay loam. In the lower part it is loam and thin strata of sandy loam and loamy sand. The substratum to a depth of 60 inches is yellowish brown and strong brown, stratified loamy sand and sand. In places the depth to sandy textures is more than 40 inches.

Included with this soil in mapping are small areas of

excessively drained Chelsea soils and severely eroded Thebes soils. Chelsea soils are loamy sand and sand. Severely eroded Thebes soils have a surface layer of brown or yellowish brown silty clay loam. They are scattered throughout the map unit and make up about 10 percent of the map unit.

Permeability of this Thebes soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**753D2—Thebes silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes in the uplands. Areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown silt loam about 8 inches thick. Plowing has mixed streaks and pockets of yellowish brown silty clay loam subsoil material into the surface layer. The subsoil is yellowish brown, friable, and about 28 inches thick. In the upper part it is silty clay loam. In the middle part it is silt loam. In the lower part it is stratified loam and sandy loam. The substratum to a depth of 60 inches is pale brown, light yellowish brown, and brownish yellow, stratified sand and loamy sand. In places the depth to sandy texture is more than 40 inches.

Included with this soil in mapping are small areas of excessively drained Chelsea soils. These soils are

loamy sand and sand. They are scattered throughout the map unit and make up about 10 percent of the map unit.

Permeability of this Thebes soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is rapid. Available water capacity is moderate. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops in rotation with small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, stripcropping, and contour farming help to prevent excessive soil loss and to maintain fair tilth. Deep cuts made to construct terraces on this soil will expose droughty sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**759—Fruitfield coarse sand, 0 to 2 percent slopes.**

This is a nearly level, excessively drained soil on high bottom lands. It is subject to rare flooding, and is protected by levees. Areas range from 10 to several hundred acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown coarse sand about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown coarse sand about 19 inches thick. The next layer is dark brown coarse sand about 9 inches thick. The substratum to a depth of 60 inches is brown and pale brown sand and coarse sand. In some places the combined thickness of the surface layer and the subsurface layer is less than 12 inches and the soil has redder colors.

Included with this soil in mapping are small areas of well drained Elrick soils. These soils are loam or sandy loam in the surface layer, the subsurface layer, and the upper part of the subsoil. They are scattered throughout and make up 5 percent of the map unit.

Permeability of this Fruitfield soil is very rapid. Runoff is slow. Available water capacity is very low. The

subsurface layer and the next layer have very low amounts of available phosphorus and available potassium.

Most areas are cultivated. If this soil is irrigated, it is suited to corn, soybeans, potatoes, tomatoes, cantaloup, watermelon, cabbage, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, soil blowing is a serious hazard. Blowing sand grains can damage seedlings on this soil and on adjacent soils. Available water capacity is very low, and irrigation is required for cultivated crops. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to improve tilth. Small grain is also planted for winter cover, and narrow strips of small grain are left standing to prevent soil blowing during early vegetable crop growth. Returning crop residue to the soil and regularly adding other organic material improve fertility and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IVs.

**759B—Fruitfield coarse sand, 2 to 5 percent slopes.** This is a gently sloping, excessively drained soil on high bottom lands. It is subject to rare flooding, and is protected by levees. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray coarse sand about 8 inches thick. The subsurface layer is coarse sand about 16 inches thick. In the upper part it is very dark gray, and in the lower part it is very dark grayish brown. The next layer is dark brown sand about 6 inches thick. The substratum to a depth of 60 inches is sand and coarse sand. In the upper part it is brown, and in the next part it is yellowish brown. In the lower part it is light yellowish brown and very pale brown.

Permeability of this Fruitfield soil is very rapid. Runoff is slow. Available water capacity is very low. The subsurface layer and the next layer have very low amounts of available phosphorus and available potassium.

Most areas are cultivated. If this soil is irrigated, it is suited to corn, soybeans, potatoes, tomatoes, cantaloup, watermelon, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, soil blowing is a serious hazard. Blowing sand grains can damage seedlings on this soil and on

adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture, to prevent soil blowing, and to improve tilth. Small grain is also planted for winter cover, and narrow strips of small grain are left standing to prevent soil blowing during early vegetable crop growth. Returning crop residue to the soil and regularly adding other organic material improve fertility and increase the available water capacity.

A cover of pasture or hay plants is effective in controlling soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IVs.

**763E3—Exette silty clay loam, 14 to 18 percent slopes, severely eroded.** This is a moderately steep, well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 3 to 30 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is brown silty clay loam about 7 inches thick. It is mixed subsoil material and surface soil material. The subsoil is friable and about 28 inches thick. In the upper part it is brown, mottled silty clay loam. In the lower part it is yellowish brown, mottled silt loam. The substratum extends to a depth of 60 inches. It is yellowish brown, mottled silt loam in the upper part and light brownish gray, mottled silt loam in the lower part. Where this soil has not been cultivated, the surface layer is very dark gray or very dark grayish brown silt loam over a subsurface layer of dark grayish brown silt loam. In a few places calcareous silt loam is at a depth of 10 to 40 inches.

Permeability of this Exette soil is moderate. Surface runoff is rapid. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Many areas are cultivated. Some are used as pastureland but have been cultivated in the past. This soil is generally not suited to cultivated crops because of the slope and the severe hazard of further erosion. It is suited to grasses and legumes for hay and pasture. Tilth is poor in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, but few areas remain in native hardwoods. The slope somewhat limits tree planting, management, and harvesting operations. In

most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIe.

**763F3—Exette silty clay loam, 18 to 25 percent slopes, severely eroded.** This is a steeply sloping, well drained soil on convex side slopes and concave head slopes on uplands. Areas range from 5 to 20 acres in size and are elongated or irregularly shaped.

Typically, the surface layer is brown and dark grayish brown silty clay loam about 6 inches thick. It is mixed subsoil material and surface soil material. The subsoil is friable and about 34 inches thick. In the upper part it is yellowish brown, mottled silty clay loam, and in the lower part it is mottled, yellowish brown and light brownish gray silt loam. The substratum is mottled, light brownish gray and yellowish brown silt loam to a depth of 60 inches. In uncultivated areas the surface layer is very dark gray or very dark grayish brown silt loam and the subsurface layer is dark grayish brown silt loam. In a few places calcareous silt loam is at a depth of 10 to 40 inches.

Permeability of this Exette soil is moderate. Runoff is very rapid. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are or have been cultivated. Some areas are now used for permanent pasture or woodland. This soil is generally not suited to cultivated crops because of the slope and the severe hazard of further erosion. It is suited to grasses and legumes for hay and pasture. Tilth is poor in the surface layer.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the soil in good condition. Renovating the pasture is difficult because some slopes are too steep for safe operation of ordinary farm machinery.

This soil is suited to trees, but few areas remain in native hardwoods. The slope somewhat limits tree planting, management, and harvesting operations. In most places laying out logging trails or roads on less sloping soils above or below this soil helps to control erosion. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is VIe.

**771C2—Waubee silt loam, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well



drained soil on convex side slopes in the uplands. Areas range from 3 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 silty clay loam subsoil material into the surface layer. The subsoil is friable and about 38 inches thick. In descending sequence, it is brown silty clay loam; yellowish brown silty clay loam; yellowish brown, mottled silty clay loam; and yellowish brown, mottled loam that has a few thin sand lenses. The substratum to a depth of 60 inches is yellowish brown, mottled loam. In places the lower part of the subsoil is sand or loamy sand. Where this soil is not so eroded, the surface layer is very dark grayish brown and the subsurface layer is brown silt loam.

Included with this soil in mapping are small areas of Gara soils and severely eroded Waubeek soils. Gara soils have a surface layer, subsurface layer, and subsoil of loam or clay loam and are scattered throughout the map unit. Severely eroded Waubeek soils have a surface layer of brown or yellowish brown silty clay loam and in most places are more convex or steeper than this moderately eroded Waubeek soil. Gara soils and severely eroded Waubeek soils together make up about 5 percent of the map unit.

Permeability of this Waubeek soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for terracing and contour farming. Deep cuts made to construct terraces will expose glacial material with poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**771D2—Waubeek silt loam, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on convex side slopes in the uplands. Areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark 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 yellowish brown, friable, and about 32 inches thick. In the upper part it is silty clay loam, and in the lower part it is sandy loam. The substratum to a depth of 60 inches is yellowish brown and strong brown loam that has pockets of loamy sand and sand. Where this soil is not so eroded, the surface layer is very dark grayish brown and the subsurface layer is brown silt loam.

Included with this soil in mapping are small areas of Gara soils and severely eroded Waubeek soils. Gara soils have a surface layer, subsurface layer, and subsoil of loam or clay loam and are scattered throughout the map unit. Severely eroded Waubeek soils have a surface layer of brown or yellowish brown silty clay loam, and in most places are steeper or more convex than this moderately eroded Waubeek soil. Gara soils and severely eroded Waubeek soils together make up about 5 percent of the map unit.

Permeability of this Waubeek soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In some places slopes are long enough and uniform enough for terracing and contour farming. Deep cuts made to construct terraces will expose glacial material with poor tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**793—Bertrand silt loam, 0 to 3 percent slopes.** This is a nearly level, well drained soil on stream terraces. Areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is about 38 inches thick. In descending sequence, it is yellowish brown, friable silt loam; yellowish brown, friable silty clay loam; yellowish brown, mottled silt loam; and yellowish brown, very friable loamy sand. The substratum to a depth of 60 inches is light yellowish brown and light gray, stratified sand and loamy sand. In some places slopes are steeper than 3 percent and the sandy substratum is at a depth of less than 40 inches.

Permeability of this Bertrand soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and to maintain fair tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is I.

**826—Rowley silt loam, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on stream terraces. Areas range from 5 to 50 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 brown and very dark grayish brown silt loam about 10 inches thick. The subsoil is friable and about 32 inches thick. In descending sequence, it is dark grayish brown silt loam; mottled grayish brown and yellowish brown silty clay loam; dark grayish brown and brown, mottled silt loam; grayish brown, mottled silt loam; and light brownish gray, mottled loam. The substratum to a depth of about 60 inches is light gray, mottled sand. In places the depth to sand is 32 to 40 inches. In other

places the upper part of the subsoil is gray.

Included with this soil in mapping are small areas of well drained Richwood soils. Richwood soils have a brown and yellowish brown subsoil and are on slight rises. They make up about 3 percent of the map unit.

Permeability of this Rowley soil is moderate in the surface layer, subsurface layer, and subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Drainage ditches and tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**916B—Downs silt loam, sandy substratum, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on convex ridges and side slopes on uplands and on high stream terraces. This soil formed in 48 to 96 inches of loess overlying sandy material. 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 7 inches thick. The subsoil is friable and about 46 inches thick. In the upper part it is brown silt loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches is yellowish brown and light yellowish brown sand that has bands of light brownish gray loamy sand. In some places the surface layer is thicker and the subsurface layer is dark colored. In other places the subsurface layer is light colored.

Included with this soil in mapping are small areas of somewhat poorly drained Atterberry soils, excessively drained Sparta soils, and Whittier soils. Atterberry soils have a grayer subsoil and are in slightly concave positions. Sparta soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. Whittier soils have a sandy substratum above a depth of 40

inches. Sparta and Whittier soils are scattered throughout the map unit. Included soils make up about 5 percent of the map unit.

Permeability of this Downs soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the underlying sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a small area remains in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**916B2—Downs silt loam, sandy substratum, 2 to 5 percent slopes, moderately eroded.** This is a gently sloping, well drained soil on narrow ridges on uplands and terraces. This soil formed in 48 to 96 inches of loess overlying sandy material. Areas range from 10 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown silt loam about 8 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam subsoil material into the surface layer. The subsoil is friable and about 40 inches thick. In the upper part it is yellowish brown silty clay loam. In the lower part it is yellowish brown mottled silt loam. The substratum to a depth of about 60 inches is yellowish brown mottled silt loam in the upper part and yellowish brown loamy sand and sand in the lower part. In places the surface layer is very dark grayish brown and does not have streaks and pockets of subsoil material. In places depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of

somewhat poorly drained Atterberry soils and excessively drained Sparta soils. Atterberry soils have a grayer and more mottled subsoil and are in slightly concave positions. Sparta soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. Sparta soils are scattered throughout the map unit. Atterberry and Sparta soils together make up about 5 percent of the map unit.

Permeability of this Downs soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. The hazard of erosion is greatest on the more convex side slopes. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the underlying sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**916C—Downs silt loam, sandy substratum, 5 to 9 percent slopes.** This is a moderately sloping, well drained soil on convex ridges and side slopes on uplands and on loess covered benches. This soil formed in 48 to 96 inches of loess overlying sandy material. 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 7 inches thick. The subsoil is friable and about 46 inches thick. In the upper part it is brown silt loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown silty clay loam and silt loam and has light brownish gray and brownish yellow mottles. The substratum to a depth

of about 60 inches is yellowish brown and brownish yellow loamy sand and sand. In some places the upper part of the subsoil has been incorporated into the surface layer. In places light brownish gray and brownish yellow mottles are in the upper part of the subsoil.

Included with this soil in mapping are areas of severely eroded Downs sandy substratum soils. These soils have a surface layer of brown or yellowish brown silty clay loam and are generally on the more convex part of the slope. Severely eroded Downs soils make up about 3 percent of the map unit.

Permeability of this Downs soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the underlying sandy material. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**916C2—Downs silt loam, sandy substratum, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridges and side slopes in the uplands. This soil formed in 48 to 96 inches of loess overlying sandy material. Areas range from 5 to 80 acres or more in size and are irregularly shaped.

Typically, the surface layer is very dark 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 yellowish brown,

friable, and about 42 inches thick. In the upper part it is silty clay loam, and in the lower part it is silt loam. The substratum to a depth of about 60 inches is yellowish brown. In the upper part it is loam and sandy loam, and in the lower part it is stratified sand and loamy sand. In some places the surface layer is very dark brown or very dark grayish brown without streaks and pockets of yellowish brown subsoil material.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded Downs, sandy substratum, soils. Chelsea soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil and are scattered throughout the map unit. Severely eroded Downs, sandy substratum, soils have a surface layer of brown or yellowish brown silty clay loam and are on the more convex parts of the slope. Chelsea and severely eroded Downs soils together make up about 6 percent of the map unit.

Permeability of this Downs soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. The hazard is greatest on the more convex side slopes, where prior erosion is greatest. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the underlying sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**917B—Fayette silt loam, sandy substratum, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on convex ridges and side slopes in the uplands

and terraces. This soil formed in 48 to 96 inches of loess overlying sandy material. Areas range from 10 to 80 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of yellowish brown subsoil material into the surface layer. The subsoil is friable and about 45 inches thick. In descending sequence, it is yellowish brown silt loam; yellowish brown silty clay loam; yellowish brown silty clay loam that has strong brown and light brownish gray mottles; and yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is brownish yellow and yellow stratified sand and loamy sand. In places depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Stronghurst soils. Stronghurst soils have a subsoil that is grayer with mottles. They are in lower and slightly concave positions and make up about 5 percent of the map unit.

Permeability of this Fayette soil is moderate in the surface layer and subsoil and rapid in the substratum. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces should be held to a minimum to maintain several feet of silty subsoil and substratum over the underlying sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIe.

**917C—Fayette silt loam, sandy substratum, 5 to 9 percent slopes.** This is a moderately sloping, well drained soil on convex ridges and side slopes in the

uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 50 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 silt loam and about 7 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The subsoil is yellowish brown, friable, and about 45 inches thick. In the upper part it is silt loam, in the next part it is silty clay loam, and in the lower part it is loamy sand and sand. The substratum to a depth of about 60 inches is light yellowish brown loamy sand and sand. In some places the surface layer is dark grayish brown silt loam about 6 inches thick. Also in places the depth to the sandy substratum is less than 40 inches thick.

Permeability of this Fayette soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Some areas are cultivated. Most areas are in pasture or woodland. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**917C2—Fayette silt loam, sandy substratum, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridges and side slopes in the uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 80 acres or more in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown and

brown silt loam about 6 inches thick. Plowing has mixed some streaks and pockets of subsoil material into the surface layer. The subsoil is friable and about 49 inches thick. In the upper part it is yellowish brown silty clay loam, and in the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is light yellowish brown, mottled silt loam in the upper part and brownish yellow loamy sand and sand in the lower part. In some places the surface layer is very dark gray silt loam about 4 inches thick. Also, in places the depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded Fayette, sandy substratum, soils. Chelsea soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. They are scattered throughout the map unit. Severely eroded Fayette, sandy substratum, soils have a surface layer of brown or yellowish brown silty clay loam and are on the more convex part of the slope. Together they make up about 6 percent of the map unit.

Permeability of this Fayette soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. The hazard of erosion is greatest on the more convex side slopes, where prior erosion is greatest. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**917D2—Fayette silt loam, sandy substratum, 9 to 14 percent slopes, moderately eroded.** This is a strongly sloping, well drained soil on narrow ridges and convex side slopes on uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 40 acres in size and are elongated.

Typically, the surface layer is dark brown and brown silt loam about 8 inches thick. Plowing has mixed streaks and pockets of yellowish brown subsoil material into the surface layer. The subsoil is friable and about 44 inches thick. In the upper part it is yellowish brown silty clay loam. In the next part it is yellowish brown silt loam. In the lower part it is yellowish brown silt loam and loam. The substratum to a depth of about 60 inches is yellowish brown loamy sand and sand. In places the depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of excessively drained Chelsea soils and severely eroded Fayette, sandy substratum, soils. Chelsea soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. They are scattered throughout the map unit. Severely eroded Fayette, sandy substratum, soils have a surface layer of brown or yellowish brown silty clay loam and are on the more convex part of the slope. Chelsea and severely eroded Fayette soils together make up about 7 percent of the map unit.

Permeability of this Fayette soil is moderate in the surface layer and subsoil and rapid in the substratum. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. A few are used for pasture. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and grassed waterways help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is IIIe.

**920B—Tama silt loam, sandy substratum, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on broad convex ridges and side slopes in the uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 80 acres or more 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 brown and very dark grayish brown silt loam about 7 inches thick. The subsoil is friable and about 34 inches thick. In the upper part it is brown silty clay loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown loamy sand and sand.

Included with this soil in mapping are small areas of somewhat poorly drained Muscatine soils and very poorly drained Sperry soils. Muscatine soils have a gray, mottled subsoil and are in nearly level, lower areas in the map unit. Sperry soils have a gray, mottled subsoil and are in slight depressions that pond water. Included soils make up about 5 percent of the map unit.

Permeability of this Tama soil is moderate in the surface layer, subsurface layer, and subsoil and rapid in the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation

grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**920B2—Tama silt loam, sandy substratum, 2 to 5 percent slopes, moderately eroded.** This is a gently sloping, well drained soil on broad, convex ridges and side slopes in the uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 40 acres or more in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed a few streaks and pockets of brown subsoil material into the surface layer. The subsoil is friable and about 49 inches thick. In the upper part it is brown and very dark grayish brown silt loam. In the next part it is yellowish brown silty clay loam that has dark brown mottles in the lower part. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches is very pale brown yellow sand and loamy sand.

Included with this soil in mapping are small areas of somewhat poorly drained Muscatine soils. Muscatine soils have a gray, mottled subsoil and are in lower, slightly concave positions. They make up about 5 percent of the map unit.

Permeability of this Tama soil is moderate in the surface layer and subsoil and rapid in the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. The hazard of erosion is greatest on the more convex side slopes. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**920C—Tama silt loam, sandy substratum, 5 to 9 percent slopes.** This is a moderately sloping, well drained soil on convex side slopes in the uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 15 acres in size and are elongated.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is friable and about 35 inches thick. In descending sequence, it is dark brown and brown silty clay loam; brown silty clay loam; yellowish brown silty clay loam; and yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loamy sand. In some places the depth to the sandy substratum is less than 40 inches.

Permeability of this Tama soil is moderate in the surface layer, subsurface layer, and subsoil and rapid in the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain good tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**920C2—Tama silt loam, sandy substratum, 5 to 9 percent slopes, moderately eroded.** This is a moderately sloping, well drained soil on convex ridges and side slopes in the uplands. This soil formed in 48 to 96 inches of loess over sandy material. Areas range from 5 to 40 acres in size and are elongated.

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 friable and about 39 inches thick. In the upper part it is brown and dark brown silty clay loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown silt loam. The substratum to a depth of about 60 inches is yellowish brown silt loam in the upper part and light yellowish brown and yellowish brown sand and loamy sand in the lower part. In some places a very dark grayish brown subsurface layer as much as 6 inches thick is below the surface layer. In places the depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of excessively drained Sparta soils and severely eroded Tama, sandy substratum, soils. Sparta soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. They are scattered throughout the map unit. Severely eroded Tama, sandy substratum, soils have a surface layer of brown or yellowish brown silty clay loam and are on the more convex parts of the slope. Together they make up about 10 percent of the map unit.

Permeability of this Tama soil is moderate in the upper part of the profile and rapid in the lower part of the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and stripcropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIIe.

**920C3—Tama silty clay loam, sandy substratum, 5 to 9 percent slopes, severely eroded.** This is a moderately sloping, well drained soil on convex side slopes in the uplands. This soil formed in 48 to 96



inches of loess over sandy material. Areas range from 5 to 10 acres in size and are elongated.

Typically, the surface layer is dark brown and brown silty clay loam about 8 inches thick. It is mixed with subsoil material. The subsoil is friable and about 40 inches thick. In descending sequence, it is brown silty clay loam; yellowish brown silty clay loam; yellowish brown, mottled silty clay loam; and yellowish brown, mottled silt loam. The substratum to a depth of about 60 inches is mottled, yellowish brown and light brownish gray silt loam in the upper part and yellowish brown and brownish yellow sand and loamy sand in the lower part. In places the depth to the sandy substratum is less than 40 inches.

Included with this soil in mapping are small areas of excessively drained Sparta soils. Sparta soils are loamy sand or sand in the surface layer, subsurface layer, and subsoil. They are scattered throughout and make up about 6 percent of the map unit.

Permeability of this Tama soil is moderate in the upper part of the profile and rapid in the lower part of the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is poorly suited to occasional row crops grown in rotation with small grain and to grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and strip cropping help to prevent excessive soil loss and to maintain fair tilth. In most places slopes are long enough and uniform enough for terracing and contour farming. Channel cuts for terraces held to a minimum will maintain several feet of silty subsoil and substratum over the sandy material. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IVe.

**925—Toolesboro sandy loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on wide bottom lands. It is subject to rare flooding and is protected by levees. Areas range from 5 to several hundred acres in size and are irregularly shaped.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark gray, mottled sandy loam about 4 inches thick. The subsoil is very friable and about 29 inches thick. In the upper part it is mottled, grayish brown and yellowish brown sandy loam. In the next part it is mottled, grayish brown and gray coarse sandy loam. In the lower part it is mottled, dark gray and strong brown coarse sandy loam. The substratum to a depth of 60 inches is mottled, dark gray and brown loamy coarse sand in the upper part and brown coarse sand in the lower part. In places the surface layer and the upper part of the subsoil are clay loam or loam.

Permeability of this Toolesboro soil is moderately rapid in the surface layer, subsurface layer, and subsoil and very rapid in the substratum. Runoff is slow. Available water capacity is moderate. The soil has a seasonal high water table. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, potatoes, tomatoes, cantaloup, watermelon, and small grain and to grasses and legumes for hay and pasture. Most areas are protected by levees and drainage ditches. Where this soil is cultivated, drainage ditches and, in a few places, tile drains improve soil aeration and allow timely tillage. Installing drainage tile is difficult because of the underlying, loose, water-bearing sand. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**930—Orion silt loam, 0 to 3 percent slopes.** This is a very gently sloping, somewhat poorly drained soil in narrow drainageways on uplands and on foot slopes and alluvial fans on bottom lands. It is subject to occasional flooding. Areas range from 10 to 100 acres in size, and most are elongated.

Typically, the surface layer is mixed dark grayish brown and very dark grayish brown silt loam about 6 inches thick. The substratum is stratified dark grayish brown and brown silt loam about 14 inches thick. The

next layer is an older, buried surface layer of very dark grayish brown silt loam about 6 inches thick. The buried subsoil is friable silt loam about 24 inches thick. In the upper part it is very dark grayish brown, dark grayish brown, and mottled, and in the lower part it is dark grayish brown, grayish brown, and mottled. The buried substratum to a depth of 60 inches is gray, mottled silt loam. In some places the buried subsoil is brown and has no mottles.

Permeability of this Orion soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. It has low amounts of available phosphorus and very low amounts of available potassium.

Many areas are used as permanent pasture. Some are cultivated. If this soil is adequately drained and protected from flooding, it is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most areas that are cultivated, tile drains or drainage ditches improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. The soil receives runoff from the more sloping soils on adjacent uplands. Diversion terraces help to protect this soil from runoff. Returning crop residue to the soil and adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is 1Iw.

**960—Shaffton silt loam, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on flood plains along the major rivers. It is subject to occasional flooding. Areas range from 10 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is black silt loam about 6 inches thick. The subsurface layer is black silt loam about 5 inches thick. The subsoil is friable loam about 37 inches thick. In the upper part it is dark grayish brown, and in the lower part it is dark grayish brown, mottled loam. The substratum to a depth of about 60 inches is mottled, grayish brown and dark grayish brown, stratified loamy sand and sand. In places the surface layer and subsurface layer are loam.

Permeability of this Shaffton soil is moderate in the solum and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

A few areas are cultivated. Most areas are used as pasture, woodland, or wildlife habitat. If flooding is controlled, this soil is suited to corn, soybeans, and small grain. Constructing diversions and building dikes on the local flood plains can help to protect this soil from overflow. Constructing flood control structures in the upper stream watershed helps to control flooding. This soil is suited to grasses and legumes for hay and pasture. In some areas drainage ditches reduce flood damage by removing excess water quickly. In other areas flood protection is needed. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is 1Iw.

**961—Ambraw silty clay loam, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on flood plains along the major rivers. It is subject to frequent flooding. Areas range from 10 to 200 acres or more in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 5 inches thick. The subsurface layer is very dark gray loam about 8 inches thick. The subsoil is friable and about 28 inches thick. In the upper part it is very dark grayish brown, mottled loam. In the next part it is dark gray mottled loam. In the lower part it is gray, mottled, stratified sandy clay loam and sandy loam. The substratum to a depth of 60 inches is gray, mottled, stratified loamy sand, sand, and coarse sand. In some places the subsurface layer and the upper part of the subsoil are silty clay loam. In some places the depth to the sandy substratum is about 30 inches.

Permeability of this Ambraw soil is moderate in the surface layer, subsurface layer, and subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are used as pasture, woodland, or wildlife



**Figure 13.—Floodwater covers areas of Ambraw silty clay loam, 0 to 2 percent slopes. The areas above the floodwater are Perks sandy loam, 0 to 2 percent slopes.**

habitat. A few areas are cultivated. A few support native grasses. Because of frequent flooding (fig. 13), siltation, and stream channels, this soil is generally not suited to corn, soybeans, and small grain. It is moderately suited to grasses and legumes for hay and pasture. In some areas drainage ditches are needed to help remove excess water quickly. In most areas flood protection levees are needed. Tilt is fair in the surface layer.

A cover of pasture or hay plants is effective in controlling channeling and soil washing. Proper stocking rates, rotation grazing, and timely deferred grazing

especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. The seasonal high water table restricts the use of equipment to drier periods or winter, when the soil is frozen. During wet periods special high flotation equipment may be needed for harvesting or management. Planted seedlings do not survive well and can be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and

controlling competing vegetation also improve the survival rate.

The land capability classification is Vw.

**963—Elvers silt loam, 0 to 1 percent slopes.** This is a nearly level, very poorly drained soil on bottom lands. It is subject to frequent flooding. Areas range from 20 to 100 acres or more in size and are irregularly shaped.

Typically, the surface layer is dark gray and very dark gray silt loam about 7 inches thick. The next layer is dark gray silt loam about 6 inches thick. The substratum is dark gray silt loam that has brown mottles and is about 27 inches thick. Below this to a depth of 60 inches is a buried, black, highly decomposed organic soil. In some places the surface layer and substratum are more than 40 inches thick.

Included with this soil in mapping are small areas of Palms soils. Palms soils have an organic surface layer. They are scattered throughout and make up about 5 percent of the map unit.

Permeability of this Elvers soil is moderate. Runoff is slow to ponded. Available water capacity is high. The soil has a seasonal high water table as much as 1 foot above the surface. The substratum has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If flooding is controlled and if the soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses for hay and pasture. This soil tends to puddle if worked when wet. If adequate drainage is provided and if this soil is not subject to further siltation, row crops can be grown quite well. In some areas subsurface drains are difficult to install because of the variability in thickness of the silty substratum where the drains need to be placed. In some areas suitable outlets for drains are difficult to find. In some years a good stand of row crops is difficult to establish because of flooding. Returning crop residue to the soil and regularly adding other organic material help to improve fertility and to maintain good tilth.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees. The seasonal high water table restricts the use of equipment to drier periods or winter, when the ground is frozen. During wet periods special high flotation equipment may also be needed for harvesting or management. Natural and planted seedlings do not survive well and seedlings can

be spaced closer together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the survival rate.

The land capability classification is Ilw.

**977—Richwood silt loam, 0 to 2 percent slopes.**

This is a nearly level, well drained soil on terraces along the major streams and rivers. Areas range from 5 to 100 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 brown and very dark grayish brown silt loam about 11 inches thick. The subsoil is friable and about 30 inches thick. In the upper part it is brown and very dark grayish brown silt loam. In the next part it is yellowish brown, mottled silt loam. In the lower part it is yellowish brown, mottled loamy fine sand. The substratum to a depth of about 60 inches is variegated, brownish yellow and light brownish gray, stratified sand and loamy sand. In some places the subsoil and the substratum are silt loam to a depth of 60 inches or more. In some places the surface layer, the subsurface layer, and the upper part of the subsoil are silty clay loam.

Permeability of this Richwood soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is I.

**977B2—Richwood silt loam, 1 to 4 percent slopes, moderately eroded.** This is a gently sloping, well drained soil on terraces along the major streams and rivers. Areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is mixed very dark grayish brown and dark grayish brown silt loam about 9 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material with the surface layer.

The subsoil is friable and about 38 inches thick. In the upper part it is brown silt loam. In the next part it is yellowish brown silt loam. In the lower part it is yellowish brown, mottled loam. The substratum to a depth of about 60 inches is stratified, yellowish brown sand and loamy sand. In some places the subsoil and the substratum are silt loam to a depth of 60 inches.

Permeability of this Richwood soil is moderate in the surface layer and the subsoil and rapid in the substratum. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to prevent erosion and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling erosion. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIe.

**1043—Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on stream terraces. It is subject to rare flooding. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 10 inches thick. The subsoil is about 36 inches thick. In the upper part it is dark gray and grayish brown firm silty clay loam. In the next part it is gray, mottled, firm silty clay loam. In the lower part it is gray, mottled, friable loam. The substratum to a depth of about 60 inches is gray, mottled, stratified sand that has lenses of loamy sand. In some places the surface layer is silt loam.

Included with this soil in mapping are small areas of somewhat poorly drained Rowley soils. Rowley soils are browner in the subsoil, have fewer mottles, and have less clay than Bremer soils. They are on slight rises and make up about 5 percent of the map unit.

Permeability of this Bremer soil is moderately slow in the surface layer, the subsurface layer, and the subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of

available phosphorus and low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained and flooding is controlled, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tile drains and drainage ditches improve soil aeration and allow timelier tillage. In some areas tile installation requires special equipment or procedures to prevent caving in of the loose, water-bearing sand. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining soil tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**1212—Kennebec silt loam, channeled, 0 to 2 percent slopes.** This is a very gently sloping, moderately well drained soil on bottom lands along small streams. It is subject to frequent flooding. Areas range from 10 to 100 acres or more in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is very dark gray silt loam about 30 inches thick. The next layer is very dark gray, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is very dark gray silt loam that has a few loam strata in the lower part. In some places the subsoil is brown below the subsurface layer at a depth of about 24 inches.

Included with this soil in mapping are small areas of poorly drained Colo soils and Aquolls. Colo soils have a subsoil that is black or very dark gray and mottled. They are in old channels. Aquolls have a sandy substratum at a depth of about 22 inches and a moderate available water capacity. In most places they are near present or former stream channels. Colo soils and Aquolls together make up less than 10 percent of the map unit.

Permeability of this Kennebec soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and moderate amounts of available potassium.

A few areas are cultivated. Most are used as pasture, woodland, or habitat for wildlife. The soil is generally

not suited to corn, soybeans, and small grain because of frequent flooding, siltation, and old stream channels. It is suited to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth.

A cover of pasture or hay plants is effective in controlling channeling or soil washing by floodwater. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and many areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is Vw.

**1490—Caneek silt loam, channeled, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on Mississippi River bottom lands and on islands in the river. This soil is subject to frequent flooding. Areas range from 50 to several hundred acres in size and are elongated or irregularly shaped.

Typically, the surface layer is dark grayish brown, mottled silt loam about 7 inches thick. The substratum is stratified, dark grayish brown and grayish brown, mottled silt loam about 32 inches thick. Below this to a depth of about 60 inches is an older, buried surface layer of very dark gray, friable silty clay loam. In some places the surface layer and the substratum extend to a depth below 40 inches.

Included with this soil in mapping are small areas along shorelines of sandy soils that consist mostly of sandy material dredged from the river channel. These soils make up about 15 percent of the map unit.

Permeability of the Caneek soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The substratum has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are used for woodland or habitat for wildlife. This soil is not suited to cultivated crops or to grasses and legumes for hay and pasture because of inaccessibility, flooding, siltation, and stream channels.

This soil is suited to trees, and most areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation and flooding are controlled.

The land capability classification is Vw.

**1520—Coppock silt loam, sandy substratum, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on stream terraces. It is subject to rare flooding. Areas range from 5 to more than 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 dark gray and gray silt loam that has mottles in the lower part. It is about 14 inches thick. The subsoil is mottled, friable silty clay loam about 23 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum to a depth of about 72 inches is light brownish gray, mottled, silt loam in the upper part and stratified, light gray, brown, and yellowish brown sand and loamy sand in the lower part. In places the subsurface layer is less than 10 inches thick.

Included with this soil in mapping are small areas of Tuskego soils. These soils have more clay in the subsoil and are in slightly concave positions. They make up about 5 percent of the map unit.

Permeability of this Coppock soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained and if flooding is controlled, the soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Constructing diversions and building dikes on the local flood plains help to protect this soil from overflow. Constructing flood control structures in the upper watershed helps to control flooding. Drainage ditches and, in some areas, tile drains improve soil aeration and allow timelier tillage. Where tile is installed in the sandy substratum, in some areas special equipment or procedures are needed to keep the sand from caving in. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is Ilw.

**1621—Houghton muck, ponded, 0 to 1 percent slopes.** This is a level, very poorly drained soil in depressional areas at the edge of wide bottom lands.

This soil is subject to frequent ponding. Areas range from 30 to 100 acres in size and are irregular in shape.

Typically, the surface layer is black, highly decomposed organic material about 8 inches thick. The subsurface layer is black, highly decomposed organic material about 42 inches thick. Below this, to a depth of 60 inches, is a layer of black, less decomposed organic material. In some places mineral soil is at a depth of less than 60 inches.

Permeability of this Houghton soil is moderately rapid to moderately slow. Surface runoff is ponded. Available water capacity is very high. This soil has a seasonal high water table near or above the surface. It is covered by as much as 3 feet of water 6 to 12 months each year. The subsurface layer has very low amounts of available phosphorus and available potassium.

In most areas this soil is used as habitat for wetland wildlife. It is not suited to cultivated crops or to hay and pasture because of the seasonal high water table and frequent ponding. It is best suited to habitat for wetland wildlife. In some places it is mined for peat.

The land capability classification is Vw.

**1926—Canoe silt loam, sandy substratum, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on stream terraces. It is subject to rare flooding. Areas range from 3 to 20 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 mottled, grayish brown and dark grayish brown silt loam about 8 inches thick. The subsoil is friable and about 29 inches thick. In the upper part it is dark yellowish brown silt loam. In the next part it is mottled, grayish brown, yellowish brown, and light brownish gray silty clay loam. In the lower part it is mottled, light brownish gray and yellowish brown silt loam. The substratum to a depth of about 60 inches is mottled, light brownish gray and yellowish brown silt loam in the upper part and mottled, yellowish brown and gray, stratified sand and loamy sand in the lower part. In some places sandy material is above a depth of 40 inches.

Included with this soil in mapping are small areas of well drained Richwood soils. These soils have a brown and yellowish brown subsoil. They are on slight rises in the map unit and make up about 3 percent of the map unit.

Permeability of this Canoe soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has

moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Drainage ditches and, in a few places, tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining good tilth. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

This soil is suited to trees, and small areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is I.

**2221—Palms muck, sandy substratum, 0 to 1 percent slopes.** This is a level, very poorly drained soil on the edge of bottom lands adjacent to stream terraces. In some areas it is on the lower edge of terrace side slopes. It is subject to ponding. Most areas range from 3 to 50 acres in size and are round or elongated.

Typically, the surface layer is black muck about 8 inches thick. The subsurface layer is black muck about 26 inches thick. The next layers are black mucky loam about 14 inches thick and gray and very dark gray sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is gray, stratified sand and loamy sand. In some places the muck extends to a depth of more than 50 inches.

Included with this soil in mapping are small areas of Ambrow soils. These soils have a surface layer and subsurface layer of black silty clay loam or loam and a subsoil of mottled clay loam. They are around the edges of the map unit or on slight rises and make up about 5 percent of the map unit.

Permeability of this Palms soil is moderately slow to moderately rapid in the muck and mucky loam and rapid in the substratum. Runoff is ponded. Available water capacity is very high. The soil has a seasonal high water table. The subsurface layer has very low amounts of available phosphorus and available potassium.

Most areas are artificially drained and are cultivated or used for pasture. If this soil is adequately drained, it is suited to corn, soybeans, and small grain and to

grasses and legumes for hay and pasture. Drainage ditches and, in some areas, tile drains improve soil aeration and allow timelier tillage. When cultivated crops are grown, soil blowing is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. In most areas subsidence after drainage eventually reduces the efficiency of the drainage system. Minimizing tillage and maintaining the water table as high as is practical for crop or pasture production reduce the subsidence rate and help to maintain productivity.

A cover of pasture plants is effective in controlling soil blowing. Maintaining a vigorous grass cover will reduce the soil damage caused by grazing animal traffic. Also, timely deferred grazing especially during wet periods helps to keep the pasture and the soil in good condition. Regardless of other management, soil subsidence will continue unless controlled by maintaining a shallow water table during periods of deferred grazing on the pasture.

This soil is suited to trees, but only trees adapted to wet soil conditions grow well. Tree species that do not develop an extensive, spreading root system are subject to a severe windthrow hazard. During wet periods harvesting or management equipment with high flotation tires may be needed, unless harvesting and management operations take place during dry periods or when the soil is frozen. Natural and planted seedlings do not survive well. Seedlings can be spaced close together when planting. The surviving trees can be thinned later to achieve the desired stand density. Planting larger seedlings and controlling competing vegetation also improve the survival rate. Subsidence can be controlled by planting tree species that tolerate the high water table and by maintaining the high water table except when management or harvesting has to be done on drier soil.

The land capability classification is IIIw.

**2226—Elrin loam, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on stream terraces. Areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black, very dark gray, and very dark grayish brown loam about 15 inches thick. The subsoil is about 25 inches thick. In the upper part it is dark grayish brown, friable loam. In the next part it is dark grayish brown and grayish brown, friable loam. In the lower part it is brown, loose fine sand. The substratum to a depth of about 60 inches is pale brown sand.

Included with this soil in mapping are small areas of well drained Bolan soils and poorly drained Marshan soils. Bolan soils have a browner subsoil and are in slightly higher, more convex areas than the Elrin soil. Marshan soils have a grayer subsoil and are in slightly lower or more concave areas than the Elrin soil. Together they make up about 5 percent of the map unit.

Permeability of this Elrin soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow. Available water capacity is moderate. The soil has a seasonal high water table. The subsoil has very low amounts of available phosphorus and available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and is suited to grasses and legumes for hay and pasture. Plant growth depends on a good distribution of rainfall. If cultivated crops are grown, soil blowing is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture and maintain good tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is too wet improve fertility, help to prevent surface crusting, and increase the available water capacity.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and deferred grazing especially during dry periods help to keep the pasture and the soil in good condition.

The land capability classification is IIs.

**2490—Caneek Variant loamy sand, 1 to 3 percent slopes.** This is a very gently sloping, somewhat poorly drained soil on foot slopes and alluvial fans. It is subject to rare flooding for brief periods. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is brown loamy sand about 9 inches thick. The substratum is about 37 inches thick. In the upper part it is pale brown, stratified sand and loamy sand. In the lower part it is dark grayish brown and grayish brown, mottled silt loam. The layer below this to a depth of about 60 inches is buried, friable silty clay loam. In the upper part it is very dark gray and mottled, and in the lower part it is black and mottled.

Included with this soil in mapping are small areas of Orion soils. These soils have a surface layer and substratum of silt loam. They are scattered throughout and make up about 3 percent of the map unit.

Permeability of this Caneek Variant soil is rapid in the upper part of the profile and moderate in the lower part. Runoff is medium. Available water capacity is low. The soil has a seasonal high water table. The



substratum has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If flooding is controlled, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Drainage ditch maintenance helps to control flooding. If cultivated crops are grown, soil blowing and water erosion are hazards. Blowing sand grains can damage seedlings on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to prevent soil blowing and to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in controlling water erosion and soil blowing. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

The land capability classification is IIs.

**2587—Dolbee silt loam, sandy substratum, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on stream terraces and high bottom lands. It is subject to rare flooding. Areas range from 10 to 300 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 very dark gray silty clay loam about 7 inches thick. The subsoil is friable and about 36 inches thick. In the upper part it is very dark gray and dark gray, mottled silty clay loam. In the next part it is gray, mottled silty clay loam. In the lower part it is gray, mottled silt loam. The substratum to a depth of 60 inches is gray and light gray, mottled sand. In places this soil is silt loam throughout, and in other places the depth to the sandy substratum is more than 60 inches.

Permeability of this Dolbee soil is moderate in the surface layer, the subsurface layer, and the subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained and flooding is controlled, the soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where this soil is cultivated, drainage ditches and, in some areas, tile drains improve soil aeration and allow timely tillage. Where tile is installed in the sandy substratum, special

equipment or procedures may be needed to keep the sand from caving in. A conservation tillage system that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**2636—Radford-Hanlon silt loams, channeled, 0 to 2 percent slopes.** This map unit consists of nearly level and gently sloping soils on channeled, narrow bottom lands. These soils are subject to frequent flooding. The Radford soil is poorly drained and generally further back from the main channel. The Hanlon soil is moderately well drained and adjacent to the main channel. In most areas this unit is about 60 percent Radford soil and 40 percent Hanlon soils. These soils are in areas so intricately mixed or so small that they could not be separated at the scale used for mapping. Areas range from 50 to several hundred acres in size and are elongated or irregularly shaped.

Typically, the surface layer of the Radford soil is very dark grayish brown silt loam about 5 inches thick. The substratum is very dark gray and very dark grayish brown silt loam about 23 inches thick. The layer below this to a depth of 60 inches is a buried, friable silty clay loam. In the upper part it is black, in the next part it is very dark gray, and in the lower part it is dark gray and mottled.

Typically, the surface layer of the Hanlon soil is very dark grayish brown silt loam about 11 inches thick. The subsurface layer is 21 inches thick. In the upper part it is very dark gray loam, and in the lower part it is very dark gray sandy loam. The subsoil is very friable sandy loam about 12 inches thick. In the upper part it is very dark grayish brown and dark grayish brown, and in the lower part it is dark grayish brown. The substratum to a depth of 60 inches is grayish brown sandy loam. In places this soil has more clay. In other places this soil is silt loam throughout to a depth of 60 inches.

Permeability is moderate in the Radford soil and moderately rapid in the Hanlon soil. Runoff is slow for both soils. Available water capacity is high in the Radford soil and moderate in the Hanlon soil. Both soils have a seasonal high water table. The substratum in the Radford soil has moderate amounts of available

phosphorus and very low amounts of available potassium. The subsoil in the Hanlon soil has very low amounts of available phosphorus and available potassium.

In most areas these soils are used as pasture or woodland. They are suited to grasses and legumes for pasture. They are not suited to cultivated crops because of flooding, siltation, and stream channels.

A cover of pasture plants is effective in controlling channeling and maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during periods of wetness help to keep the pasture and the soil in good condition.

This soil is suited to trees, and areas remain in native hardwoods. Planted seedlings survive and grow well if competing vegetation is controlled.

The land capability classification is Vw.

**3133—Colo silty clay loam, rarely flooded, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on bottom lands. It is subject to rare flooding. Areas range from 15 to several hundred acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsurface layer is black silty clay loam about 25 inches thick. The subsoil is friable, mottled silty clay loam about 16 inches thick. In the upper part it is very dark gray, and in the lower part it is gray. The substratum to a depth of about 60 inches is light olive gray, mottled silty clay loam. In many places the depth to dark gray or lighter colors is less than 36 inches. In other places about 8 to 15 inches of recently deposited silty clay loam and silt loam overlies the surface layer.

Permeability of this Colo soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Flooding is a hazard. This soil is protected from flooding by levees or stream channel improvements. Tile drains and drainage ditches improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**3134—Zook silty clay, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on low bottom lands. It is subject to rare flooding. Areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is about 30 inches thick. It is black silty clay in the upper part and black silty clay loam in the lower part. The subsoil is friable and about 20 inches thick. It is black silty clay loam in the upper part and dark gray and gray silt loam in the lower part. The substratum to a depth of about 60 inches is light olive gray, mottled silt loam. In some places the surface layer is overlain by about 12 inches of recently deposited silt loam. In some places the subsoil is silt loam.

Included with this soil in mapping are small areas of Coland and Colo soils. These soils are less clayey than the Zook soil. They are scattered throughout and make up about 5 percent of the map unit.

Permeability of this Zook soil is slow. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The shrink-swell potential is high. The subsoil has moderate amounts of available phosphorus and low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained and if flooding is controlled, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Shallow ditches and tile drains improve soil aeration and allow timelier tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIIw.

**3135—Coland clay loam, rarely flooded, 0 to 2 percent slopes.** This is a nearly level, poorly drained

soil on bottom lands. It is subject to rare flooding. Areas range from 10 to 100 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is black, mottled clay loam about 20 inches thick. The subsoil is mottled, friable clay loam about 18 inches thick. It is very dark gray in the upper part and gray and dark gray in the lower part. The substratum extends to a depth of about 60 inches. In the upper part it is gray, mottled loam. In the lower part it is gray and dark gray, mottled sandy loam. In places the substratum is stratified loamy sand and sandy loam. In places the subsoil is lighter colored in the upper part and sandy loam in the lower part.

Included with this soil in mapping are small areas of Zook soils. These soils are in slight depressions and have more clay and less sand than Coland soils. They make up about 3 percent of the map unit.

Permeability of this Coland soil is moderate. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. This soil is protected from flooding by levees and stream channel improvements. Tile drains and drainage ditches improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil, regularly adding other organic material, and deferring tillage when the soil is wet improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**3960—Shaffton loam, rarely flooded, 0 to 2 percent slopes.** This is a nearly level, somewhat poorly drained soil on bottom lands. It is subject to rare flooding. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsurface layer is very dark gray and very dark grayish brown loam about 12 inches thick. The subsoil is friable and about 28 inches thick.

In the upper part it is mottled dark brown and dark grayish brown loam. In the next part it is grayish brown, mottled loam. In the lower part it is grayish brown, mottled sandy loam. The substratum to a depth of 60 inches is grayish brown, mottled loamy sand. In places the surface layer and the subsurface layer are thicker. Also, in places the subsoil is grayer.

Permeability of this Shaffton soil is moderate in the surface layer, the subsurface layer, and the subsoil, and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. This soil is protected from flooding by levees and stream channel improvement. Drainage ditches and, in places, tile drains improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**3961—Ambraw loam, rarely flooded, 0 to 2 percent slopes.** This is a nearly level, poorly drained soil on bottom lands. It is subject to rare flooding. Areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is mottled loam about 15 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The subsoil is friable and about 24 inches thick. In the upper part it is mottled dark gray and yellowish brown loam. In the next part it is mottled gray and yellowish brown sandy clay loam. In the lower part it is dark gray and gray, mottled, stratified loam and sandy loam. The substratum to a depth of 60 inches is gray, mottled, stratified sand and loamy sand. In some places the subsurface layer is dark colored and extends below a depth of 24 inches. In places silt loam overwash above the surface layer is as much as 12 inches thick.

Included with this soil in mapping are small areas of

Aquolls. These soils have sand above a depth of 30 inches. They are scattered throughout and make up about 2 percent of the map unit.

Permeability of this Ambraw soil is moderate in the surface layer, the subsurface layer, and the subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Most areas are cultivated. If this soil is adequately drained, it is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. This soil is protected from flooding by levees and drainage ditches. Tile drains and drainage ditches improve soil aeration and allow timelier tillage. A conservation tillage system that leaves crop residue on the surface helps to maintain fair tilth. Returning crop residue to the soil and regularly adding other organic material improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture or hay plants is effective in maintaining tilth. Proper stocking rates, rotation grazing, and timely deferred grazing especially during wet periods help to keep the pasture and the soil in good condition.

The land capability classification is IIw.

**4160—Walford-Urban land complex, 0 to 2 percent slopes.** This map unit consists of the Walford soil and built-up areas on broad, upland divides and in the upper part of concave drainageways in and around the city of Muscatine. The Walford soil is nearly level and poorly drained. The unit is about 50 percent Walford soil and 50 percent Urban land. The Walford soil and Urban land are so intricately mixed or so small in size that they could not be mapped separately at the scale used for mapping. Areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer of the Walford soil is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is friable silty clay loam about 28 inches thick. In the upper part it is gray and has brownish yellow mottles. In the next part it is grayish brown and has brownish yellow and gray mottles. In the lower part it is light olive gray and has brownish yellow and strong brown mottles. The substratum to a depth of 60 inches is light olive gray, mottled silt loam. In some places sandy material is at a depth of 48 to 96 inches. In places this soil is better drained and the subsoil is not as gray.

Urban land is covered by streets, parking lots, buildings, shopping centers, and other structures that so obscure or alter the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled, and reworked by earthmovers so that the former soils no longer remain.

Permeability of the Walford soil is moderately slow. Runoff is slow. Available water capacity is high. The Walford soil has a seasonal high water table. The shrink-swell potential of the subsoil is high. The subsoil of the Walford soil has moderate amounts of available phosphorus and very low amounts of available potassium. The Urban land has a seasonal high water table. The other properties of this Urban land differ from place to place.

Most areas of this unit are artificially drained by sewer systems, gutters, and drainage tile. Much of this unit has 24 to 48 inches or more of fill over the original soil.

This map unit is suitable for additional development. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4162C—Downs-Urban land complex, 2 to 9 percent slopes.** This map unit consists of the Downs soil and built-up areas on convex upland ridgetops and side slopes in and around the city of Muscatine. The Downs soil is gently sloping and moderately sloping, and well drained. The unit is about 50 percent Downs soil, 45 percent Urban land, and 5 percent other soils. These soils and Urban land are so intricately mixed or so small in size that they could not be mapped separately at the scale used for mapping. Areas range from 5 to 200 acres in size and are irregularly shaped.

Typically, the surface layer of the Downs soil is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 3 inches thick. The subsoil is friable and about 44 inches thick. In the upper part it is brown and yellowish brown silt loam. In the next part it is yellowish brown silty clay loam. In the lower part it is mottled yellowish brown and light brownish gray silt loam. The substratum to a depth of 60 inches is light yellowish brown, mottled silt loam. In some places this soil has sandy material at a depth of 48 to 96 inches.

Urban land is covered by streets, buildings, parking lots, and other structures that so obscure or alter the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled,

and otherwise reworked by earthmovers so that the former soils no longer remain.

Permeability of the Downs soil is moderate. Runoff is medium. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Properties of Urban land are variable. Most of the Urban land is artificially drained through sewer systems, gutters, and drainage tile. On much of this unit, 24 to 72 inches or more of fill is over the original soil or 24 to 72 inches or more of the original soil has been removed.

This map unit is suitable for additional development. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4163D—Fayette-Urban land complex, 9 to 18 percent slopes.** This map unit consists of the Fayette soil and built-up areas on convex, upland side slopes in and around the city of Muscatine. The Fayette soil is strongly sloping and moderately steep and well drained. The unit is about 50 percent Fayette soil and 50 percent Urban land. The Fayette soil and the Urban land are in areas so intricately mixed or so small that they could not be mapped separately at the scale used for mapping. Areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer of the Fayette soil is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 5 inches thick. The subsoil is friable and about 49 inches thick. In the upper part it is brown silt loam. In the next part it is yellowish brown silty clay loam. In the lower part it is yellowish brown silt loam. In some places this soil has sandy material at a depth of 48 to 96 inches.

Urban land is covered by streets, buildings, parking lots, and other structures that so obscure or alter the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled, and otherwise reworked by earthmovers so that the former soils no longer remain.

Permeability of the Fayette soil is moderate. Runoff is rapid. Available water capacity is high. The subsoil has high amounts of available phosphorus and very low amounts of available potassium.

Properties of Urban land are variable. Most of the Urban land is artificially drained through sewer systems, gutters, and drainage tile. On some of this unit 24 to 72 inches or more of fill is over the original soil or 24 to 72 inches or more of the original soil has been removed.

This map unit is suitable for additional development. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4636—Radford-Urban land complex, 0 to 3 percent slopes.** This map unit consists of the Radford soil and built-up areas on low bottom lands along streams in and around the city of Muscatine. The Radford soil is nearly level and poorly drained. Unless protected the soil in this map unit is subject to flooding. The unit is about 50 percent Radford soil and 50 percent Urban land. This soil and Urban land are in areas so intricately mixed or so small that they could not be separated at the scale used for mapping. Areas range from 10 to 200 acres in size and are elongated or irregularly shaped.

Typically, the surface layer of the Radford soil is very dark grayish brown silt loam about 5 inches thick. The substratum is very dark gray and very dark grayish brown silt loam about 23 inches thick. The layer below this to a depth of 60 inches is buried, friable silty clay loam. In the upper part it is black, in the next part it is very dark gray, and in the lower part it is dark gray and mottled. In places the substratum is loam and sandy loam to a depth of more than 40 inches.

Urban land is covered by streets, parking lots, buildings, dumps, and other structures or by a thick layer of fill that so obscures or alters the soil that identification is not feasible.

Permeability of the Radford soil is moderate. Surface runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The substratum and the buried soil have low amounts of available phosphorus and very low amounts of available potassium.

Properties of the Urban land differ from place to place. Most areas of the Urban land are artificially drained by sewer systems, gutters, and drainage tile. In much of the unit 24 to 120 inches or more of fill is over the original soils.

This map unit is suitable for additional development if it is protected from flooding. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4759—Fruitfield-Urban land complex, 0 to 2 percent slopes.** This map unit consists of the Fruitfield soil and built-up areas on wide bottom lands in and around the city of Muscatine. The Fruitfield soil is nearly

level and excessively drained. It is subject to rare flooding and is protected by levees. The unit is about 50 percent Fruitfield soil and 50 percent Urban land. The Fruitfield soil and Urban land are in areas so intricately mixed or so small that they could not be mapped separately at the scale used for mapping. Areas range from 10 to 200 acres in size and are irregularly shaped.

Typically, the surface layer of the Fruitfield soil is very dark brown coarse sand about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown coarse sand about 19 inches thick. The next layer is dark brown coarse sand about 9 inches thick. The substratum to a depth of 60 inches is brown and pale brown sand and coarse sand.

Urban land is covered by streets, parking lots, buildings, and other structures or by a thick layer of fill that so obscures or alters the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled, and reworked by earthmovers so that the former soils no longer remain. In a few places the surface layer and the subsurface layer are loam or sandy loam.

Permeability of the Fruitfield soil is very rapid. Runoff is slow. Available water capacity is very low. The subsurface layer and the next layer have low amounts of available phosphorus and very low amounts of available potassium.

Properties of Urban land are variable. Most areas of Urban land are artificially drained by sewer systems and gutters. On much of this unit 24 to 72 inches or more of fill is over the original soil.

This map unit is suitable for additional development if it is protected from flooding. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4960—Shaffton-Urban land complex, 0 to 2 percent slopes.** This map unit consists of the Shaffton soil and built-up areas on wide bottom lands in and around the city of Muscatine. The Shaffton soil is nearly level and somewhat poorly drained. It is subject to rare flooding, but most areas are protected from flooding. The unit is about 50 percent Shaffton soil, 40 percent Urban land, and 10 percent other soils. The Shaffton soil and Urban land are in areas so intricately mixed or so small in size that they could not be mapped separately at the scale used for mapping. Areas range from 50 to several hundred acres in size and are irregularly shaped.

Typically, the surface layer of the Shaffton soil is very dark gray loam about 8 inches thick. The subsurface

layer is very dark gray and very dark grayish brown loam about 12 inches thick. The subsoil is friable and about 28 inches thick. In the upper part it is mottled dark brown and dark grayish brown loam. In the next part it is grayish brown, mottled loam. In the lower part it is grayish brown, mottled sandy loam. The substratum to a depth of 60 inches is grayish brown, mottled loamy sand. In some places the surface and subsurface layers are thicker. In places the subsoil is grayer.

Urban land is covered by streets, parking lots, buildings, shopping centers, and other structures that so obscure or alter the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled, and reworked by earthmovers so that the former soils no longer remain.

Permeability of the Shaffton soil is moderate in the surface layer, the subsurface layer, and the subsoil and rapid in the substratum. Runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The subsoil has low amounts of available phosphorus and very low amounts of available potassium.

Properties of Urban land are variable. Most areas of Urban land are artificially drained by sewer systems, gutters, and drainage tile. On much of this unit 24 to 72 inches or more of fill is over the original soil.

This map unit is suitable for additional development if it is protected from flooding. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**4977B—Richwood-Urban land complex, 2 to 5 percent slopes.** This map unit consists of the Richwood soil and built-up areas on convex slopes of stream terraces in and around the city of Muscatine. The Richwood soil is gently sloping and well drained. The unit is about 50 percent Richwood soils and 50 percent Urban land. The Richwood soil and Urban land are in areas so intricately mixed or so small in size that they could not be mapped separately at the scale used for mapping. Areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer of the Richwood soil is very dark brown silt loam about 10 inches thick. The subsurface layer is very dark grayish brown silt loam also about 10 inches thick. The subsoil is friable and about 24 inches thick. In the upper part it is brown silt loam. In the next part it is yellowish brown silty clay loam and silt loam. In the lower part it is yellowish brown, mottled silt loam. The substratum to a depth of

60 inches is yellowish brown and light brownish gray, stratified sand and loamy sand. In places the surface layer is about 8 inches thick, the subsurface layer is grayish brown silt loam, and the subsoil is silt loam and silty clay loam. In other places the depth to sand and loamy sand is more than 60 inches.

Urban land is covered by streets, parking lots, buildings, shopping centers, and other structures that so obscure or alter the soils that identification is not feasible. It also includes areas of exposed land that have been graded, filled, and otherwise reworked by earthmovers so that the former soils no longer remain.

Permeability of the Richwood soil is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. Available water capacity is high. The subsoil has moderate amounts of available phosphorus and very low amounts of available potassium.

Properties of Urban land are variable. Most areas of this unit are artificially drained through sewer systems, gutters, and drainage tile. On much of this unit 24 to 72 inches or more of fill is over the original soil or 24 to 72 inches or more of the original soil has been removed.

This map unit is suitable for additional development. Onsite investigation is needed to ensure proper design and installation procedures.

This map unit has not been assigned a land capability classification.

**5010—Pits.** This map unit is on bottom lands near major rivers. Areas range from 5 to more than 100 acres in size and are square or rectangular.

Most pits are 10 to 30 feet deep, and contain ground water. The sand and gravel are used as roadbuilding material and in manufacturing cement and concrete.

In areas that are not ponded pits that have been abandoned for a number of years support some trees, shrubs, and herbaceous vegetation. The density of the vegetation varies with the content of gravel in the remaining material. Some of the pits are suitable for use as wildlife habitat. Some with water are stocked with fish.

This map unit has not been assigned a land capability classification.

**5040—Orthents, loamy.** These are nearly level to moderately steep soils in areas on uplands, terraces, and bottom lands where part or all of the original soil either has been excavated or buried by fill. Areas range from 3 to 80 acres in size and are roughly square, rectangular, or long and narrow.

Typically, the surface layer is silt loam about 12 inches thick. It is mixed backfill material from the topsoil

and the subsoil of the original soil. In most places on uplands the underlying material is brown, grayish brown, or gray silt loam. On stream terraces and bottom lands the underlying material is mixed loamy material underlain by sandy or gravelly material.

Included with these soils in mapping are areas that are covered by roads or structures, areas that are used for solid waste disposal, and areas that have coarse textures. Areas that are used for solid waste disposal vary greatly, depending on the kind and amount of fill covering the solid waste. Areas that have coarse textures are droughty and have a lower available water capacity. Included areas make up about 15 percent of the map unit.

Properties of Orthents, loamy, differ greatly from place to place. The most common Orthents on uplands are moderately permeable. Surface runoff is medium. Available water capacity is moderate or high.

Most areas are in grasses and legumes for hay and pasture. A few areas are cultivated. Cultivated crops are more productive where grasses and legumes have been grown for several years after the borrow areas have been reclaimed. Growing grasses and legumes increases the content of organic matter in the surface layer and in the upper part of the underlying material. In cultivated areas, erosion and soil blowing are hazards. A conservation tillage system that leaves crop residue on the surface and contour farming help to control erosion and soil blowing.

A cover of pasture and hay plants helps to prevent excessive soil loss. Proper stocking rates, rotation grazing, and timely deferred grazing help to keep the pasture and the soil in good condition.

These soils have not been assigned a land capability classification.

## 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 and 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 inputs 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 167,000 acres in the survey area, or nearly 60 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern part, mainly in associations 1, 2, 7, and 8, which are described under the heading "General Soil Map Units." About 150,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated two-thirds of the county's total agricultural income each year.

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."

All of the prime farmland soils in Muscatine County are not equally suited to all of the commonly grown crops. For example, some crops require a sustained moisture supply throughout the growing season. These crops tend to grow better on soils that have a high available water capacity than on soils that have a low available water capacity. An example of the former is Downs silt loam, 2 to 5 percent slopes, and of the latter is Dickinson fine sandy loam, 0 to 2 percent slopes.

Soils that have limitations, such as a seasonal high water table, frequent flooding during the growing season, or inadequate rainfall, qualify for prime farmland only in areas where these limitations have been overcome by such measures as drainage, flood control, or irrigation. The need for these measures is indicated after the map unit name. 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 behavior 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 potentials and 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 all or part of 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

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 1982, about 238,000 acres in Muscatine County was used for crops and pasture. About 106,000 acres was used for corn, 51,000 acres was used for soybeans, 8,000 acres was used for oats, 12,000 acres was used for oats, and 12,000 acres was used for alfalfa and other hay (27). The acreage used for corn and soybeans has increased in recent years, whereas that used for alfalfa, other crops, and pasture has decreased.

The potential of the soils in Muscatine County for sustained, efficient crop production is good, provided the soils are managed according to their properties and capabilities. This soil survey provides the soil information needed to apply the crop production technology necessary for sustained, efficient crop production. This section describes the most important soil management concerns in the county and the crop production technology related to those concerns.

Water erosion is the major soil management concern on about 37 percent of the land in Muscatine County used for cropland. Water erosion is a hazard on soils that have slopes of more than 3 percent. It is a more severe hazard where slopes are steeper or where the slope length is long. The most common types of water erosion in the county are sheet and rill erosion.

Water erosion makes efficient crop production more difficult. Fertilizers and other soil-applied chemicals are lost along with topsoil when soils erode. When water

erosion removes soil material from the surface layer, subsequent tillage generally maintains the surface layer thickness by incorporating material from the subsurface layer or the subsoil into the surface layer. When the erosion tillage-incorporation cycle continues for several years, two things happen. The organic matter content in the surface layer gradually declines, and the clay content in the surface layer gradually increases. For example, the surface layer of the slightly eroded Tama soils is silt loam and 3 or 4 percent organic matter and that of the severely eroded Tama soils is silty clay loam and 0.5 to 1 percent organic matter. This increase in clay and loss of organic matter cause an increased power requirement for tillage and make seedbed preparation more difficult.

Only about 1,500 acres of severely eroded Tama soils were mapped in this survey, but that acreage is likely to increase significantly unless available technology for controlling erosion is more widely adopted. Tama soils were found to be much less erodible than soils of comparable textures with less organic matter than Tama soils (21). Downs, Tama, and Newvienna soils are likely to be much more erodible in severely eroded areas than in uneroded areas.

Gully erosion is not as common as sheet and rill erosion in the county, but it is a serious problem where it occurs. The most serious gully erosion is occurring within a few miles of the bottom lands along the Mississippi River. Most of the gully development is on moderately steep to very steep soils that are used for pasture. Accelerated runoff from adjacent, less sloping, cultivated soils increases the rate of gully erosion.

Soil erosion can be controlled by conservation practices, structures, or both. Conservation practices include contouring and conservation tillage systems that maintain a protective cover of residue on the surface. Structures, such as terraces and sediment control basins, help to control erosion by reducing the effective slope length.

Conservation tillage systems have both short-term and long-term benefits. By increasing the amount of crop residue on the soil surface, they reduce runoff and help to control erosion on sloping soils. Over a long period, soils receiving less tillage are higher in content of organic matter and nitrogen, even where they are not eroded (19). Conservation tillage also changes other physical and chemical soil properties. Most of these changes improve soil productivity or reduce production costs. On some soils under certain conditions more soil nitrogen is lost through leaching and as gaseous nitrous oxide under no-till than under conventional tillage (14).

Some examples of conservation tillage systems are

no-till or slot planting, ridge-till, till-plant, and certain preplant tillage operations. In no-till or slot planting, ridge-till, and till-plant, the seedbed is prepared and the seed planted in one operation while leaving much of the protective residue on the surface. In no-till or slot planting, a fluted coulter prepares a narrow seedbed. In ridge-till, a sweep prepares a seedbed by clearing residue from the top of the row crop ridge from the previous year. In till-plant, a tillage implement prepares a seedbed strip no wider than one-third of the row width and leaves a protective cover of residue on two-thirds of the row width. These conservation tillage systems also control soil blowing, which is a serious hazard on such soils as Chelsea and Sparta soils.

No-till has been increasing in Muscatine County in recent years. Farmers have reported that, in addition to controlling erosion, no-till planting has reduced harvesting difficulties when wet weather occurs during the harvest season. Apparently, the larger soil pores, which extend to the surface in soils that are undisturbed by tillage, drain excess water out of the surface layer. Thus, the capacity of the soil to support harvesting equipment is increased.

Chisel plowing followed by secondary tillage are the most common tillage methods in Muscatine County that can be part of a conservation tillage system. Many soils, however, do not have enough residue on the surface after chisel plowing to control erosion or soil blowing. On some farms, residue covering is reduced by changes in chisel size, shape, spacing, or tillage depth. On other farms, the amount of residue needed to protect the soil is reduced by contouring and terracing. Residue must remain on the surface after planting to effectively control water erosion on sloping soils, such as Downs and Tama soils, and soil blowing on sandy soils, such as Chelsea, Fruitfield, and Sparta soils. Where specialty crops are grown on these sandy soils, winter cover crops and spring cover crop strips effectively control soil blowing (fig. 14).

On many soils in the country contour farming and stripcropping help to control erosion. They are most effective in areas where slopes are smooth and uniform. Many areas of Downs, Fayette, and Tama soils, for example, are well suited to contouring and stripcropping.

Farmers and researchers have observed that sloping soils are more erodible if they are used for soybean production than for corn production. Soil aggregate size and stability are not maintained as well when soybeans are grown (7). A conservation tillage system, especially no-till, will compensate for the increased erodibility of soils because of soybean production.



Figure 14.—Irrigated soybeans and bell peppers on Fruitfield coarse sand, 0 to 2 percent slopes.

On many soils in the county terraces and sediment control basins can be used alone or with a conservation tillage system to control water erosion. They are most effective and practical where slopes are relatively long and where the soils do not have sandy unproductive material that will be exposed or be shallow enough to reduce productivity after construction. Some newer terrace designs with steeper, unfarmable slopes require much less fill material than conventional broad-base terraces. They often can be used on the more sloping

soils or on soils underlain by coarse material, such as Downs, Fayette, and Tama, sandy substratum, soils.

Reducing the depth of cut is most beneficial on soils that are underlain by coarse material. Minimizing the area cut is beneficial on all the soils in the county that are suited to terracing. On some soils terraces and sediment control basins are not practical. In such soils as Bolan and Dickinson soils, terrace cuts will expose unproductive, sandy material. In such soils as Pilot, Thebes, and Whittier soils, they will expose

unproductive, sandy or shallow-to-sand material. Information and assistance in designing erosion control practices are available at the local office of the Soil Conservation Service.

Irrigation has been used in the production of specialty crops in Muscatine County since the early 1900's (28). The irrigation technology used has changed several times since then, and the technology continues to change. Irrigation began with modest scale, solid-set sprinkler systems on the Mississippi River bottom land south of Muscatine, where nearly all the irrigated acreage is at present. Irrigation expanded significantly in the early 1940's when portable aluminum sprinkler irrigation pipe was adopted (17). Beginning in the mid-1960's, center-pivot sprinkler systems have gradually replaced most of the hand-moved and tow-line sprinkler systems. The most recent trend is toward deeper, higher capacity irrigation wells and larger, more versatile center-pivot sprinkler systems.

The most extensive irrigated soils on the Mississippi River bottom land are Fruitfield soils. They are the driest agricultural soils in the county. With irrigation they are used mainly for production of corn, soybeans, cantaloups, cabbage, potatoes, tomatoes, and watermelon. The main hazards to irrigated crop production on Fruitfield and other soils on this bottom land are soil blowing and ground water contamination.

Field shelterbelts were planted, mostly in the 1930's, to control soil blowing on Fruitfield soils. In recent years many of them have been removed to expand fields and permit center-pivot sprinkler operation. Currently, a winter cover crop commonly is used to control soil blowing. In many areas of Fruitfield soils, the percentage of very coarse sand and gravel in the surface layer is higher. This indicates significant soil blowing has occurred in the past. Ground water contamination is likely on the sandier bottom land soils, like Fruitfield soils, when fertilizer nitrogen or irrigation water is applied in excess of crop needs.

Irrigation has been utilized to a relatively small extent on Dickinson, Hoopston, Sparta, and Watseka soils in the southwestern part of the county. These soils are not as droughty as Fruitfield soils. Thus, irrigation tends to be less beneficial than it is on Fruitfield soils.

Crop production technology includes selecting crops and crop varieties and using agricultural chemicals and fertilizers. Crops that require most of the growing season to mature, such as full-season corn or soybeans, grow poorly on droughty soils, such as Sparta and Chelsea soils, in years with a poor distribution of rainfall. In most years, crops that mature earlier in the season are more productive on these

soils. Examples of these crops include wheat, oats, and shorter season corn or soybeans. In most years deep-rooted perennial crops, such as alfalfa, also grow well on these soils because they can utilize soil moisture from a much greater depth than can annual crops.

Soil pH may be too low for alfalfa to grow well on Sparta, Chelsea, and other soils that have not been limed in recent years. Soil profile pH measurements during the soil survey seem to indicate that some of the lime applied in the past has increased the pH in part of the subsoil. Thus, some soils that have not been limed recently are more acid in the topsoil than they are in part of the subsoil. A soil test will determine the amount of lime needed for alfalfa to grow well.

Many soil-applied herbicides are sensitive to soil organic matter level, and some are sensitive to soil clay content. Many fields in Muscatine County that are managed as a unit consist of areas of soils that have widely varying contents of organic matter and clay in the surface layer. For example, slightly eroded Tama soils are associated in many fields with moderately eroded or severely eroded Tama soils. In the surface layer the organic matter varies from about 0.5 to 4 percent if the three erosion classes are present.

Tile drainage is needed for cultivated crop production on most poorly drained soils, which make up about 44 percent of the acreage in Muscatine County. Some poorly drained soils on terraces, such as Coppock and Dolbee soils, are adequately drained with open ditches, but some are drained with a combination of tile and open ditches. On most farms, tile drainage is also beneficial on somewhat poorly drained soils, such as Atterberry and Muscatine soils, because it improves timeliness of tillage. Some areas of poorly drained and somewhat poorly drained soils that are used only for pasture need little or no artificial drainage. Information and assistance in designing artificial drainage systems are available at the local office of the Soil Conservation Service.

Sampling for soil fertility tests is an important part of crop production technology. Soil test data are most useful when the combined sample that is analyzed is from areas of soils that have similar properties, such as Downs and Newvienna soils. However, that part of a field known to have had different past fertility management generally should be sampled separately, even if the soils have similar properties. Soils that have different properties, such as Richwood and Sparta soils, generally should be sampled separately also, even if the same management is planned. Samples from soils of minor extent in a field are needed only if the soil properties are so different from those of the major soils

that different management is planned. For example, an area of Sparta soils generally would be sampled separately from an area of Richwood soils for lime requirement analysis. More specific information on sampling for soil fertility tests is available in the local office of the Cooperative Extension Service.

In 1982 about 80,000 acres in Muscatine County was used for pasture. Some areas are used for pasture that is rotated with row crops. Most areas are used for permanent pasture because the soils are too sloping, too wet, or too frequently flooded to be used for cultivated crops. A cover of pasture plants effectively controls erosion and soil blowing. The most common pasture plants are brome grass, bluegrass, reed canarygrass, orchardgrass, switchgrass, bluestem, indiagrass, alfalfa, birdsfoot trefoil, ladina clover, and red clover.

Good management practices can enhance forage production. On established stands they include fertilizer applications, weed and brush control, rotation grazing and deferred grazing in a full season grazing system, proper stocking rates, and adequate livestock watering facilities.

Most of the permanent pasture in Muscatine County is in the fine silty over sandy Ambraw-Aquolls-Colo and Fayette-Lindley associations. About 60 percent of the permanent pasture is pastured woodland. Nonforage plants, such as shrubs and trees, are the dominant vegetation on most of the pastured woodland. The main management concern is controlling nonforage plants, but in many areas this is hampered by frequent flooding on bottom lands and by steep slopes on uplands. Some areas presently managed as pastured woodland can be more efficiently managed for timber production.

### **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 are also 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 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

When Muscatine County was settled, according to surveyors' notes, about 90,800 acres in the county was forest. By 1954 the forest acreage was about 30,000 acres, and by 1974 it was about 19,200 acres. Recent aerial photography and vegetation observed during this survey indicate that the forest acreage is less than 19,000 acres. Most of the forest acreage has been commercially harvested or is available for harvesting.

Most of the remaining forest acreage is on steep and very steep Fayette and Lindley soils on upland side slopes and on nearly level, frequently flooded Ambraw soils and Aquolls and on Colo fine silty over sandy soils on bottom lands. These soils are better suited to forest-related uses than to other uses. Under good

management trees grow well on these soils. Windthrow is a hazard on bottom lands, especially on Aquolls.

In Muscatine County, forest on uplands is mainly the white oak-red oak-hickory forest type, but varies with landscape position (31). Forest composition is similar to that inventoried in 1973-74, except American elm has been replaced by other species. In 1974, forest land in the county contained about 50,000,000 board feet of saw timber (31). In selective harvesting in some places the larger white oak and other, more valuable species were removed. In extensive areas, however, forest quality declined because of livestock grazing. In a few areas on steep and very steep Fayette soils, the forest has recently been cleared and converted to cropland. Crop production technology is not available to maintain soil productivity for this use on steep and very steep soils.

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; *F*, a high content of rock fragments in the soil; and *L*, low strength. 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*, *F*, and *L*.

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 are also 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 *volume* number. 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 *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on 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

Muscatine County provides many opportunities for outdoor recreation. The Mississippi and Cedar Rivers and numerous public and private impoundments are convenient. Fishing is the main water recreation, but pleasure boating is popular on the Mississippi River and, to a lesser extent, on the Cedar River. Many private vacation homes and cottages are on or near the shorelines of both rivers. Public camping and picnicking facilities are near both rivers, and access for shore fishing and boating is good.

County, state, and federal administered recreation areas are located in the county. The Muscatine County Conservation Board administers 11 areas; the Iowa State Conservation Commission, 5 areas; and the U.S. Army Corps of Engineers, 2 areas. Most communities maintain municipal parks. Most of these recreation areas are in the Fayette-Lindley, Ambraw-Aquolls-Colo, and Colo-Coland-Ambraw associations. These associations are described in the section "General Soil Map Units."

In summer some of the public recreation facilities are sometimes used at or near capacity. The potential is good for additional development of public recreation facilities in the county.

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 sewerlines. 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 gentle 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 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 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

Muscatine County has a varied population of fish and other wildlife. The rivers, streams, and ponds contain bluegill, bullhead and other kinds of catfish, crappie, largemouth bass, paddlefish, sunfish, northern pike, and walleye. The streams and shallow water areas provide habitat for furbearers and resting and feeding areas for migratory waterfowl and shore birds. The land areas of the county provide habitat for cottontail, coyote, pheasant, quail, red and gray squirrels, fox, wild turkey, white-tailed deer, and numerous predatory birds and songbirds. Sandy soils, such as Sparta and Fruitfield soils, are the habitat for several rare and endangered animals (10).

Land areas that have the best potential for wildlife habitat generally are adjacent to streams, ponds, drainage ditches, and undrained depressions. Many of these areas are in the Colo-Coland-Ambraw, Coppock-Rowley-Dolbee, and Ambraw-Aquolls-Colo associations. These associations are described in the section "General Soil Map Units."

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 are also 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 are also 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 are also 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, apple, hawthorn, dogwood, hickory, hazelnut, 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, cattail, 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 need to 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 (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) 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 the 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 the 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 to 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 due to rapid permeability of 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 soil blowing.

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 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, 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 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 the depth to the water table is less than 1 foot. They 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, stones, or soluble salts, 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. 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 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 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 groundwater 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 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 water 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 soil blowing 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 soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

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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 classifications, 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. "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 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 (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

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 soil blowing in cultivated areas. The groups indicate the susceptibility of soil to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse 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 sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
- 4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.
4. Clays, silty clays, 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 soil blowing are used.
5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium

carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## 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 intake 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 and 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; November-May, for example, means that flooding can occur during the period November through May.

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 (30). 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.** Ten 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 *aquolls*, 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. Mostly 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. The soil is compared with similar soils and with nearby soils of other 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* (29). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (30). Unless otherwise stated, matrix 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."

## Ambraw Series

The Ambraw series consists of poorly drained soils on bottom land. These soils formed in loamy alluvium under native vegetation of prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Ambraw loam, rarely flooded, 0 to 2 percent slopes, in a cultivated field; 1,800 feet west and 170 feet north of the southeast corner of sec. 14, T. 76 N., R. 3 W.

Ap—0 to 9 inches; black (10YR 2/1) loam (about 20 percent clay), dark gray (10YR 4/1) dry; weak fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.

A—9 to 16 inches; very dark gray (10YR 3/1) loam (about 20 percent clay), grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on faces of peds; common fine distinct dark grayish brown (2.5Y 4/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

AB—16 to 24 inches; very dark grayish brown (10YR 3/2) loam (about 23 percent clay), grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; many fine and medium distinct dark grayish brown (2.5Y 4/2) and yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; slightly acid; clear wavy boundary.

Bg1—24 to 30 inches; mottled dark gray (10YR 4/1) and yellowish brown (10YR 5/6) loam (about 24 percent clay); very dark grayish brown (2.5Y 3/2) coatings on faces of peds; weak medium subangular blocky structure; friable; very few very fine roots; common very fine tubular pores; slightly acid; gradual wavy boundary.

Bg2—30 to 41 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) sandy clay loam (about 24 percent clay); dark gray (10YR 4/1) faces of peds; weak fine prismatic and subangular blocky structure; friable; very few very fine roots; common very fine tubular pores; few very dark grayish brown (2.5Y 3/2) root channel fillings; slightly acid; clear wavy boundary.

BCg—41 to 48 inches; dark gray (10YR 4/1) and gray (10YR 5/1) stratified loam and sandy loam (about 15 percent clay); common fine distinct yellowish

brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles; weak medium and fine prismatic structure; friable; common very fine tubular pores; slightly acid; clear wavy boundary.

Cg—48 to 60 inches; gray (10YR 5/1) stratified sand and loamy sand (about 6 percent clay); common fine and medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; very friable; very few fine relict roots; few very fine tubular pores; slightly acid.

The solum ranges from 40 to 60 inches in thickness. The mollic epipedon is 12 to 24 inches thick. Free carbonates are below a depth of 60 inches.

The A horizon is 12 to 24 inches thick. It has chroma of 1 or 2. It is loam or clay loam. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and dominantly chroma of 1 or 2. It has mottles or mottled colors of higher chroma. It is loam, clay loam, or sandy clay loam. The C horizon has colors like those of the Bg horizon, and has variable texture.

## Ankeny Series

The Ankeny series consists of well drained, moderately rapidly permeable soils on stream terraces. These soils formed in loamy and sandy alluvium under native vegetation of prairie grasses. Slopes range from 0 to 3 percent.

Typical pedon of Ankeny sandy loam, 0 to 3 percent slopes, in a cultivated field; 1,140 feet south and 1,230 feet east of the northwest corner of sec. 23, T. 77 N., R. 4 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam (about 12 percent clay), grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; few fine and very fine roots; common very fine pores; slightly acid; abrupt smooth boundary.

A1—9 to 16 inches; very dark brown (10YR 2/2) sandy loam (about 15 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

A2—16 to 26 inches; very dark grayish brown (10YR 3/2) sandy loam (about 15 percent clay), grayish brown (10YR 5/2) dry; weak very fine subangular blocky and granular structure; friable; few fine and very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

BA—26 to 32 inches; very dark grayish brown (10YR

3/2) and brown (10YR 4/3) sandy loam (about 18 percent clay); weak fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

Bw—32 to 41 inches; brown (10YR 4/3) sandy loam (about 16 percent clay); weak medium and fine subangular blocky structure; friable; common very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; gradual smooth boundary.

BC—41 to 47 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; few very fine tubular pores; slightly acid; gradual smooth boundary.

C—47 to 60 inches; pale brown (10YR 6/3) sand variegated with clean sand grain colors; single grained; loose; few ½-inch yellowish brown (10YR 5/4) iron lamellae; neutral.

The solum ranges from 40 to 60 inches in thickness. The depth to loamy sand or sand is 36 inches or more. Free carbonates are below a depth of 60 inches. The mollic epipedon ranges from 24 to 36 inches in thickness.

The A horizon is 24 to 36 inches thick. It has chroma of 1 or 2. The Bw horizon has value of 3 to 5 and chroma of 3 or 4. The C horizon is loamy sand or sand. It has layers or lamellae in which iron or clay and iron have accumulated.

### Atterberry Series

The Atterberry series consists of somewhat poorly drained, moderately permeable soils on upland ridgetops, side slopes, and head slopes. These soils formed in loess under native vegetation of mixed prairie grasses and deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Atterberry silt loam, 0 to 2 percent slopes, in a cultivated field; 1,425 feet west and 105 feet north of the center of sec. 8, T. 77 N., R. 1 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam (about 25 percent clay), grayish brown (10YR 5/2) dry; weak thin and very thin platy and granular structure; friable; very few very fine roots; very few very fine random pores; neutral; abrupt smooth boundary.

E—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam (about 25 percent clay), brown (10YR 5/3) dry; weak thin platy and fine granular structure; friable; few very fine roots; common fine and very fine and

few medium tubular pores; few very fine yellowish red (5YR 5/8) concretions (iron oxides); common very dark grayish brown (10YR 3/2) and few grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) worm casts; neutral; abrupt wavy boundary.

Bt1—12 to 17 inches; brown (10YR 5/3) silty clay loam (about 32 percent clay); very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on faces of peds; few fine prominent light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine and few medium tubular pores; common very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

Bt2—17 to 23 inches; light olive brown (2.5Y 5/4) silty clay loam (about 34 percent clay); many dark grayish brown (2.5Y 4/2) coatings on faces of peds; common fine faint light brownish gray (2.5Y 6/2) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; few thin clay films on faces of peds; few very fine roots; common fine and very fine and few medium tubular pores; common dark grayish brown (2.5Y 4/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

Bt3—23 to 28 inches; mottled light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) silty clay loam (about 32 percent clay); brown (10YR 5/3) coatings on faces of peds; common fine prominent reddish yellow (7.5YR 6/6) mottles; moderate fine and very fine subangular blocky structure; friable; few thin clay films on faces of peds; few very fine roots; common fine and very fine and few medium tubular pores; few dark grayish brown (2.5Y 4/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Btg—28 to 33 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 29 percent clay); few grayish brown (2.5Y 5/2) coatings on faces of peds; many fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BC—33 to 45 inches; mottled light brownish gray (2.5Y

6/2) and brownish yellow (10YR 6/6 and 6/8) silty clay loam (about 27 percent clay); few fine distinct reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky structure; friable; very few very fine roots; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Cg1—45 to 52 inches; mottled light gray (10YR 6/1) and brownish yellow (10YR 6/6 and 6/8) silt loam (about 24 percent clay); common fine distinct reddish yellow (7.5YR 6/8) mottles; massive; friable; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

2Cg2—52 to 60 inches; mottled brownish yellow (10YR 6/6) and gray (10YR 6/1) loam (about 26 percent clay); massive; friable; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid.

The solum ranges from 42 to 60 inches or more in thickness. Free carbonates, if any, are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 45 to more than 60 inches.

The Ap horizon is 7 to 9 inches thick. Value is 2 or 3, and chroma is 1 or 2. The E horizon is 4 to 8 inches thick, but is thinner than 4 inches where it has been truncated by deep tillage. It has value of 4 to 6 and chroma of 1 or 2. Some pedons have a BE horizon. The Bt horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It has mottles that have chroma of 1 to 8. It is 25 to 35 percent clay. Most pedons have a BC horizon. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 6. It has mottles that have redder hues and higher chromas.

## Bertrand Series

The Bertrand series consists of well drained soils on stream terraces. These soils formed in silty alluvium and the underlying sandy and loamy alluvium under native vegetation of deciduous trees. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 3 percent.

Typical pedon of Bertrand silt loam, 0 to 3 percent slopes, in a cultivated field; 230 feet east and 200 feet south of the northwest corner of sec. 13, T. 77 N., R. 4 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam (about 15 percent clay), light brownish gray

(10YR 6/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; medium acid; abrupt smooth boundary.

BE—10 to 16 inches; yellowish brown (10YR 5/4) silt loam (about 25 percent clay); weak fine and very fine angular blocky and subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.

Bt1—16 to 24 inches; yellowish brown (10YR 5/4) silty clay loam (about 33 percent clay); moderate fine and very fine subangular blocky structure; friable; many thin clay films on faces of peds; few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—24 to 31 inches; yellowish brown (10YR 5/4) silty clay loam (about 34 percent clay); moderate medium and fine subangular blocky structure; friable; many thin clay films on faces of peds; few very fine roots; common very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Bt3—31 to 40 inches; yellowish brown (10YR 5/4) silt loam high in sand (about 27 percent clay); common fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few thin clay films on faces of peds; common very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

2BC—40 to 48 inches; yellowish brown (10YR 5/4) loamy sand (about 10 percent clay); weak medium subangular blocky structure; very friable; few thin clay films bridging sand grains; medium acid; gradual wavy boundary.

2C—48 to 60 inches; light yellowish brown (10YR 6/4) and light gray (10YR 7/2) stratified sand and loamy sand; single grained; loose; medium acid.

The solum ranges from 43 to 60 inches or more in thickness. Free carbonates, if any, are below a depth of 60 inches. The depth to the underlying loamy sand or sand is 40 to 60 inches.

The Ap horizon is 6 to 10 inches thick. It has chroma of 2 or 3. Pedons that have not been cultivated have an A horizon that is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) and is 3 to 5 inches thick. They



also have an E horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silt loam. Some pedons have a BC horizon, and most pedons have a 2BC horizon. The 2C horizon is sand or loamy sand. It has hue of 10YR or 7.5YR, value of 4 to 8, and chroma of 2 to 8.

### Bolan Series

The Bolan series consists of well drained soils on stream terraces and uplands. These soils formed in wind- and water-sorted loamy and sandy sediments under native vegetation of prairie grasses. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 5 percent.

Typical pedon of Bolan loam, 0 to 2 percent slopes, in a cultivated field; 1,050 feet north and 40 feet west of the southeast corner of sec. 31, T. 76 N., R. 4 W.

- Ap—0 to 7 inches; very dark brown (10YR 2/2) loam (about 16 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.
- A—7 to 12 inches; very dark brown (10YR 2/2) loam (about 16 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common very fine tubular pores; neutral; clear smooth boundary.
- AB—12 to 18 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam (about 17 percent clay), brown (10YR 5/3) dry; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine granular and subangular blocky structure; friable; few very fine roots; common very fine tubular pores; common very dark brown (10YR 2/2) worm casts; neutral; clear smooth boundary.
- Bw1—18 to 22 inches; brown (10YR 4/3) loam (about 17 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; common very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) worm casts; slightly acid; clear wavy boundary.
- Bw2—22 to 27 inches; brown (10YR 4/3) loam (about 16 percent clay); dark brown (10YR 3/3) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few very

dark grayish brown (10YR 3/2) worm casts; slightly acid; clear wavy boundary.

- Bw3—27 to 33 inches; brown (10YR 4/3) sandy loam (about 13 percent clay); weak medium subangular blocky structure; friable; few very fine roots; common very fine tubular pores; slightly acid; clear wavy boundary.
- 2BC—33 to 45 inches; brown (10YR 4/3) loamy sand (about 5 percent clay); weak medium subangular blocky structure; very friable; common very fine tubular pores; slightly acid; clear wavy boundary.
- 2C—45 to 60 inches; yellowish brown (10YR 5/4) sand (about 1 percent clay); single grained; loose; slightly acid.

The solum ranges from 30 to 48 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon is 10 to 18 inches thick. It has value of 2 or 3. It is loam or silt loam. The Bw horizon has value and chroma of 3 to 6. It is loam or sandy loam and about 12 to 20 percent clay, by weight. The 2BC horizon has value of 4 or 5. It is sandy loam or loamy sand. The 2C horizon has value of 4 or 5 and chroma of 3 to 6. It is loamy sand or sand.

### Bremer Series

The Bremer series consists of poorly drained soils on stream terraces. These soils formed in silty over sandy alluvium under native vegetation of prairie grasses. Permeability is moderately slow in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field; 2,400 feet east and 91 feet south of the northwest corner of sec. 32, T. 77 N., R. 4 W.

- Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (about 33 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; few very fine random pores; neutral; clear smooth boundary.
- A—8 to 12 inches; black (10YR 2/1) silty clay loam (about 35 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few fine and common very fine tubular pores; few fine black (10YR 2/1) and dark reddish brown (5YR 3/2) concretions (iron and magnesium oxides); neutral; clear smooth boundary.

- AB—12 to 18 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay loam (about 35 percent clay), dark gray (10YR 4/1) dry; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine and very fine subangular blocky structure; firm; few fine and very fine roots; few very fine tubular pores; few black (10YR 2/1) and dark reddish brown (5YR 3/2) concretions (iron and magnesium oxides); neutral; clear smooth boundary.
- Btg1—18 to 22 inches; dark gray (N 4/0) and grayish brown (2.5Y 5/2) silty clay loam (about 40 percent clay); very dark gray (10YR 3/1) and dark gray (10YR 4/1) coatings on faces of peds; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine and very fine subangular blocky structure; firm; common faint clay films on faces of peds; few very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.
- Btg2—22 to 30 inches; gray (5Y 5/1) silty clay loam (about 40 percent clay); many fine prominent yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium and fine subangular blocky structure; firm; common faint clay films on faces of peds; few very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.
- Btg3—30 to 38 inches; gray (5Y 5/1) silty clay loam (about 37 percent clay); common fine prominent yellowish brown (10YR 5/4) mottles; moderate fine prismatic and subangular blocky structure; firm; few faint clay films on faces of peds; few very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; gradual wavy boundary.
- Btg4—38 to 46 inches; gray (5Y 5/1) silty clay loam (about 36 percent clay); common fine prominent yellowish brown (10YR 5/4) mottles; weak fine prismatic structure; friable; few faint clay films on faces of peds; few very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.
- BCg—46 to 54 inches; gray (5Y 5/1) loam (about 25 percent clay); few fine prominent yellowish brown (10YR 5/4) mottles; weak fine prismatic structure; friable; few very fine tubular pores; few fine black (10YR 2/1) concretions (iron and magnesium oxides); neutral; clear smooth boundary.
- Cg—54 to 60 inches; gray (10YR 5/1) stratified sand with loamy sand lenses (about 10 percent clay); few fine prominent yellowish brown (10YR 5/4) mottles;

single grained and massive; very friable; neutral.

The solum ranges from 40 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. Textures coarser than loam are at a depth of 40 to 60 inches. The mollic epipedon is 18 to 24 inches thick.

The A horizon is 18 to 24 inches thick. It has value of 2 or 3. It is silt loam or silty clay loam. Some pedons have an AB or BA horizon. The Btg horizon has hue of 10YR to 5Y. It has mottles of high and low chroma. It is about 35 to 40 percent clay, by weight. The BCg and Cg horizons have a color range like that of the Btg horizon.

### Caneek Series

The Caneek series consists of poorly drained, moderately permeable soils on bottom lands. These soils formed in 20 to 40 inches of calcareous, stratified, recent silty alluvium over a buried soil under native vegetation of water-tolerant trees and grasses. Slopes range from 0 to 2 percent.

Typical pedon of Caneek silt loam, 0 to 2 percent slopes, in a cultivated field; 2,500 feet east and 1,060 feet south of the northwest corner of sec. 12, T. 76 N., R. 3 W.

- Ap—0 to 7 inches; dark grayish brown (2.5Y 4/2) silt loam (about 24 percent clay), light brownish gray (2.5Y 6/2) dry; few fine faint light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) mottles; weak fine and very fine granular structure; friable; few very fine roots; few very fine tubular pores; very slight effervescence; mildly alkaline; abrupt smooth boundary.
- Cg1—7 to 11 inches; dark grayish brown (2.5Y 4/2) silt loam with a few thin very dark grayish brown (2.5Y 3/2) strata (about 24 percent clay); few very fine prominent brown (7.5YR 4/4) and few fine faint light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) mottles; weak medium platy fragments parting to fine and very fine granular structure; friable; very few very fine roots; common fine and very fine tubular pores; slight effervescence; mildly alkaline; abrupt smooth boundary.
- Cg2—11 to 31 inches; stratified grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) silt loam (about 20 percent clay); common very fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6), common fine faint light brownish gray (2.5Y 6/2), and few fine prominent dark brown (7.5YR 3/4) mottles; weak medium and thin platy fragments; friable; very few very fine roots; common

fine and very fine tubular pores; few thin very fine sand lenses; slight effervescence; mildly alkaline; clear smooth boundary.

2Ab—31 to 46 inches; black (10YR 2/1) silty clay loam (about 36 percent clay); moderate fine and very fine subangular blocky structure; friable; few very fine tubular pores; common grayish brown (2.5Y 5/2) worm casts and root channel fillings in the upper 6 inches; neutral; gradual wavy boundary.

2ABb—46 to 54 inches; black (10YR 2/1) silty clay loam (about 34 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; few very fine tubular pores; neutral; gradual wavy boundary.

2Bgb—54 to 60 inches; very dark gray (5Y 3/1) silty clay loam (about 34 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate medium and fine angular blocky and subangular blocky structure; friable; few very fine tubular pores; neutral.

Depth to the buried 2Ab horizon ranges from 20 to 40 inches. Free carbonates, if any, are in the A and C horizons, but not in the 2Ab horizon.

The Ap horizon is 7 to 10 inches thick, but in pedons that have not been disturbed it is 3 to 6 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. Where deposition has stopped, it has thin layers of very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) material. The C horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 1 or 2. It is silt loam, but some pedons have thin strata or lenses with coarser textures. The 2Ab and 2ABb horizons and, in some pedons, the 2BAB and 2Bb horizons have hue of 10YR to 5Y, value of 2 or 3, and chroma of 0 or 1. They are silty clay loam or silt loam. Some pedons do not have a 2BAB or 2Bb horizon.

### Caneek Variant

The Caneek Variant consists of somewhat poorly drained soils on alluvial fans below steep upland side slopes. These soils formed in recently deposited, calcareous, sandy alluvium over silty alluvium under native vegetation of trees and grasses. Permeability is rapid in the upper part of the profile and moderate in the lower part. Slopes range from 1 to 3 percent.

Typical pedon of Caneek Variant loamy sand, 1 to 3 percent slopes, in a cultivated field; 2,500 feet west and 680 feet south of the northeast corner of sec. 12, T. 76 N., R. 3 W.

Ap—0 to 9 inches; brown (10YR 4/3) loamy sand (about 5 percent clay), pale brown (10YR 6/3) dry; weak fine and very fine granular structure; very friable; few very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—9 to 31 inches; pale brown (10YR 6/3) stratified sand and loamy sand (about 3 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; few very fine roots; few thin grayish brown (2.5Y 5/2) silt bands; slight effervescence; mildly alkaline; clear smooth boundary.

C2—31 to 46 inches; dark grayish brown (2.5Y 4/2) and grayish brown (10YR 5/2) silt loam (about 14 percent clay); common fine distinct yellowish brown (10YR 5/6), light gray (10YR 6/1), and brown (7.5YR 4/4) mottles; massive; friable; few very fine tubular pores; few very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); mildly alkaline; gradual smooth boundary.

2Ab1—46 to 54 inches; very dark gray (10YR 3/1) silty clay loam (about 29 percent clay); common fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; common fine and very fine tubular pores; mildly alkaline; gradual smooth boundary.

2Ab2—54 to 60 inches; black (10YR 2/1) silty clay loam (about 30 percent clay); common fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; weak medium and fine subangular blocky structure; friable; common fine and very fine tubular pores; neutral.

Depth to the buried 2Ab horizon ranges from 40 to 60 inches.

The A horizon is 7 to 9 inches thick. It has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 2 or 3. Where no recent deposition has occurred, the horizon has thin layers of very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) material. The C horizon has value of 4 to 6 and chroma of 1 to 3. It typically is loamy sand or sand, but in many pedons the lower part is silt loam. The 2Ab horizon has hue of 10YR to 5Y and chroma of 0 or 1. It is silty clay loam, silt loam, clay loam, or loam.

### Canoe Series

The Canoe series consists of somewhat poorly

drained soils on stream terraces. These soils formed in silty over sandy alluvium under native vegetation of prairie grasses and trees. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Canoe silt loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field; 440 feet south and 125 feet east of the northwest corner of sec. 20, T. 78 N., R. 3 W.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam (about 24 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; few fine and very fine random pores; few dark grayish brown (10YR 4/2) worm casts; neutral; abrupt smooth boundary.
- E—9 to 17 inches; mottled grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) silt loam (about 24 percent clay); few very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on faces of peds; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium and thin platy structure; friable; few fine and very fine roots; common very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; neutral; clear smooth boundary.
- BE—17 to 21 inches; dark yellowish brown (10YR 4/4) silt loam (about 27 percent clay); dark brown (10YR 4/3) coatings on faces of peds; weak very fine subangular blocky structure; friable; few fine and very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; clear smooth boundary.
- Bt1—21 to 29 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky and granular structure; friable; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few fine and very fine roots; common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; gradual wavy boundary.
- Bt2—29 to 36 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few faint grayish brown (10YR 5/2) clay films on faces

of peds and in pores; few fine and very fine roots; common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; gradual wavy boundary.

- BC—36 to 46 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silt loam (about 26 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; friable; few thin grayish brown (10YR 5/2) clay films on faces of peds; few faint very dark grayish brown (10YR 3/2) clay films on pores and a few fillings in pores; common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; gradual wavy boundary.
- C—46 to 54 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silt loam (about 24 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few faint clay films in pores; common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear wavy boundary.
- 2C—54 to 60 inches; mottled yellowish brown (10YR 5/4) and gray (5Y 6/1) stratified sand and loamy sand (about 8 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; few thin sandy loam and loam layers; medium acid.

The solum ranges from 40 to 60 inches in thickness. The depth to the underlying loamy sand or sand is 48 to 60 inches. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 6 to 9 inches thick. It has chroma of 1 or 2. The E horizon is 8 to 12 inches thick. The Bt horizon is 14 to 21 inches thick. It has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 4. It is silt loam or silty clay loam. The BC and C horizons are silt loam or silty clay loam to a depth of 48 inches. Stratified sandy textures are below a depth of 48 inches.

### Chelsea Series

The Chelsea series consists of excessively drained, rapidly permeable soils on uplands and stream terraces. These soils formed in eolian sands or alluvial sands that have been reworked by wind under native vegetation of deciduous trees. Slopes range from 1 to 45 percent.

Typical pedon of Chelsea loamy fine sand, 1 to 5 percent slopes, in woodland; 2,500 feet north and 400 feet east of the southwest corner of sec. 13, T. 77 N., R. 4 W.

- A1—0 to 4 inches; very dark gray (10YR 3/1) loamy fine sand (about 85 percent sand), grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common very fine roots; slightly acid; clear smooth boundary.
- A2—4 to 6 inches; dark brown (10YR 3/3) and brown (10YR 4/3) loamy fine sand (about 85 percent sand); weak medium platy structure; very friable; common very fine roots; slightly acid; clear smooth boundary.
- E1—6 to 12 inches; dark yellowish brown (10YR 4/4) fine sand (about 90 percent sand); weak very thick platy structure; very friable; common very fine roots; slightly acid; gradual smooth boundary.
- E2—12 to 23 inches; dark yellowish brown (10YR 4/4) fine sand (about 95 percent sand); single grained; loose; few very fine roots; medium acid; gradual smooth boundary.
- E3—23 to 45 inches; yellowish brown (10YR 5/4) fine sand (about 95 percent sand); single grained; loose; medium acid; gradual smooth boundary.
- E&Bt—45 to 60 inches; light yellowish brown (10YR 6/4) and pale brown (10YR 6/3) fine sand (E) (about 95 percent sand); single grained; loose; few brown (7.5YR 4/4) sandy loam layers (Bt) less than ½ inch thick above 52 inches and ⅛ to ½ inch thick below 52 inches; medium acid.

The solum is more than 60 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon has value of 3 or 4 and chroma of 1 to 3. It is loamy fine sand or fine sand. The E horizon and the E part of the E&Bt horizon have value of 4 to 6 and chroma of 3 to 6. The Bt part of the E&Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 3 or 4. It is sandy loam or loamy sand and typically is in thicker layers with increasing depth. The upper layer of the Bt part in the E&Bt horizon is at a depth of 30 to 46 inches. The total thickness of the Bt layer above a depth of 60 inches is less than 6 inches.

### Coland Series

The Coland series consists of poorly drained, moderately permeable soils on bottom lands and the lower parts of upland drainageways. These soils formed in loamy alluvium under native vegetation of prairie

grasses. Slopes range from 0 to 5 percent.

Typical pedon of Coland clay loam, rarely flooded, 0 to 2 percent slopes, in a cultivated field; 2,500 feet north and 2,525 feet west of the southeast corner of sec. 13, T. 76 N., R. 3 W.

- Ap—0 to 8 inches; black (10YR 2/1) clay loam (about 32 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.
- A1—8 to 16 inches; black (N 2/0) clay loam (about 30 percent clay), very dark gray (10YR 3/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.
- A2—16 to 28 inches; black (10YR 2/1) clay loam (about 30 percent clay), dark gray (10YR 4/1) dry; common fine prominent reddish brown (5YR 4/4) and few fine distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.
- Bw—28 to 39 inches; very dark gray (10YR 3/1) clay loam (about 30 percent clay), gray (10YR 5/1) dry; few black (10YR 2/1) coatings on faces of peds; common fine prominent reddish brown (5YR 4/4), distinct yellowish brown (10YR 5/6), and common medium distinct gray (10YR 6/1) and light yellowish brown (2.5Y 6/4) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; clear wavy boundary.
- BCg—39 to 46 inches; gray (5Y 5/1) and dark gray (5Y 4/1) clay loam (about 30 percent clay); few black (10YR 2/1) and very dark gray (10YR 3/1) coatings on faces of peds; common fine prominent yellowish brown (10YR 5/6) and medium faint gray (5Y 6/1) mottles; weak medium subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.
- Cg1—46 to 52 inches; gray (5Y 5/1) loam (about 25 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; common very fine tubular pores; neutral; clear wavy boundary.
- Cg2—52 to 60 inches; gray (5Y 5/1) and dark gray (5Y 4/1) sandy loam (about 12 percent clay); common fine prominent yellowish brown (10YR 5/6) and

strong brown (7.5YR 5/6) and faint gray (5Y 6/1) mottles; massive; very friable; few very fine tubular pores; strongly acid.

The solum ranges from 36 to 48 inches in thickness. Free carbonates are below a depth of 60 inches. The mollic epipedon is 36 inches thick or more.

The A horizon is 26 to 36 inches thick. It is neutral or has hue of 10YR and value of 2 or 3. It is silty clay loam that has a moderate content of sand or clay loam, but in some pedons the upper part is loam. Some pedons have an AC horizon. The Bw horizon is as much as 14 inches thick but is not in all pedons. It has value of 2 or 3. The Cg horizon has hue of 2.5Y or 5Y and value of 2 to 5. It is clay loam or loam in the upper part but ranges from silty clay loam to sandy loam below a depth of 48 inches.

### Colo Series

The Colo series consists of poorly drained, moderately permeable soils on silty bottom land and the lower parts of upland drainageways. These soils formed in alluvium under native vegetation of prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Colo silty clay loam, rarely flooded, 0 to 2 percent slopes, in a cultivated field; 1,200 feet west and 870 feet south of the northeast corner of sec. 31, T. 76 N., R. 3 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam (about 29 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; clear smooth boundary.

A1—9 to 16 inches; black (10YR 2/1) silty clay loam (about 29 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky and granular structure; friable; common very fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.

A2—16 to 25 inches; black (10YR 2/1) silty clay loam (about 32 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine subangular blocky structure; firm; few very fine roots concentrated along faces of peds; common fine and very fine tubular pores; neutral; gradual smooth boundary.

AB—25 to 34 inches; black (10YR 2/1) silty clay loam (about 32 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine subangular and angular blocky structure; firm; few very fine roots concentrated along faces of peds and in pores;

common fine and very fine tubular pores; neutral; gradual smooth boundary.

Bg—34 to 44 inches; very dark gray (10YR 3/1) silty clay loam (about 34 percent clay), gray (10YR 5/1) dry; very few fine prominent light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) mottles; weak fine prismatic and angular blocky structure; friable; very few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; neutral; gradual smooth boundary.

BCg—44 to 50 inches; gray (10YR 5/1) silty clay loam (about 33 percent clay); few very dark gray (10YR 3/1) and dark gray (10YR 4/1) coatings on faces of peds; common fine faint light brownish gray (2.5Y 6/2) and prominent yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8) mottles; weak fine prismatic structure; friable; common fine and very fine tubular pores; few very dark gray (10YR 3/1) and dark gray (10YR 4/1) pore fillings; neutral; clear irregular boundary.

Cg—50 to 60 inches; light olive gray (5Y 6/2) silty clay loam (about 31 percent clay); common fine and medium prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; weak medium prismatic structure; friable; few fine and very fine relict roots in pores; common fine and very fine tubular pores; few dark gray (10YR 4/1) and gray (10YR 5/1) medium and fine pore fillings; neutral.

The solum ranges from 36 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 36 inches thick or more.

The A horizon is 30 to 36 inches thick. It is neutral or has hue of 10YR and chroma of 0 or 1. Some pedons have an AB or a BA horizon. Most pedons have a Bg horizon that is as much as 14 inches thick. It has value of 2 or 3. Some pedons do not have a Bg horizon but have an ACg horizon. The Cg horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. Textures below a depth of 48 inches are variable, range from silty clay loam to sandy loam, and in some pedons are stratified.

### Coppock Series

The Coppock series consists of poorly drained soils on stream terraces. These soils formed in silty over sandy alluvium under native vegetation of prairie grasses and forest. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Coppock silt loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field; 1,520 feet west and 1,960 feet north of the southeast corner of sec. 1, T. 76 N., R. 4 W.

- Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam (about 24 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; clear smooth boundary.
- E1—9 to 13 inches; dark gray (10YR 4/1) silt loam (about 22 percent clay); weak medium and thin platy structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.
- E2—13 to 18 inches; gray (10YR 5/1) silt loam (about 22 percent clay); weak medium and thin platy structure; friable; few very fine roots; common fine and very fine tubular pores; common dark gray (10YR 4/1) and gray (10YR 5/1) worm casts; slightly acid; clear smooth boundary.
- E3—18 to 23 inches; gray (10YR 5/1) silt loam (about 25 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure parting to weak fine and very fine subangular blocky; friable; few white (10YR 8/1) dry silt coatings on faces of peds; few very fine roots; common fine and very fine tubular pores; medium acid; clear smooth boundary.
- Btg1—23 to 29 inches; grayish brown (2.5Y 5/2) silty clay loam (about 30 percent clay); many fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; common faint gray (5Y 5/1) clay films on faces of peds; common white (10YR 8/1) dry silt coats; very few very fine roots; common fine and very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear wavy boundary.
- Btg2—29 to 38 inches; grayish brown (2.5Y 5/2) silty clay loam (about 34 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; friable; few faint gray (5Y 5/1) clay films on faces of peds and very dark gray (10YR 3/1) clay films in pores; few white (10YR 8/1) dry silt coats; very few very fine roots; common fine and very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and

manganese oxides); medium acid; gradual wavy boundary.

- BCg—38 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 30 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; weak medium prismatic and subangular blocky structure; friable; few faint very dark gray (10YR 3/1) clay films in pores; common fine and very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual wavy boundary.
- Cg—46 to 58 inches; light brownish gray (2.5Y 6/2) silt loam (about 25 percent clay); common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; few fine and common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; clear wavy boundary.
- 2C—58 to 72 inches; light gray (5Y 6/1), brown (10YR 5/3), and yellowish brown (10YR 5/4) stratified sand and loamy sand (about 5 percent clay); single grained; loose; neutral.

The solum ranges from about 40 to more than 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The depth to stratified sandy and loamy textures is more than 48 inches.

The A horizon is 7 to 10 inches thick. It has chroma of 1 or 2. The E horizon is 14 to 24 inches thick. It has value of 4 to 6 and chroma of 1 or 2. The Btg horizon is 10 to 16 inches thick. It has value of 5 or 6 and chroma of 1 or 2. The BCg and Cg horizons are silty clay loam or silt loam. The 2C horizon is sand or loamy sand that in some pedons has thin strata of loam, sandy loam, or silt loam.

### Dickinson Series

The Dickinson series consists of somewhat excessively drained, moderately rapidly permeable soils on stream terraces and on uplands. These soils formed in wind- and water-sorted, loamy and sandy sediments under native vegetation of prairie grasses. Slopes range from 0 to 9 percent.

Typical pedon of Dickinson fine sandy loam, 0 to 2 percent slopes, in a cultivated field; 1,350 feet north and 390 feet west of the southeast corner of sec. 31, T. 76 N., R. 4 W.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) fine sandy loam (about 10 percent clay), dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.
- A1—8 to 14 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) fine sandy loam (about 11 percent clay), grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.
- A2—14 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam (about 11 percent clay), grayish brown (10YR 5/2) dry; weak fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.
- Bw1—20 to 27 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) fine sandy loam (about 12 percent clay), brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; slightly acid; clear wavy boundary.
- Bw2—27 to 32 inches; brown (10YR 4/3) fine sandy loam (about 13 percent clay); dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; common very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; clear wavy boundary.
- Bw3—32 to 38 inches; brown (10YR 4/3) sandy loam (about 10 percent clay); dark brown (10YR 3/3) coatings on faces of peds; weak medium subangular blocky structure; very friable; common very fine tubular pores; few dark brown (10YR 3/3) worm casts and pore fillings; slightly acid; clear wavy boundary.
- BC—38 to 43 inches; brown (10YR 4/3) loamy sand (about 7 percent clay); weak coarse subangular blocky structure; very friable; few very fine tubular pores; slightly acid; clear wavy boundary.
- C—43 to 60 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) sand (about 96 percent sand); single grained; loose; slightly acid.

The solum ranges from 30 to 50 inches in thickness. Free carbonates, if any, are below a depth of 60 inches.

The depth to loamy sand or sand ranges from 24 to 42 inches.

The A horizon is 12 to 24 inches thick. It has chroma of 2 or 3. It is fine sandy loam, sandy loam, or loam and has a clay content of 10 to 15 percent. The Bw horizon has value of 3 to 5 and chroma of 2 to 6. It is sandy loam or fine sandy loam. The BC and C horizons have value of 4 to 6 and chroma of 3 to 6. They are loamy sand, loamy fine sand, or sand.

## Dolbee Series

The Dolbee series consists of poorly drained soils on stream terraces and high bottom land. These soils formed in silty over sandy alluvium under native vegetation of wetland prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Dolbee silt loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field; 490 feet west and 140 feet south of the northeast corner of sec. 20, T. 78 N., R. 3 W.

- Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam (about 26 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.
- A—9 to 16 inches; very dark gray (10YR 3/1) silty clay loam (about 32 percent clay), gray (10YR 5/1) dry; moderate fine and very fine angular blocky and granular structure; friable; few very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.
- BA—16 to 21 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay loam (about 32 percent clay); common fine distinct olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) mottles; weak fine prismatic and moderate fine and very fine subangular blocky structure; friable; many faint very dark gray (10YR 3/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; slightly acid; clear wavy boundary.
- Btg1—21 to 27 inches; dark gray (5Y 4/1) silty clay loam (about 34 percent clay); common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine prismatic and subangular blocky structure; friable; many faint very dark gray (10YR 3/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; slightly acid; gradual wavy boundary.
- Btg2—27 to 35 inches; gray (5Y 5/1) silty clay loam



(about 32 percent clay); common fine distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; common faint dark gray (5Y 4/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; slightly acid; gradual wavy boundary.

Btg3—35 to 42 inches; gray (5Y 5/1) silty clay loam (about 28 percent clay); common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic and subangular blocky structure; friable; few faint dark gray (5Y 4/1) clay films on faces of peds and in pores; few very fine roots; common very fine simple tubular pores; slightly acid; gradual wavy boundary.

BCg—42 to 52 inches; gray (5Y 5/1) silt loam (about 20 percent clay); common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; few very fine roots; few very fine tubular pores; few fine black concretions (iron and manganese oxides); slightly acid; clear wavy boundary.

2C—52 to 60 inches; gray (5Y 5/1) and light gray (5Y 6/1) sand (about 90 percent sand); few fine prominent yellowish brown (10YR 5/6) mottles; single grained; loose; neutral.

Solum thickness and depth to sandy textures range from 48 to 60 inches. Free carbonates, if any, are below a depth of 60 inches. The solum is silt loam or silty clay loam and 10 to 25 percent sand, by volume. The mollic epipedon is 14 to 24 inches thick.

The A horizon is 14 to 20 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons have an AB horizon. The Btg horizon has hue of 10YR to 5Y and chroma of 1 or 2. The C horizon has colors like those of the Bg horizon, except value ranges from 4 to 6. It is loamy sand or sand, but in some pedons it contains strata of finer textures.

## Douds Series

The Douds series consists of moderately well drained, moderately permeable soils on side slopes on uplands and high terraces. These soils formed in stratified loamy alluvium under native vegetation of deciduous trees. Slopes range from 18 to 40 percent.

These soils are taxadjuncts to the Douds series because they have more sand in the Bt horizon and more silt in the BC and C horizons than is definitive for the Douds series.

Typical pedon of Douds silt loam, in an area of

Lindley-Douds-Orwood silt loams, 18 to 40 percent slopes, in a pasture; 1,940 feet south and 515 feet east of the northwest corner of sec. 11, T. 78 N., R. 2 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam (about 20 percent clay), grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; weak thin platy and fine angular blocky structure; friable; common very fine roots; few very fine tubular pores; slightly acid; clear smooth boundary.

E—3 to 7 inches; brown (10YR 5/3) and dark grayish brown (10YR 4/2) silt loam (about 20 percent clay); weak medium and thin platy structure; friable; few very fine roots; few very fine tubular pores; slightly acid; abrupt smooth boundary.

Bt1—7 to 13 inches; dark yellowish brown (10YR 4/4) loam (about 26 percent clay); weak fine and very fine subangular blocky structure; friable; few thin clay films on faces of peds; few very fine roots; few very fine tubular pores; few dark grayish brown (10YR 4/2) worm casts and pore fillings; few pebbles; strongly acid; clear smooth boundary.

Bt2—13 to 30 inches; dark yellowish brown (10YR 4/4) stratified loamy sand and sand (about 10 percent clay); weak medium subangular blocky structure; very friable; few faint clay films bridging sand grains; few very fine roots; about 10 percent gravel; strongly acid; abrupt smooth boundary.

BC—30 to 46 inches; mottled yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) stratified silty clay loam with a few loam and sandy loam bands (about 30 percent clay); common fine prominent reddish brown (5YR 5/4) and yellowish red (5YR 5/6) mottles; brown (7.5YR 4/4) in upper 3 inches with a dark reddish brown (5YR 3/2) band at top; weak medium subangular blocky structure; friable; few very fine roots; few very fine tubular pores; medium acid; gradual smooth boundary.

C—46 to 60 inches; mottled yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) silt loam (about 26 percent clay); massive; friable; very few very fine roots; very few very fine tubular pores; medium acid.

The solum ranges from 36 to 60 inches or more in thickness. Free carbonates, if any, are below a depth of 60 inches. Mottles or mottled colors with chroma of 2 are below a depth of 30 inches.

The A horizon is 2 to 5 inches thick. In cultivated areas the Ap horizon is 6 to 9 inches thick. The A or Ap horizon has value of 3 to 5 and chroma of 2 or 3 and is

silt loam or loam. The A or Ap horizon is silt loam or loam. The E horizon is 3 to 6 inches thick, but in cultivated areas it is incorporated into the Ap horizon. Some pedons have a BE horizon. The Bt horizon has chroma of 4 to 8. It is loam or sandy loam, but in many pedons contains strata of coarser textures. Textures are stratified and variable in the BC and C horizons. The C horizon has value of 4 to 6 and chroma of 2 to 6.

## Downs Series

The Downs series consists of well drained, moderately permeable soils on upland ridges and side slopes and on high terraces. These soils formed in loess under native vegetation of mixed prairie grasses and deciduous trees. Slopes range from 2 to 14 percent.

Typical pedon of Downs silt loam, 2 to 5 percent slopes, in a cultivated field; 1,220 feet north and 635 feet west of the southeast corner of sec. 33, T. 76 N., R. 3 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam (about 19 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.

E—9 to 12 inches; brown (10YR 5/3) and dark grayish brown (10YR 4/2) silt loam (about 22 percent clay); weak medium and thin platy structure; friable; few very fine roots; few very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; medium acid; abrupt smooth boundary.

BE—12 to 18 inches; yellowish brown (10YR 5/4) silt loam (about 26 percent clay); brown (10YR 4/3) faces of peds; weak fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few very fine roots; common very fine tubular pores; few very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) worm casts; medium acid; clear smooth boundary.

Bt1—18 to 25 inches; yellowish brown (10YR 5/4) silty clay loam (about 31 percent clay); few very fine distinct strong brown (7.5YR 5/8) mottles; moderate fine and very fine subangular blocky structure; friable; many faint clay films on faces of peds; few light gray (10YR 7/1) dry silt coats; few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

Bt2—25 to 34 inches; yellowish brown (10YR 5/4) silty

clay loam (about 34 percent clay); common very fine and fine distinct strong brown (7.5YR 5/8) mottles; moderate medium and fine subangular blocky structure; friable; common faint clay films on faces of peds; common white (10YR 8/1) dry silt coats; few very fine roots; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

Bt3—34 to 40 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); common fine and medium distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6 and 5/8) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of peds; common white (10YR 8/1) dry silt coats; few very fine roots; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

Bt4—40 to 52 inches; yellowish brown (10YR 5/4) silty clay loam (about 31 percent clay); many fine and medium common fine and medium distinct strong brown (7.5YR 5/6 and 5/8) mottles; common fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine prismatic structure; friable; few faint clay films on faces of peds and few moderately thick very dark grayish brown (10YR 3/2) clay films in pores; few white (10YR 8/1) dry silt coats; very few very fine roots; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BC—52 to 60 inches; mottled yellowish brown (10YR 5/4 and 5/6) and light brownish gray (2.5Y 6/2) silt loam (about 26 percent clay); few fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure; friable; few distinct very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) clay films in pores; very few very fine roots; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid.

The solum ranges from 42 to more than 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 40 to more than 60 inches.

The A horizon is 6 to 9 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The E horizon is as much as 6 inches thick, but in many pedons it has been incorporated into the Ap horizon. The E horizon has value of 4 or 5 and chroma of 2 or 3. Most pedons have

a BE horizon, but some that are eroded do not. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is 27 to 35 percent clay, by weight. Some pedons have a C horizon that has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 8. The mottles and mottled colors were caused by a relict weathering zone in the loess and not by present drainage.

Map units 162C3 and 162D3 are taxadjuncts because the Ap horizon has more clay and is lighter colored than is defined for this series.

### Elrick Series

The Elrick series consists of well drained soils on bottom lands. These soils formed in loamy and sandy alluvium under native vegetation of prairie grasses. Permeability is moderately rapid in the solum and very rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Elrick sandy loam, 0 to 2 percent slopes, in a cultivated field; 150 feet east and 1,450 feet north of the southwest corner of sec. 28, T. 76 N., R. 2 W.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common fine and very fine roots; neutral; abrupt smooth boundary.
- A—8 to 13 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common fine and very fine roots; slightly acid; clear wavy boundary.
- Bw1—13 to 18 inches; brown (7.5YR 4/4) sandy loam; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; common fine and very fine roots; strongly acid; clear wavy boundary.
- Bw2—18 to 25 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; common very fine roots; strongly acid; clear wavy boundary.
- C1—25 to 31 inches; brown (7.5YR 4/4) loamy sand; single grained; loose; few very fine roots; 3 percent gravel; medium acid; clear wavy boundary.
- C2—31 to 40 inches; brown (7.5YR 4/4) sand; many medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; 4 percent gravel; slightly acid; gradual wavy boundary.
- C3—40 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; 5 percent gravel; neutral.

The solum ranges from about 20 to 40 inches in thickness. The depth to sand ranges from 24 to 36 inches. Free carbonates, if any, are below a depth of 60 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is sandy loam or loam. The Bw horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. Gravel content of the C horizon is 0 to 5 percent.

### Elrin Series

The Elrin series consists of somewhat poorly drained soils on stream terraces. These soils formed in loamy alluvium and in the underlying sandy alluvium under native vegetation of prairie grasses. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

These soils are taxadjuncts to the Elrin series because they have less sand that is coarser than very fine sand in the A and Bw horizons than is definitive for the Elrin series.

Typical pedon of Elrin loam, 0 to 2 percent slopes, in a cultivated field; 595 feet south and 125 feet east of the northwest corner of sec. 34, T. 77 N., R. 4 W.

- Ap—0 to 8 inches; black (10YR 2/1) loam (about 12 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few fine and very fine random pores; slightly acid; abrupt smooth boundary.
- A—8 to 17 inches; black (10YR 2/1) loam (about 14 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; common very fine tubular pores; slightly acid; gradual smooth boundary.
- AB—17 to 23 inches; very dark gray (10YR 3/1) and very dark grayish brown (2.5Y 3/2) loam (about 15 percent clay), grayish brown (2.5Y 5/2) dry; weak fine and very fine subangular blocky and granular structure; friable; few very fine roots; common very fine tubular pores; few black (10YR 2/1) worm casts and pore fillings; slightly acid; clear smooth boundary.
- Bw1—23 to 30 inches; dark grayish brown (2.5Y 4/2) loam (about 15 percent clay); very dark grayish brown (2.5Y 3/2) faces of peds; weak fine and very fine subangular blocky structure; friable; very few very fine roots; common very fine tubular pores; common very dark gray (10YR 3/1) and very dark

grayish brown (2.5Y 3/2) worm casts and pore fillings; slightly acid; clear smooth boundary.

Bw2—30 to 35 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) loam (about 14 percent clay); faces of some peds very dark grayish brown (10YR 3/2); weak medium and fine subangular blocky structure; friable; common very fine tubular pores; few very dark grayish brown (2.5Y 3/2) worm casts and pore fillings; slightly acid; clear smooth boundary.

BC—35 to 48 inches; brown (10YR 5/3) fine sand; weak medium subangular blocky structure; loose; few dark grayish brown (2.5Y 4/2) pore fillings in upper part; neutral; clear wavy boundary.

C—48 to 60 inches; pale brown (10YR 6/3) sand; single grained; loose; neutral.

The solum ranges from 48 to more than 60 inches in thickness. The depth to sandy sediments is 24 to 40 inches. The mollic epipedon is 14 to 24 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 12 to 20 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam that has a high sand content. Most pedons have an AB horizon. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. Pedons that have chroma of 3 or 4 also have mottles that have chroma of 2 in the Bw horizon. This horizon is loam in the upper part and loam or sandy loam in the lower part. Most pedons have a BC horizon. The C horizon has chroma of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is sand, coarse sand, or fine sand.

## Elvers Series

The Elvers series consists of very poorly drained, moderately permeable soils on bottom lands. These soils formed in 16 to 40 inches of silty alluvium and the underlying organic material under native vegetation of marsh. Slopes range from 0 to 1 percent.

These soils are taxadjuncts to the Elvers series because the clay content of the profile is more than is definitive for the Elvers series.

Typical pedon of Elvers silt loam, 0 to 1 percent slopes, in a cultivated field; 2,390 feet north of the center of sec. 24, T. 76 N., R. 3 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silt loam (about 26 percent clay), light gray (10YR 6/1) and gray (10YR 5/1) dry; common fine distinct brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) mottles; weak fine

granular structure; friable; few very fine roots; few very fine random pores; mildly alkaline; clear smooth boundary.

Cg1—7 to 13 inches; dark gray (5Y 4/1) silt loam (about 26 percent clay); common fine prominent reddish brown (5YR 4/4 and 5/4) mottles; massive with weak horizontal parting; friable; few very fine roots; few very fine tubular pores; mildly alkaline; gradual smooth boundary.

Cg2—13 to 21 inches; dark gray (5Y 4/1) silt loam (about 25 percent clay); common fine prominent reddish brown (5YR 4/4 and 5/4) mottles; massive with horizontal parting; friable; few very fine roots; few very fine tubular pores; mildly alkaline; gradual smooth boundary.

Cg3—21 to 40 inches; dark gray (5Y 4/1) silt loam (about 20 percent clay); common fine prominent reddish brown (5YR 4/4 and 5/4) mottles; massive with horizontal parting; friable; few very fine roots; few very fine tubular pores; mildly alkaline; clear wavy boundary.

Oa—40 to 60 inches; black (10YR 2/1) broken faced and rubbed sapric material, about 10 percent herbaceous fiber, less than 5 percent rubbed; initial exposure color very dark gray (10YR 3/1); massive; slightly sticky (wet); mildly alkaline.

The silty layer is 16 to 40 inches thick. The underlying organic material is at least 20 inches thick.

The A horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. The Cg horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. The Oa horizon has varying amounts of herbaceous fiber, and some pedons have an Oe horizon.

## Exette Series

The Exette series consists of well drained, moderately permeable soils on side slopes and concave head slopes on uplands. These soils formed in loess under native vegetation of deciduous trees. Slopes range from 14 to 25 percent.

Typical pedon of Exette silty clay loam, 14 to 18 percent slopes, severely eroded, in a cultivated field; 1,600 feet north and 175 feet west of the southeast corner of sec. 1, T. 77 N., R. 1 W.

Ap—0 to 7 inches; brown (10YR 4/3 and 5/3) silty clay loam (about 30 percent clay), very pale brown (10YR 7/3) dry; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) mottles in streaks and pockets of subsoil material; weak fine and very fine

- granular structure; friable; common very fine roots; few very fine random pores; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.
- Bw1—7 to 14 inches; brown (10YR 5/3) silty clay loam (about 28 percent clay); many fine distinct light brownish gray (2.5Y 6/2) and common fine distinct strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) mottles; weak very fine subangular blocky structure; friable; few very fine roots concentrated in pores and along faces of peds; common very fine tubular pores; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.
- Bw2—14 to 23 inches; yellowish brown (10YR 5/4) silt loam (about 26 percent clay); many fine distinct light brownish gray and common fine distinct reddish brown (5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots concentrated in pores and along faces of peds; common very fine tubular pores; few dark grayish brown (10YR 4/2) and brown (10YR 4/3) worm casts and coatings in root channels; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; gradual wavy boundary.
- BC—23 to 35 inches; yellowish brown (10YR 5/4) silt loam (about 24 percent clay); many fine distinct light brownish gray (2.5Y 6/2) and few fine distinct reddish brown (5YR 4/4) and common fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure; friable; few very fine roots concentrated in pores; common very fine tubular pores; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; gradual wavy boundary.
- C1—35 to 42 inches; yellowish brown (10YR 5/4) silt loam (about 22 percent clay); common fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) and few fine distinct yellowish red (5YR 5/6) mottles; massive with horizontal cleavage; friable; few thin clay films in pores; very few very fine roots concentrated in pores; common very fine tubular pores; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; diffuse wavy boundary.
- C2—42 to 60 inches; light brownish gray (2.5Y 6/2) silt loam (about 18 percent clay); common fine distinct yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) mottles; massive; friable; very few very fine roots concentrated in pores; few very fine tubular pores; mildly alkaline.
- The solum ranges from 30 to 50 inches in thickness. Free carbonates are below a depth of 40 inches. The depth to glacial till or stratified coarse textures ranges from 40 to 60 inches or more. Most pedons have high and low chroma mottles or mottled colors within a depth of 10 inches. The mottles are relict and are not related to present drainage.
- The A horizon is 6 to 9 inches thick. It has value of 4 or 5 and chroma of 2 to 4. Some pedons have an E horizon that is 4 to 6 inches thick in uncultivated areas, but in cultivated areas this horizon has been incorporated into the Ap horizon. Uneroded pedons have a BE horizon. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8. In many pedons it is mottled with these colors and also has mottles that have hue of 7.5YR or 5YR. It is 22 to 29 percent clay, by weight. The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8 and is mottled.

### Fayette Series

The Fayette series consists of well drained, moderately permeable soils on upland ridges and side slopes and on high terraces. These soils formed in loess under native vegetation of deciduous trees. Slopes range from 2 to 40 percent.

Typical pedon of Fayette silt loam, 2 to 5 percent slopes, in a cultivated field; 2,400 feet east and 385 feet north of the southwest corner of sec. 34, T. 76 N., R. 3 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam (about 22 percent clay), light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine pores; few brown (10YR 5/3) worm casts; neutral; abrupt smooth boundary.

E—8 to 12 inches; yellowish brown (10YR 5/4) silt loam (about 22 percent clay); weak medium and thin platy structure; friable; few light brownish gray (10YR 6/2) silt coats on plates; few very fine roots; common fine and very fine tubular pores; few dark grayish brown (10YR 4/2) worm casts; few very fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.

BE—12 to 17 inches; yellowish brown (10YR 5/4) silty clay loam (about 28 percent clay); moderate fine and very fine subangular blocky structure; friable;

few light gray (10YR 7/1) dry silt coats; few very fine roots; common fine and very fine tubular pores; few dark grayish brown (10YR 4/2) worm casts; few very fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt1—17 to 23 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); strong fine and very fine subangular blocky structure; firm; many thin clay films on faces of peds; few light gray (10YR 7/1) dry silt coats; few very fine roots concentrated along faces of peds; common fine and very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—23 to 29 inches; yellowish brown (10YR 5/4) silty clay loam (about 34 percent clay); moderate very fine prismatic and subangular blocky structure; firm; many thin clay films on faces of peds; few light gray (10YR 7/1) dry silt coats; few very fine roots concentrated along faces of peds; common very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

Bt3—29 to 38 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); moderate fine prismatic and subangular blocky structure; firm; common faint clay films on faces of peds and in pores; few light gray (10YR 7/1) dry silt coats; few very fine roots concentrated along faces of peds; common very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BC—38 to 48 inches; yellowish brown (10YR 5/4) silty clay loam (about 28 percent clay); common fine distinct light brownish gray (2.5Y 6/2) and few fine faint strong brown (7.5YR 5/6) mottles; weak fine prismatic structure; friable; few faint clay films on faces of peds and in pores; few very fine roots concentrated along faces of peds and in pores; common very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) silt loam (about 24 percent clay); common fine distinct light brownish gray (2.5Y 6/2) and many fine distinct yellowish brown (10YR 5/6 and 5/8) and strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; few faint clay films in pores; common very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid.

The solum ranges from 40 to 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 40 to more than 60 inches.

The A horizon is 1 to 4 inches thick. It has value of 3 and chroma of 1 or 2. The Ap horizon is 6 to 9 inches thick. It has value of 4 and chroma of 2 or 3. In uncultivated areas the E horizon is 4 to 10 inches thick, but in many cultivated areas it has been incorporated into the Ap horizon. The E horizon has value of 4 or 5 and chroma of 2 to 4. Some pedons that are eroded do not have a BE horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It has no low chroma mottles in the upper part. It is 27 to 35 percent clay, by weight. The C horizon has value of 4 or 5. It has low chroma mottles and mottled colors because of a relict weathering zone in the loess and not because of present drainage.

### Fruitfield Series

The Fruitfield series consists of excessively drained, very rapidly permeable soils on high bottom lands. These soils formed in sandy alluvium under native vegetation of prairie grasses. Slopes are 0 to 5 percent.

Typical pedon of Fruitfield coarse sand, 0 to 2 percent slopes, in a cultivated field; 2,515 feet south and 880 feet east of the northwest corner of sec. 29, T. 76 N., R. 2 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) coarse sand (about 93 percent sand), dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; about 1 percent fine gravel; slightly acid; clear smooth boundary.

A1—8 to 18 inches; very dark brown (10YR 2/2) coarse sand (about 93 percent sand), dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; about 1 percent fine gravel; slightly acid; gradual smooth boundary.

A2—18 to 27 inches; very dark grayish brown (10YR 3/2) coarse sand (about 94 percent sand), grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; about 2 percent fine gravel; medium acid; gradual smooth boundary.

AC—27 to 36 inches; dark brown (10YR 3/3) coarse sand (about 95 percent sand), brown (10YR 5/3) dry; single grained; loose; about 2 percent fine gravel; medium acid; gradual smooth boundary.

C1—36 to 42 inches; brown (10YR 4/3) sand (about 97 percent sand); single grained; loose; about 2 percent fine gravel; medium acid; gradual smooth boundary.

C2—42 to 48 inches; brown (10YR 5/3) sand (about 98 percent sand); single grained; loose; about 2 percent fine gravel; slightly acid; gradual smooth boundary.

C3—48 to 60 inches; pale brown (10YR 6/3) coarse sand (about 99 percent sand); single grained; loose; about 4 percent fine gravel; slightly acid.

The solum ranges from 30 to 42 inches in thickness. The mollic epipedon ranges from 18 to 36 inches in thickness. Gravel content in the solum ranges from trace to 5 percent and increases irregularly with depth. Most of the gravel is fine or very fine in size.

The A horizon has value of 2 or 3 and chroma of 1 or 2 but ranges to hue of 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is sand or coarse sand. The AC horizon has hue of 10YR or 7.5Y, value of 3 or 4, and chroma of 3 or 4. It is sand or coarse sand. The C horizon has hue of 10YR or 7.5Y, value of 4 to 6, and chroma of 3 to 6. Its texture is sand or coarse sand.

### Gale Series

The Gale series consists of well drained soils on upland side slopes. These soils formed in loess and in the sandy residuum weathered from the underlying sandstone under native forest vegetation. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 18 to 40 percent.

Typical pedon of Gale silt loam, 18 to 40 percent slopes, in woodland; 2,030 feet east and 360 feet south of the northwest corner of sec. 20, T. 77 N., R. 1 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam (about 22 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; common very fine roots; common very fine tubular pores; neutral; abrupt smooth boundary.

E—4 to 9 inches; brown (10YR 5/3) silt loam (about 22 percent clay); dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) coatings on faces of peds; weak medium and thin platy structure; friable; common fine and very fine and few medium roots; common fine and very fine tubular pores; strongly acid; clear smooth boundary.

BE—9 to 15 inches; yellowish brown (10YR 5/4) silt loam (about 25 percent clay); grayish brown (10YR 5/2) and brown (10YR 5/3) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few white (10YR 8/1) dry silt coats; common fine and very fine roots; common

fine and very fine tubular pores; strongly acid; clear smooth boundary.

Bt1—15 to 21 inches; yellowish brown (10YR 5/4) silty clay loam (about 28 percent clay); weak fine and very fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; few white (10YR 8/1) dry silt coats; common fine and very fine roots; common fine and very fine tubular pores; strongly acid; clear smooth boundary.

Bt2—21 to 28 inches; yellowish brown (10YR 5/4) silty clay loam (about 31 percent clay); moderate medium and fine subangular blocky structure; friable; many faint dark yellowish brown (10YR 4/4) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few fine and very fine roots; common fine and very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; clear wavy boundary.

2BC—28 to 32 inches; yellowish brown (10YR 5/4) sandy loam (about 10 percent clay); weak medium subangular blocky structure; friable; few thin brown (10YR 5/3) clay films on faces of peds; few very fine roots; few thin hard dusky red (2.5YR 3/2) lamellae (iron oxide); common thin light yellowish brown (10YR 6/4) and light gray (10YR 7/2) sandstone fragments in a few layers; medium acid; gradual wavy boundary.

2C—32 to 39 inches; yellowish brown (10YR 5/4) loamy sand; single grained; loose; few thin light yellowish brown (10YR 6/4) sandstone fragments; medium acid; abrupt wavy boundary.

2Cr—39 to 60 inches; light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), very pale brown (10YR 7/3), and strong brown (7.5YR 5/8) weakly cemented sandstone interbedded with yellowish brown (10YR 5/4 and 5/6), brown (7.5YR 5/4), and strong brown (7.5YR 5/6) loose sandstone.

The solum ranges from 14 to 34 inches in thickness. The depth to sandstone is 24 to 40 inches. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 2 to 4 inches thick. It has value of 3 or 4 and chroma of 2 or 3. In most pedons the E horizon is 3 to 5 inches thick, but a few pedons do not have an E horizon. The horizon has value of 4 to 6 and chroma of 2 or 3. Most pedons have a BE or EB horizon. The Bt horizon is 9 to 15 inches thick. It has value of 4 or 5 and chroma of 3 or 4. Some pedons have a 2Bt horizon that formed in varying proportions of loess and sandy residuum. The 2C horizon has hue of

10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 8. It is loamy sand or sand. The Cr horizon consists of alternating layers of weakly cemented sandstone and loose sandstone.

### Gara Series

The Gara series consists of well drained, moderately slowly permeable soils on side slopes on uplands. These soils formed in glacial till under native vegetation of prairie grasses and deciduous trees. Slopes range from 9 to 25 percent.

Typical pedon of Gara loam, 14 to 25 percent slopes, in a pasture: 940 feet east and 800 feet south of the northwest corner of sec. 25, T. 78 N., R. 1 W.

- A—0 to 7 inches: very dark grayish brown (10YR 3/2) loam (about 24 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; common very fine roots; common fine and very fine tubular pores; few yellowish brown (10YR 5/4) worm casts; about 2 percent gravel; medium acid; clear smooth boundary.
- BE—7 to 12 inches: yellowish brown (10YR 5/4) loam (about 26 percent clay); brown (10YR 4/3) coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; common very fine roots; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts; about 3 percent gravel; medium acid; gradual smooth boundary.
- Bt1—12 to 19 inches: yellowish brown (10YR 5/4) clay loam (about 29 percent clay); brown (10YR 4/3) coatings on faces of peds; moderate fine and very fine subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) and brown (10YR 4/3) worm casts; about 5 percent gravel; slightly acid; gradual smooth boundary.
- Bt2—19 to 24 inches: yellowish brown (10YR 5/4) clay loam (about 36 percent clay); brown (10YR 4/3) coatings on faces of peds; moderate fine and very fine subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; few brown (10YR 4/3) worm casts; few fine black (10YR 2/1) concretions (iron and manganese oxides); few fine and medium yellowish red (5YR 5/8) concretions

(iron oxides); about 5 percent gravel; slightly acid; gradual smooth boundary.

- Bt3—24 to 30 inches; yellowish brown (10YR 5/4) clay loam (about 34 percent clay); moderate medium and fine subangular blocky structure; firm; few faint clay films on faces of peds; very few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent gravel; slightly acid; gradual wavy boundary.
- BC—30 to 40 inches; yellowish brown (10YR 5/4) clay loam (about 33 percent clay); weak medium and fine subangular blocky structure; firm; few faint clay films in pores; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent gravel; slightly acid; clear wavy boundary.
- C1—40 to 48 inches; light olive brown (2.5Y 5/4) clay loam (about 37 percent clay); many fine faint light brownish gray (2.5Y 6/2) mottles; weak fine prismatic structure; firm; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent gravel; weak effervescence; mildly alkaline; gradual wavy boundary.
- C2—48 to 60 inches; light brownish gray (2.5Y 6/2) clay loam (about 37 percent clay); common fine and medium prominent strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) mottles; massive with vertical cleavage planes; firm; few very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 38 to 55 inches in thickness. Solum thickness and depth to free carbonates are about the same. All pedons have coarse fragments, but the amount is variable. Some pedons do not have coarse fragments in the upper part.

The A horizon is 6 to 9 inches thick. It has chroma of 1 or 2. It is loam, clay loam, or silt loam. Some pedons have a BE horizon, but some that are cultivated and eroded do not. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. The C horizon has value of 4 to 6 and chroma of 2 to 6.

### Garwin Series

The Garwin series consists of poorly drained, moderately permeable soils on broad, upland ridgetops,



in the upper part of upland drainageways, and on high stream benches. These soils formed in loess under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

These soils are taxadjuncts to the Garwin series because they have a greater increase in clay from the A horizon to the B horizon, less clay in the A horizon, and more clay in the B horizon than are definitive for the Garwin series.

Typical pedon of Garwin silty clay loam, 0 to 2 percent slopes, in a cultivated field; 2,275 feet east and 150 feet north of the southwest corner of sec. 5, T. 77 N., R. 1 W.

- Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (about 28 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; common very fine roots; few very fine random pores; neutral; abrupt smooth boundary.
- A—8 to 14 inches; very dark gray (10YR 3/1) silty clay loam (about 29 percent clay), gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; moderate fine and very fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); slightly acid; clear smooth boundary.
- AB—14 to 19 inches; very dark gray (10YR 3/1) silty clay loam (about 33 percent clay), gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; common very fine distinct grayish brown (2.5Y 5/2) mottles; moderate fine and very fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine tubular pores; few dark grayish brown (2.5Y 4/2) worm casts; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); slightly acid; clear smooth boundary.
- Btg1—19 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay loam (about 35 percent clay); common fine distinct light brownish gray (2.5Y 6/2) and prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate fine and very fine subangular blocky structure; firm; common thin very dark gray (10YR 3/1) clay films on faces of peds; few very fine roots; few common fine and very fine tubular pores; few very dark gray (10YR 3/1) worm casts; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8)

concretions (iron oxides); slightly acid; gradual smooth boundary.

- Btg2—23 to 30 inches; mottled yellowish brown (10YR 5/6 and 5/8) and gray (10YR 5/1) silty clay loam (about 38 percent clay); moderate fine and very fine subangular blocky structure; firm; many thin very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; few very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) worm casts; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); slightly acid; gradual smooth boundary.

- Btg3—30 to 42 inches; mottled yellowish brown (10YR 5/6 and 5/8) and gray (5Y 5/1) silty clay loam (about 34 percent clay); moderate fine prismatic and subangular blocky structure; firm; common thin dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); neutral; gradual smooth boundary.

- BCg—42 to 50 inches; mottled gray (5Y 5/1) and light olive brown (2.5Y 5/6) silty clay loam (about 28 percent clay); common fine distinct reddish yellow (7.5YR 6/6 and 6/8) mottles; weak fine prismatic and subangular blocky structure; friable; few thin dark gray (10YR 4/1) clay films on faces of peds and in pores; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); neutral; gradual smooth boundary.

- Cg—50 to 60 inches; gray (5Y 6/1) silt loam (about 24 percent clay); many fine and medium prominent brownish yellow (10YR 6/6 and 6/8) and reddish yellow (7.5YR 6/6 and 6/8) mottles; massive; friable; common very fine tubular pores; few dark gray (10YR 4/1) root channels; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral.

The solum ranges from 40 to 60 inches in thickness. Free carbonates are below a depth of 60 inches. The mollic epipedon is 18 to 24 inches thick.

The A horizon is 8 to 16 inches thick. It dominantly has hue of 10YR or 5Y or is neutral in hue. It has chroma of 0 or 1. Most pedons have an AB horizon. The Btg horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 1 or 2. It is mottled with hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 4 to 8. The Cg

horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It ranges from 20 to 26 percent clay, by weight.

### Gosport Series

The Gosport series consists of moderately well drained, very slowly permeable soils on convex side slopes on uplands. These soils formed mainly in residuum weathered from shale under native vegetation of deciduous trees. Slopes range from 18 to 40 percent.

Typical pedon of Gosport silty clay loam, 18 to 40 percent slopes, in woodland; 150 feet east and 930 feet north of the southwest corner of sec. 30, T. 77 N., R. 1 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silty clay loam (about 33 percent clay), light brownish gray (10YR 6/2) dry; weak fine platy and granular structure; friable; common fine and very fine roots; few fine and very fine tubular pores; few dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) worm casts; neutral; clear smooth boundary.

Bw1—3 to 8 inches; light olive brown (2.5Y 5/4) silty clay loam (about 36 percent clay); dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) coatings on faces of peds; few fine distinct brownish yellow (10YR 6/6) mottles; moderate fine and very fine subangular blocky structure; friable; few very fine roots concentrated along faces of peds; few very fine tubular pores; few dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) root channel fillings; few fine shale fragments; very strongly acid; gradual smooth boundary.

Bw2—8 to 15 inches; light olive brown (2.5Y 5/4) silty clay (about 43 percent clay); light brownish gray (2.5Y 6/2) coatings on faces of peds; common fine distinct light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/6), and brownish yellow (10YR 6/6) mottles; moderate fine and very fine subangular blocky structure; firm; few very fine roots concentrated along faces of peds; few very fine tubular pores; few fine shale fragments; very strongly acid; gradual smooth boundary.

Bw3—15 to 23 inches; mottled light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) silty clay (about 55 percent clay); common fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; moderate medium and fine subangular blocky structure; firm; few very fine roots concentrated along faces of peds; few very fine

tubular pores; few fine shale fragments; very strongly acid; clear smooth boundary.

BC—23 to 30 inches; gray (10YR 6/1) silty clay (about 55 percent clay); common fine distinct light olive brown (2.5Y 5/4), yellowish brown (10YR 5/4), and brownish yellow (10YR 6/6) mottles; moderate medium and fine prismatic and subangular blocky structure; firm; few very fine roots concentrated along faces of peds; few very fine tubular pores; few fine shale and sandstone fragments; very strongly acid; clear smooth boundary.

Cr—30 to 60 inches; very dark gray (2.5Y 3/0) and dark gray (2.5Y 4/0) clay shale; few fine distinct pale yellow (5Y 7/3), light olive brown (2.5Y 5/4), and brownish yellow (10YR 6/6) mottles; few very fine roots; few very fine tubular pores; few fine sandstone fragments; very strongly acid.

The solum ranges from 20 to 40 inches in thickness. The depth to material formed mainly from shale typically is less than 15 inches.

The A horizon is 0 to 5 inches thick. It has value of 3 or 4 and chroma of 1 or 2. It is silty clay loam, silt loam, or loam. Some pedons have an E horizon as much as 8 inches thick. The Bw horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. The Cr horizon varies widely in color; it has hue of 7.5YR to 5Y, value of 3 to 6, and chroma of 0 to 8.

### Hanlon Series

The Hanlon series consists of moderately well drained, moderately rapidly permeable soils on bottom lands. These soils formed in alluvium under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Hanlon silt loam, overwash, in an area of Radford-Hanlon silt loams, channeled, 0 to 2 percent slopes, in a pasture; 400 feet south and 30 feet west of the northeast corner of sec. 34, T. 78 N., R. 1 W.

A1—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam (about 21 percent clay), grayish brown (10YR 5/2) dry; weak medium platy and fine angular blocky and granular structure; friable; common very fine roots; few medium and fine and common very fine tubular pores; slightly acid; clear smooth boundary.

A2—11 to 16 inches; very dark gray (10YR 3/1) loam (about 18 percent clay), gray (10YR 5/1) dry; weak fine and very fine subangular blocky and granular structure; friable; few very fine roots; few fine and

common very fine tubular pores; slightly acid; gradual wavy boundary.

- A3—16 to 21 inches; very dark gray (10YR 3/1) sandy loam (about 17 percent clay), gray (10YR 5/1) dry; weak fine subangular blocky and granular structure; friable; few very fine roots; few fine and common very fine tubular pores; neutral; gradual wavy boundary.
- A4—21 to 25 inches; very dark gray (10YR 3/1) sandy loam (about 16 percent clay), gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; neutral; gradual wavy boundary.
- A5—25 to 32 inches; very dark gray (10YR 3/1) sandy loam (about 16 percent clay), gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; very few very fine roots; few fine and common very fine tubular pores; slightly acid; gradual wavy boundary.
- Bw—32 to 40 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) sandy loam (about 14 percent clay); few very fine distinct reddish brown (5YR 4/4) mottles; weak medium and fine subangular blocky structure; very friable; few fine and common very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; clear wavy boundary.
- BC—40 to 44 inches; dark grayish brown (2.5Y 4/2) sandy loam (about 13 percent clay); few fine distinct reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; very friable; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.
- C—44 to 60 inches; grayish brown (2.5Y 5/2) sandy loam (about 10 percent clay); common fine distinct reddish brown (5YR 4/4) mottles; single grained; loose; few very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The solum ranges from 40 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon ranges from 30 to 60 inches in thickness.

The A horizon is 30 to 48 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The Bw horizon is as much as 20 inches thick. It has value of 3 or 4 and chroma of 1 or 2. Some pedons do not have a Bw horizon. The C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is sandy loam or loamy sand.

## Hoopeston Series

The Hoopeston series consists of somewhat poorly drained, moderately rapidly permeable soils on stream terraces. These soils formed in wind- and water-sorted loamy and sandy sediments under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Hoopeston sandy loam, 0 to 2 percent slopes, in a cultivated field; 2,420 feet north and 240 feet east of the southwest corner of sec. 20, T. 76 N., R. 4 W.

- Ap—0 to 9 inches; very dark gray (10YR 3/1) sandy loam (about 10 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.
- A—9 to 17 inches; very dark grayish brown (10YR 3/2) sandy loam (about 11 percent clay), grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4) mottles; weak fine and very fine granular structure; friable; few fine roots; few very fine tubular pores; slightly acid; clear wavy boundary.
- BA—17 to 21 inches; mottled, dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 4/4) sandy loam (about 12 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; many fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; few very fine tubular pores; few very dark grayish brown (10YR 3/2) pore fillings; slightly acid; clear smooth boundary.
- Bw—21 to 27 inches; dark yellowish brown (10YR 4/4) sandy loam (about 10 percent clay); common fine distinct grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; few very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; few dark grayish brown (10YR 4/2) pore fillings; slightly acid; clear smooth boundary.
- BC—27 to 32 inches; mottled, dark yellowish brown (10YR 4/4) and grayish brown (2.5Y 5/2) sandy loam (about 10 percent clay); common fine distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; few very fine tubular pores; slightly acid; clear smooth boundary.
- C1—32 to 40 inches; yellowish brown (10YR 5/4) sand (about 5 percent clay); common fine distinct light brownish gray (2.5Y 6/2) mottles; single grained; loose; neutral; clear smooth boundary.

C2—40 to 60 inches; light brownish gray (2.5Y 6/2) sand (about 5 percent clay); single grained; loose; neutral.

The solum thickness and the depth to the underlying loamy sand or sand range from 20 to 44 inches. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 12 to 24 inches.

The A horizon is sandy loam, fine sandy loam, or loam that has a low clay content. The B horizon has value of 4 or 5 and chroma of 2 to 4. Either the matrix or the mottles have chroma of 2. The B horizon is sandy loam or fine sandy loam, but in some pedons part of the B horizon, less than 6 inches thick, is loam. The C horizon is loamy sand or sand.

### Houghton Series

The Houghton series consists of very poorly drained soils in marshes and depressional areas on bottom lands. These soils formed in more than 50 inches of organic material under native vegetation of prairie marsh. Permeability is moderately slow to moderately rapid. Slopes are 0 or 1 percent.

Typical pedon of Houghton muck, ponded, 0 to 1 percent slopes, in a marsh; 490 feet north and 60 feet east of the center of sec. 23, T. 77 N., R. 4 W.

Oa1—0 to 8 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent herbaceous fiber, less than 5 percent rubbed, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly sticky (wet); neutral; gradual smooth boundary.

Oa2—8 to 20 inches; black (10YR 2/1) broken face and rubbed sapric material; about 10 percent herbaceous fiber, less than 5 percent rubbed, very dark gray (10YR 3/1) dry; weak medium and fine granular structure; slightly sticky (wet); neutral; clear smooth boundary.

Oa3—20 to 30 inches; black (10YR 2/1) broken face and rubbed sapric material; about 30 percent herbaceous fiber, less than 10 percent rubbed, very dark gray (10YR 3/1) dry; massive; slightly sticky (wet); common very fine roots; neutral; clear smooth boundary.

Oa4—30 to 50 inches; black (10YR 2/1) broken face and rubbed sapric material; about 15 percent herbaceous fiber, less than 5 percent rubbed; massive; slightly sticky (wet); few very fine roots; neutral; gradual smooth boundary.

Oe—50 to 60 inches; black (10YR 2/1) broken face and rubbed hemic material; about 60 percent

herbaceous fiber, less than 40 percent rubbed; massive; slightly sticky (wet); few very fine roots; neutral.

The surface tier has hue of 10YR or 5Y or is neutral in hue. It has value of 2 and chroma of 0 to 2. It typically is sapric, but in a few pedons it is hemic. The subsurface and lower tiers have hue of 10YR, 7.5YR, or 5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. They are sapric or hemic.

### Kennebec Series

The Kennebec series consists of moderately well drained, moderately permeable soils on bottom lands. These soils formed in silty alluvium under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, in a cultivated field; 2,500 feet north and 2,510 feet east of the southwest corner of sec. 10, T. 78 N., R. 2 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam (about 26 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; common very fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.

A1—8 to 20 inches; black (10YR 2/1) silt loam (about 24 percent clay), dark gray (10YR 4/1) dry; weak fine subangular blocky and granular structure; friable; few very fine roots; common very fine tubular pores; slightly acid; gradual smooth boundary.

A2—20 to 32 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; slightly acid; gradual smooth boundary.

A3—32 to 40 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; slightly acid; gradual smooth boundary.

BA—40 to 49 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 3/3) silt loam (about 24 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium and fine

subangular blocky structure; friable; few very fine roots; common very fine tubular pores; common very dark gray (10YR 3/1) worm casts and pore fillings; slightly acid; clear smooth boundary.

Bw1—49 to 56 inches; brown (10YR 4/3) silt loam (about 24 percent clay); dark grayish brown (10YR 4/2) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; common very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; clear wavy boundary.

Bw2—56 to 60 inches; brown (10YR 4/3) silt loam (about 24 percent clay); few very fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common very fine tubular pores; slightly acid.

Both the solum and the mollic epipedon range from 36 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 30 to 50 inches thick. It has chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. It is silt loam or silty clay loam.

### Lindley Series

The Lindley series consists of well drained, moderately slowly permeable soils on upland side slopes. These soils formed in glacial till under native vegetation of deciduous trees. Slopes range from 5 to 50 percent.

Typical pedon of Lindley silt loam, in an area of Lindley-Douds-Orwood silt loams, 18 to 40 percent slopes, in a pasture; 1,300 feet north and 30 feet west of the southeast corner of sec. 32, T. 77 N., R. 2 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam (about 24 percent clay), light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; friable; common very fine roots; common very fine tubular pores; few yellowish brown (10YR 5/4) worm casts; medium acid; clear smooth boundary.

E—4 to 10 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loam (about 24 percent clay); weak medium and thin platy structure; friable; few fine and very fine roots; common fine and very fine tubular pores; few yellowish brown (10YR 5/4) and very dark grayish brown (10YR 3/2) worm casts; medium acid; clear smooth boundary.

BE—10 to 16 inches; yellowish brown (10YR 5/4) loam (about 27 percent clay); weak fine and very fine

subangular blocky structure; friable; few light gray (10YR 7/2) dry silt coats; few fine and very fine roots; few fine and very fine tubular pores; few dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) worm casts; medium acid; clear smooth boundary.

Bt1—16 to 24 inches; yellowish brown (10YR 5/4) clay loam (about 30 percent clay); moderate fine and very fine subangular blocky structure; firm; many faint clay films on faces of peds; few fine and very fine roots concentrated along faces of peds and in pores; few fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt2—24 to 36 inches; yellowish brown (10YR 5/4) clay loam (about 32 percent clay); moderate fine and very fine subangular blocky structure; firm; many faint clay films on faces of peds; few fine and very fine roots concentrated along faces of peds and in pores; few fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—36 to 45 inches; yellowish brown (10YR 5/4) clay loam (about 30 percent clay); few fine distinct strong brown (7.5YR 5/8) and light brownish gray (2.5Y 6/2) mottles; moderate fine prismatic and subangular blocky structure; firm; many faint dark brown (10YR 3/3) and brown (10YR 4/3) clay films on faces of peds; few fine and very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; clear wavy boundary.

BC—45 to 54 inches; yellowish brown (10YR 5/4) clay loam (about 30 percent clay); few fine distinct strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) mottles; weak medium and fine prismatic structure; firm; common faint brown (10YR 4/3) clay films on faces of peds; few fine and very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); strong effervescence; lime segregated in fine filaments and in seams; mildly alkaline; clear wavy boundary.

C1—54 to 60 inches; yellowish brown (10YR 5/4) loam with loamy sand lenses (about 20 percent clay); few fine distinct strong brown (7.5YR 5/8) and light brownish gray (2.5Y 6/2) mottles; massive with vertical parting; friable; few fine black (10YR 2/1) concretions (iron and manganese oxides); strong effervescence; lime segregated in seams and

disseminated lime; mildly alkaline; clear wavy boundary.

The solum ranges from 32 to 54 inches in thickness. It formed in glacial till, but as much as 10 inches in the upper part of the solum formed in silt loam loess. A small and variable percentage of coarse fragments are in the part of the solum that formed in glacial till.

The A horizon is 2 to 5 inches thick. It has value of 3 or 4 and chroma of 1 or 2. It is silt loam or loam, except in some cultivated areas it is clay loam. Where this soil is eroded or has been cultivated, the Ap horizon has value of 4 or 5 and chroma of 2 to 5. The E horizon is 2 to 8 inches thick. It has value of 4 to 6 and chroma of 2 to 4. Most cultivated areas do not have an E horizon. The B horizon has value of 4 or 5 and chroma of 4 to 6. It is clay loam or loam. The C horizon has value of 4 or 5 and chroma of 2 to 6. It is loam or clay loam glacial till, but in places has layers of sandy loam or loamy sand.

### Marshan Series

The Marshan series consists of poorly drained soils on stream terraces. These soils formed in loamy alluvium over sandy alluvium under native vegetation of wetland prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 425 feet west and 275 feet north of the center of sec. 22, T. 77 N., R. 4 W.

Ap—0 to 7 inches; black (10YR 2/1) clay loam (about 28 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.

A—7 to 17 inches; black (10YR 2/1) clay loam (about 33 percent clay), dark gray (10YR 4/1) dry; weak fine granular structure; friable; few very fine roots; few very fine tubular pores; common fine yellowish brown (10YR 5/4) organic stains; neutral; clear wavy boundary.

AB—17 to 22 inches; black (5Y 2/1) and very dark gray (5Y 3/1) clay loam (about 35 percent clay), dark gray (5Y 4/1) and gray (5Y 5/1) dry; common fine distinct gray (5Y 5/1) and yellowish brown (10YR 5/4) mottles; weak fine subangular blocky and granular structure; firm; few very fine roots; few very

fine tubular pores; neutral; clear wavy boundary.

Btg1—22 to 29 inches; dark gray (5Y 4/1) and gray (5Y 5/1) clay loam (about 32 percent clay); common fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common faint very dark gray (5Y 3/1) clay films on faces of peds; few very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

Btg2—29 to 37 inches; gray (5Y 5/1) and olive gray (5Y 5/2) clay loam (about 30 percent clay); common fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few faint dark gray (5Y 4/1) clay films on faces of peds; few very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

2C1—37 to 44 inches; dark gray (10YR 4/1) sand (less than 5 percent clay); single grained; loose; neutral; clear wavy boundary.

2C2—44 to 52 inches; dark gray (10YR 4/1) and light brownish gray (2.5Y 6/2) sand (less than 5 percent clay); loose; neutral; clear wavy boundary.

2C3—52 to 60 inches; light brownish gray (2.5Y 6/2) sand (less than 5 percent clay); loose; neutral.

Solum thickness and the depth to underlying sands are 32 to 40 inches. The mollic epipedon is 12 to 24 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 12 to 20 inches thick. It is neutral or has hue of 10YR or 5Y, value of 2 or 3, and chroma of 0 to 2. It is clay loam, silty clay loam, or loam. The Bg horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It has few to many mottles that have hue of 10YR or 7.5YR and chroma of 3 or more. In most pedons part or all of the Bg horizon has thin clay or clay-organic films. The Bg horizon is clay loam, loam, or silty clay loam. The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is sand, coarse sand, or gravelly coarse sand. In this horizon sand-size distribution, content of gravel, and color vary with depth.

### Moingona Series

The Moingona series consists of moderately well drained, moderately permeable soils on foot slopes and alluvial fans. These soils formed in loamy, local alluvium under native vegetation of prairie grasses. Slopes range from 2 to 9 percent.

These soils are taxadjuncts to the Moingona series

because they have less clay in the solum and increase less in clay from the A horizon to the B horizon than is definitive for the Moingona series.

Typical pedon of Moingona loam, 2 to 5 percent slopes, in a cultivated field; 1,060 feet south and 1,930 feet west of the northeast corner of sec. 27, T. 76 N., R. 3 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam (about 15 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark brown (10YR 2/2) loam (about 15 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.

BA—12 to 18 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) loam (about 18 percent clay); very dark brown (10YR 2/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark brown (10YR 2/2) worm casts; few fine and medium black (10YR 2/1) accumulations (charcoal); slightly acid; clear smooth boundary.

Bt1—18 to 24 inches; brown (10YR 4/3) loam (about 17 percent clay); moderate medium and fine subangular blocky structure; friable; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts; few fine and medium black (10YR 2/1) accumulations (charcoal); slightly acid; gradual smooth boundary.

Bt2—24 to 36 inches; brown (10YR 4/3) loam (about 17 percent clay); moderate medium and fine subangular blocky structure; friable; few faint clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; few fine and medium black (10YR 2/1) accumulations (charcoal); slightly acid; gradual smooth boundary.

Bw—36 to 44 inches; brown (10YR 4/3) loam (about 15 percent clay); weak medium and fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; few very

fine prominent yellowish red (5YR 4/6 and 5/6) accumulations (iron oxides); few fine and medium black (10YR 2/1) accumulations (charcoal); neutral; gradual smooth boundary.

BC—44 to 60 inches; brown (10YR 4/3 and 5/3) loam (about 15 percent clay); weak medium and fine prismatic structure; friable; common fine and very fine tubular pores; few very fine prominent yellowish red (5YR 4/6 and 5/6) accumulations (iron oxides); few fine and medium black (10YR 2/1) accumulations (charcoal); neutral.

The solum ranges from 45 to 60 inches in thickness. The mollic epipedon is 12 to 20 inches thick.

The A horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The B horizon has value of 3 to 5 and chroma of 2 to 4. It is slightly acid or neutral. Some pedons have a C horizon that has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loam, silt loam, or sandy loam.

### Moingona Variant

The Moingona Variant consists of somewhat poorly drained, moderately permeable soils on foot slopes and alluvial fans. These soils formed in loamy local alluvium under native vegetation of prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Moingona Variant loam, 2 to 5 percent slopes, in a cultivated field; 1,100 feet south and 250 feet east of the northwest corner of sec. 35, T. 76 N., R. 3 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam (about 13 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; few very dark grayish brown (2.5Y 3/2) and brown (7.5YR 4/4) organic stains; neutral; abrupt smooth boundary.

A—8 to 16 inches; very dark gray (10YR 3/1) loam (about 13 percent clay), gray (10YR 5/1) dry; weak thin platy and fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark brown (7.5YR 2/2) organic stains; neutral; clear smooth boundary.

BA—16 to 23 inches; mixed very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) loam (about 12 percent clay); black (10YR 2/1) and very dark gray (10YR 3/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very

fine tubular pores; few very dark gray (10YR 3/1) worm casts; few brown (7.5YR 4/4) organic stains; neutral; gradual wavy boundary.

Bw1—23 to 30 inches; light olive brown (2.5Y 5/4) loam (about 12 percent clay); very dark grayish brown (2.5Y 3/2) coatings on faces of peds and in pores; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (2.5Y 3/2) worm casts; neutral; gradual wavy boundary.

Bw2—30 to 38 inches; mottled light olive brown (2.5Y 5/4) and light brownish gray (2.5Y 6/2) loam (about 15 percent clay); dark grayish brown (2.5Y 4/2) coatings on faces of peds; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (2.5Y 3/2) coatings in root channels; neutral; gradual wavy boundary.

BC—38 to 47 inches; mottled light olive brown (2.5Y 5/4) and light brownish gray (2.5Y 6/2) loam (about 16 percent clay); dark grayish brown (2.5Y 4/2) coatings on faces of prisms and in pores; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure; friable; common fine and very fine tubular pores; few very dark grayish brown (2.5Y 3/2) coatings in root channels; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; gradual wavy boundary.

C—47 to 60 inches; light olive brown (2.5Y 5/4) loam (about 14 percent clay); common fine distinct light brownish gray (2.5Y 6/2) mottles; weak medium and fine prismatic structure; friable; common fine and very fine tubular pores; few dark grayish brown (2.5Y 4/2) coatings in root channels; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral.

The solum ranges from 42 to 60 inches in thickness. The mollic epipedon is 12 to 20 inches thick.

The A horizon has value of 2 or 3 and chroma of 1. It is loam or sandy loam. The B horizon has hue of 10YR or 2.5Y, value of 2 to 6, and chroma of 2 to 4. It has low chroma mottles where the hue is 10YR and matrix chroma is 3 or 4. It is loam or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 2 to 6, and chroma of 2 to 4 and is mottled. It is loam or sandy loam.

## Muscatine Series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on ridgetops or divides on uplands and on high stream benches. These soils formed in loess under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

These soils are taxadjuncts to the Muscatine series because they increase more in clay from the A horizon to the B horizon than is definitive for the Muscatine series.

Typical pedon of Muscatine silty clay loam, 0 to 2 percent slopes, in a cultivated field; 2,500 feet west and 145 feet north of the southeast corner of sec. 5, T. 77 N., R. 1 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam (about 28 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; medium acid; abrupt smooth boundary.

A—8 to 14 inches; very dark brown (10YR 2/2) silty clay loam (about 28 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; medium acid; clear smooth boundary.

BA—14 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam (about 30 percent clay); very dark brown (10YR 2/2) coatings on faces of peds; moderate fine and very fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine tubular pores; common light olive brown (2.5Y 5/4) worm casts; few fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

Bt1—20 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam (about 34 percent clay); many fine distinct light olive brown (2.5Y 5/4) and few very fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate fine and very fine subangular blocky structure; friable; few faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; few light gray (10YR 7/2) dry silt coats; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; few fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.



Btg2—26 to 32 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); many fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate medium and fine subangular blocky structure; friable; common faint clay films on faces of peds; many light gray (10YR 7/2) dry silt coats; very few very fine roots; common fine and very fine tubular pores; few fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—32 to 40 inches; mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6 and 6/8) silty clay loam (about 30 percent clay); weak fine prismatic and subangular blocky structure; friable; common faint clay films on faces of peds; many light gray (10YR 7/2) dry silt coats; very few very fine roots; common fine and very fine tubular pores; common medium and fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—40 to 48 inches; mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6 and 6/8) silt loam (about 26 percent clay); weak fine prismatic structure; friable; few faint clay films on faces of peds and in pores; common light gray (10YR 7/2) dry silt coats; common fine and very fine tubular pores; common medium and fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—48 to 60 inches; light brownish gray (2.5Y 6/2) silt loam (about 24 percent clay); common fine and medium prominent brownish yellow (10YR 6/6 and 6/8) and few fine prominent strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; few faint clay films in pores; common very fine tubular pores; common medium and fine black (10YR 2/1) accumulations (iron and manganese oxides); neutral; clear smooth boundary.

The solum ranges from 40 to more than 60 inches in thickness. The depth to sandy sediments or glacial till is 48 to 96 inches. Free carbonates are below a depth of 60 inches.

The A horizon is 14 to 20 inches thick. It has chroma of 1 or 2. It is silty clay loam or silt loam. Most pedons have either an AB or a BA horizon. The Bt horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 to 4. The Bt horizon is 30 to 35 percent clay, by weight. The BC and C horizons have hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4.

## Newvienna Series

The Newvienna series consists of moderately well drained, moderately permeable soils on upland side slopes and head slopes. These soils formed in deoxidized loess under native vegetation of prairie grasses and deciduous trees. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Newvienna series because they have an Ap horizon with lighter colors than is definitive for the Newvienna series.

Typical pedon of Newvienna silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 90 feet east and 190 feet south of the center of sec. 21, T. 78 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) and yellowish brown (10YR 5/4) silt loam (about 26 percent clay), grayish brown (10YR 5/2) and very pale brown (10YR 7/4) dry; weak fine and very fine granular structure; friable; few very fine random pores; slightly acid; abrupt wavy boundary.

Bt1—9 to 15 inches; brown (10YR 5/3) silty clay loam (about 32 percent clay); grayish brown (10YR 5/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine and fine roots concentrated along faces of peds; common faint clay films on faces of peds; many medium and fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

Bt2—15 to 23 inches; brown (10YR 5/3) silty clay loam (about 34 percent clay); light brownish gray (2.5Y 6/2) coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; common faint clay films on faces of peds; common very fine and fine roots concentrated along faces of peds; many fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; clear wavy boundary.

Bt3—23 to 32 inches; mottled brown (10YR 5/3) and light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of peds; few very fine roots concentrated in pores; common fine and very fine and few medium tubular pores; common fine black (10YR 2/1) concretions

(iron and manganese oxides); slightly acid; gradual wavy boundary.

BC—32 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 30 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium and fine prismatic structure; friable; few faint clay films in pores; common fine and very fine and few medium tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

C—46 to 60 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) silt loam (about 26 percent clay); massive; friable; common very fine tubular pores; few dark grayish brown (10YR 4/2) pore fillings; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral.

The solum ranges from 40 to 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 40 to more than 60 inches.

The A horizon is 6 to 9 inches thick. It has value of 3 or 4 and chroma of 2 or 3. A few pedons have an E horizon that is less than 4 inches thick. In many pedons a BE horizon has been incorporated into the Ap horizon. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8. It is mottled with these colors and, in many pedons, also has mottles that have hue of 7.5YR or 5YR. The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8 and is mottled.

## Orion Series

The Orion series consists of somewhat poorly drained, moderately permeable soils in upland drainageways and on foot slopes and alluvial fans. These soils formed in recently deposited, stratified silty alluvium overlying buried soils under native vegetation of deciduous trees. Slopes range from 0 to 3 percent.

Typical pedon of Orion silt loam, 0 to 3 percent slopes, in a cultivated field; 2,555 feet west and 20 feet south of the northeast corner of sec. 33, T. 76 N., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam (about 15 percent clay), light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; common very fine

roots; few very fine random pores; mildly alkaline; abrupt smooth boundary.

C—6 to 20 inches; stratified dark grayish brown (10YR 4/2) and brown (10YR 5/3) silt loam (about 15 percent clay); common fine distinct yellowish brown (10YR 5/4 and 5/6) and light brownish gray (2.5Y 6/2) mottles; massive with horizontal parting; friable; few very fine roots; common fine and very fine tubular pores; common dark grayish brown (10YR 4/2) worm casts; mildly alkaline; abrupt smooth boundary.

Ab—20 to 26 inches; very dark grayish brown (2.5Y 3/2) silt loam (about 20 percent clay); common very fine distinct dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) worm casts and pore fillings; mildly alkaline; clear smooth boundary.

Bgb—26 to 39 inches; very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) silt loam (about 20 percent clay); common fine distinct yellowish brown (10YR 5/4) and brown (7.5YR 4/4) and common fine faint grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky and angular blocky structure; friable; common fine and very fine tubular pores; mildly alkaline; clear smooth boundary.

BCgb—39 to 50 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silt loam (about 25 percent clay); common very fine distinct brown (7.5YR 4/4) and reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; friable; common very fine tubular pores; very slight effervescence; mildly alkaline; clear smooth boundary.

Cg—50 to 60 inches; gray (5Y 5/1) silt loam (about 15 percent clay); common fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; few very fine tubular pores; very slight effervescence; mildly alkaline.

The A and C horizons combined are 20 to 40 inches thick. The buried solum extends to a depth of 40 to 60 inches or more. In some pedons free carbonates are in the buried solum.

The A horizon is 5 to 10 inches thick. In undisturbed pedons it is stratified with value of 3 to 5 and chroma of 2 or 3 in lamellae of varying thickness. The C horizon is also stratified with the same colors; however, in some pedons the very dark grayish brown (10YR 3/2)

lamellae are thin. 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 and is 5 to 10 inches thick. The solum beneath the Ab horizon is variable. It has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2, except mottles or mottled colors have chroma of 1 to 8. Texture beneath the Ab horizon is stratified silt loam to sand.

### Orwood Series

The Orwood series consists of well drained, moderately permeable soils on side slopes on uplands. These soils formed in loess and loamy sediments under native vegetation of prairie grasses and forest. Slopes range from 5 to 40 percent.

These soils are taxadjuncts to the Orwood series because they have more sand and less clay in the solum and have higher value and lower chroma below a depth of 24 inches than is definitive for the Orwood series.

Typical pedon of Orwood silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 2,640 feet south and 300 feet east of the northwest corner of sec. 28, T. 78 N., R. 1 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam (about 24 percent clay), grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (10YR 4/3) subsoil material; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; clear smooth boundary.

Bt1—9 to 17 inches; yellowish brown (10YR 5/4) loam (about 23 percent clay); weak fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; medium acid; clear smooth boundary.

Bt2—17 to 21 inches; yellowish brown (10YR 5/4) sandy loam (about 16 percent clay); weak fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; medium acid; clear smooth boundary.

Bt3—21 to 29 inches; yellowish brown (10YR 5/4) loamy sand (about 10 percent clay); weak medium subangular blocky structure; very friable; few faint clay films on faces of peds and as bridges between sand grains; few fine and very fine tubular pores; medium acid; clear wavy boundary.

Bt4—29 to 48 inches; light brownish gray (2.5Y 6/2) silt

loam (about 21 percent clay); common fine and medium prominent strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; weak fine prismatic structure; friable; few faint clay films on faces of peds and in pores; few white (10YR 8/2) dry silt coats; common very fine tubular pores; common fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual wavy boundary.

BC—48 to 60 inches; light brownish gray (2.5Y 6/2) silt loam (about 21 percent clay); common fine and medium prominent strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; weak medium prismatic structure; friable; common white (10YR 8/2) dry silt coats on prism faces; few fine and common very fine tubular pores; common fine and medium black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid.

The solum ranges from 40 to more than 60 inches in thickness. Free carbonates are below a depth of 60 inches.

The A horizon is 6 to 10 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is silt loam or loam. Some pedons have an E horizon or a BE horizon. Some have both. The Bt horizon has value of 4 or 5 and chroma of 3 or 5 in the upper part. It has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6 in the lower part. The Bt horizon has strata with textures ranging from silty clay loam to loamy sand. In some pedons the lower part has chroma of 2, mottles that have high chroma, and texture of silt loam or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6 and is mottled. These low chroma colors and mottles were caused by relict weathering zones in the loess, and not by present drainage. The C horizon typically is silt loam but in some pedons has strata of sandier textures and in a few pedons has a loam texture.

### Palms Series

The Palms series consists of very poorly drained soils in depressions on bottom lands. These soils formed in 16 to 50 inches of organic material and in the underlying loamy and sandy alluvium under native vegetation of prairie marsh. Permeability is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 1 percent.

Typical pedon of Palms muck, sandy substratum, 0 to 1 percent slopes, in a cultivated field; 1,010 feet west

and 115 feet north of the southeast corner of sec. 33, T. 78 N., R. 3 W.

Ap—0 to 8 inches; black (10YR 2/1) broken face and rubbed sapric material; about 2 percent herbaceous fiber, less than 2 percent rubbed; about 15 percent very fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly sticky (wet); few very fine roots; medium acid; abrupt smooth boundary.

Oa1—8 to 20 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent herbaceous fiber, less than 5 percent rubbed; about 15 percent very fine sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly sticky (wet); few very fine roots; common very fine pores; medium acid; clear smooth boundary.

Oa2—20 to 34 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent herbaceous fiber, less than 5 percent rubbed; about 10 percent very fine sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly sticky (wet); few very fine roots; common very fine pores; slightly acid; clear smooth boundary.

2A1—34 to 48 inches; black (10YR 2/1) mucky loam (about 25 percent sand); few fine distinct gray (5Y 5/1) mottles; weak medium subangular blocky structure; friable; common very fine pores; neutral; clear smooth boundary.

2A2—48 to 55 inches; gray (5Y 5/1) and very dark gray (5Y 3/1) sandy loam (about 70 percent sand); few black (10YR 2/1) and very dark gray (5Y 3/1) coatings on faces of peds; weak medium subangular blocky structure; friable; few thin sand layers; few very fine pores; mildly alkaline; clear smooth boundary.

2Cg—55 to 60 inches; gray (5Y 5/1 and 6/1) stratified sand and loamy sand (about 90 percent sand); few medium faint grayish brown (2.5Y 5/2) mottles; single grained; loose; mildly alkaline.

The surface tier has hue of 10YR or 5Y or is neutral in hue. It has chroma of 0 to 2. It is sapric and has a variable, very fine sand content. The subsurface and lower tiers have hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 0 to 3. Some pedons have an AC horizon. The 2C horizon is stratified. It is loamy sand or sand.

### Perks Series

The Perks series consists of excessively drained, rapidly permeable soils on bottom lands. These soils

formed in alluvium under native vegetation of deciduous trees and prairie grasses. Slopes range from 0 to 3 percent.

Typical pedon of Perks loamy sand, 0 to 3 percent slopes, in open woodland; 2,200 feet north and 160 feet east of the southwest corner of sec. 29, T. 78 N., R. 2 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand (about 80 percent sand), grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; few fine and common very fine roots; neutral; clear smooth boundary.

C1—4 to 12 inches; brown (10YR 4/3 and 5/3) sand (about 95 percent sand); single grained; loose; few fine and very fine roots; neutral; gradual smooth boundary.

C2—12 to 30 inches; brown (10YR 5/3) and pale brown (10YR 6/3) sand (more than 95 percent sand); single grained; loose; few thin dark grayish brown (10YR 4/2) layers; very few fine and very fine roots; neutral; gradual wavy boundary.

C3—30 to 60 inches; stratified brown (10YR 5/3) sand and pale brown (10YR 6/3) coarse sand (more than 95 percent sand); single grained; loose; few thin dark grayish brown (10YR 4/2) loamy sand layers; very few very fine roots; neutral.

The thickness of the solum corresponds to that of the A or Ap horizon. The A horizon is 2 to 5 inches thick, except where the soil is cultivated. The Ap horizon is as much as 9 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon has chroma of 1 or 2. It is sandy loam or loamy sand. The C horizon has variable colors because of stratification. It has chroma of 3 or 4. Its texture typically is sand or coarse sand, but in places it has layers of sandy loam or loamy sand.

Map unit 539, Perks sandy loam, 0 to 2 percent slopes, is a taxadjunct to the series because the A horizon is thicker than and the depth to loamy sand is greater than is defined for the Perks series.

### Pillot Series

The Pillot series consists of well drained soils on upland ridgetops and side slopes and on stream terraces. These soils formed in loess or silty alluvium and the underlying sandy sediments under native vegetation of prairie grasses. Permeability is moderate in the upper part of the profile 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 cultivated field; 700 feet east and 95 feet north of the southwest corner of sec. 4, T. 77 N., R. 2 W.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam (about 26 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; many fine roots; few medium and common fine and very fine tubular pores; neutral; gradual smooth boundary.
- A—8 to 12 inches; very dark brown (10YR 2/2) silt loam (about 25 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; common fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.
- AB—12 to 16 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay), grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; common fine roots; common fine and very fine tubular pores; few very dark brown (10YR 2/2) worm casts; neutral; gradual smooth boundary.
- Bw1—16 to 23 inches; brown (10YR 4/3) silty clay loam (about 29 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; common fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; neutral; gradual wavy boundary.
- Bw2—23 to 29 inches; yellowish brown (10YR 5/4) and brown (10YR 4/3) silty clay loam (about 31 percent clay); brown (10YR 4/3) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; common fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts and root channel fillings; slightly acid; gradual wavy boundary.
- Bw3—29 to 36 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); brown (10YR 4/3) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; common fine roots; common fine and very fine tubular pores; slightly acid; clear wavy boundary.
- 2BC—36 to 41 inches; yellowish brown (10YR 5/4) loamy sand (about 10 percent clay); weak medium subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.
- 2C—41 to 60 inches; banded brown (10YR 4/3 and 5/3) and pale brown (10YR 6/3) sand (less than 5 percent clay); single grained; loose; few fine roots; neutral.

The solum ranges from 36 to 50 inches in thickness. The depth to the underlying loamy sand or sand is 20 to 40 inches. The mollic epipedon is 10 to 20 inches thick. Free carbonates are below a depth of 60 inches.

The A horizon is 10 to 16 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. Most pedons have either an AB or BA horizon. The B horizon is 12 to 24 inches thick. It has value and chroma of 3 to 5. It is silt loam or silty clay loam. The 2B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. It is loamy sand or, less commonly, sandy loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is coarse sand or sand.

Map unit 450C2, Pillot silt loam, 5 to 9 percent slopes, moderately eroded, is a taxadjunct to the series because it does not have a mollic epipedon.

### Radford Series

The Radford series consists of poorly drained, moderately permeable soils on bottom lands and the lower parts of upland drainageways. These soils formed in recently deposited silty alluvium over buried soils under native vegetation of prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Radford silt loam, 0 to 2 percent slopes, in a cultivated field; 605 feet south and 220 feet east of the northwest corner of sec. 21, T. 78 N., R. 1 E.

- Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few fine and very fine random pores; neutral; abrupt smooth boundary.
- C—10 to 30 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay), grayish brown (10YR 5/2) dry; few thin dark grayish brown (10YR 4/2) strata; weak medium platy fragments parting to weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; few black (10YR 2/1) worm casts; few fine reddish brown (5YR 4/4) stains; neutral; abrupt smooth boundary.
- 2Ab1—30 to 36 inches; black (10YR 2/1) silty clay loam (about 32 percent clay), very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.

2Ab2—36 to 48 inches; very dark gray (10YR 3/1) silty clay loam (about 35 percent clay), dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; neutral; gradual smooth boundary.

2BAb—48 to 56 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay loam (about 32 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; common fine and very fine tubular pores; neutral; clear smooth boundary.

2Bgb—56 to 60 inches; dark gray (5Y 4/1) silty clay loam (about 28 percent clay); few fine and medium prominent strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common fine and very fine tubular pores; mildly alkaline.

The A and C horizons combined are 20 to 36 inches thick. The buried solum extends to a depth of 60 inches or more, and free carbonates are below that depth.

The Ap horizon is 5 to 10 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. Strata in the C horizon range from a value of 3 to 5 and chroma of 1 or 2. The 2Ab horizon has value of 2 or 3 and chroma of 1. The 2Bgb horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2 and is mottled.

### Richwood Series

The Richwood series consists of well drained soils on stream terraces. These soils formed in 40 to 60 inches of silty alluvium and in the underlying sandy alluvium under native vegetation of prairie grasses. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 4 percent.

Typical pedon of Richwood silt loam, 0 to 2 percent slopes, in a cultivated field; 870 feet west and 195 feet south of the northeast corner of sec. 7, T. 76 N., R. 4 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam (about 21 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.

A—9 to 15 inches; very dark brown (10YR 2/2) silt loam (about 21 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure;

friable; few very fine roots; common very fine tubular pores; common very dark gray (10YR 2/2) worm casts; neutral; clear smooth boundary.

AB—15 to 20 inches; very dark grayish brown (10YR 3/2) silt loam (about 21 percent clay), grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky and granular structure; friable; few very fine roots; common very fine tubular pores; common very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) worm casts; slightly acid; clear smooth boundary.

BA—20 to 26 inches; brown (10YR 4/3) and very dark grayish brown (10YR 3/2) silt loam (about 21 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; common very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) worm casts; slightly acid; clear smooth boundary.

Bt1—26 to 32 inches; brown (10YR 4/3) and yellowish brown (10YR 5/4) silt loam (about 21 percent clay); weak fine and very fine subangular blocky structure; friable; common faint dark brown (10YR 3/3) clay films on faces of peds; few very fine roots; few fine and common very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.

Bt2—32 to 38 inches; yellowish brown (10YR 5/4) silt loam (about 24 percent clay); few fine distinct light brownish gray (2.5Y 6/2), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds and in pores; few white (10YR 8/1) dry silt coats; few very fine roots; few fine and common very fine tubular pores; few dark brown (10YR 3/3) worm casts; slightly acid; clear smooth boundary.

Bt3—38 to 44 inches; yellowish brown (10YR 5/4) silt loam (about 24 percent clay); many fine and medium distinct light brownish gray (2.5Y 6/2) and few fine faint strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of peds and in pores; few white (10YR 8/1) dry silt coats; few very fine roots; few fine and common very fine tubular pores; slightly acid; clear smooth boundary.

2BC—44 to 50 inches; yellowish brown (10YR 5/4) loamy fine sand; common fine distinct light brownish

gray (2.5Y 6/2) mottles; weak fine prismatic structure; very friable; common very fine tubular pores; slightly acid; gradual smooth boundary.

2C—50 to 60 inches; variegated brownish yellow (10YR 6/6) and light brownish gray (10YR 6/2) stratified sand and loamy sand; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; single grained; loose; slightly acid.

Solum thickness and the depth to sandy sediments range from 40 to more than 60 inches. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 10 to 20 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The Bt horizon has value and chroma of 3 to 5. It is silt loam or silty clay loam. The 2C horizon has value of 4 to 8 and chroma of 2 to 6. It dominantly is sand and loamy sand.

Map unit 977B2, Richwood silt loam, 1 to 4 percent slopes, moderately eroded, is a taxadjunct to this series because the A horizon is lighter colored than is defined for this series.

## Rowley Series

The Rowley series consists of somewhat poorly drained soils on stream terraces. These soils formed in silty alluvium and in the underlying loamy and sandy alluvium under native vegetation of prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Rowley silt loam, 0 to 2 percent slopes, in a cultivated field; 1,220 feet west and 200 feet south of the northeast corner of sec. 7, T. 76 N., R. 4 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam (about 22 percent clay), dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; common very fine random pores; slightly acid; abrupt smooth boundary.

A1—9 to 14 inches; very dark brown (10YR 2/2) silt loam (about 20 percent clay), dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

A2—14 to 19 inches; very dark grayish brown (10YR 3/2) silt loam (about 20 percent clay), grayish brown (10YR 5/2) dry; weak fine subangular blocky and granular structure; friable; common very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

BA—19 to 24 inches; dark grayish brown (10YR 4/2) silt

loam (about 25 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; clear smooth boundary.

Btg1—24 to 30 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silt loam (about 26 percent clay); few fine faint grayish brown (2.5Y 5/2) mottles; weak fine and very fine subangular blocky structure; friable; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; common very fine roots; common very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts; medium acid; clear smooth boundary.

Btg2—30 to 36 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silty clay loam (about 29 percent clay); few fine distinct strong brown (7.5YR 5/6) and brown (7.5YR 4/4) mottles; weak faint and very fine subangular blocky structure; friable; common thin dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

Btg3—36 to 47 inches; grayish brown (2.5Y 5/2) silt loam (about 26 percent clay); common fine distinct yellowish brown (10YR 5/4) and few fine prominent brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few faint clay films on faces of peds and in pores; few white (10YR 8/1) dry silt coats; few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

2BCg—47 to 51 inches; light brownish gray (2.5Y 6/2) loam (about 20 percent clay); common fine prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few faint clay films in pores; few white (10YR 8/1) dry silt coats; few very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

2Cg—51 to 60 inches; light gray (10YR 7/2) sand (about 97 percent sand); common fine and medium distinct light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/6) mottles; single grained; neutral.

The solum ranges from 45 to 60 inches in thickness. The depth to the underlying loamy sand or sand is 40 to 60 inches. The mollic epipedon is 14 to 20 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 14 to 20 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The Bg horizon is 16 to 32 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. Its texture is silt loam or silty clay loam. Some pedons have a 2Bg horizon that has a color range like that of the Bg horizon. The 2Bg horizon ranges in texture from loam to loamy sand, and is stratified. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 8, and chroma of 2 to 6. It is fine or medium sand, but in many pedons is stratified with layers of loamy sand.

### Rozetta Series

The Rozetta series consists of moderately well drained, moderately permeable soils on upland side slopes and on low ridgetops. These soils formed in loess under native vegetation of deciduous trees. Slopes range from 5 to 14 percent.

Typical pedon of Rozetta silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 1,500 feet west and 260 feet north of the southeast corner of sec. 18, T. 77 N., R. 1 E.

Ap—0 to 8 inches; brown (10YR 4/3 and 5/3) silt loam (about 23 percent clay), very pale brown (10YR 7/3) dry; few streaks and pockets of silty clay loam subsoil material; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; neutral; abrupt smooth boundary.

Bt1—8 to 18 inches; brown (10YR 5/3) silty clay loam (about 33 percent clay); moderate fine and very fine subangular blocky structure; friable; common faint clay films on faces of pedis; few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—18 to 26 inches; brown (10YR 5/3) silty clay loam (about 34 percent clay); many fine distinct light brownish gray (2.5Y 6/2) and common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate fine and very fine subangular blocky structure; friable; many faint clay films on faces of pedis; few very fine roots; common very fine tubular pores; common fine black (10YR 2/1) concretions

(iron and manganese oxides); medium acid; gradual wavy boundary.

Bt3—26 to 36 inches; brown (10YR 5/3) silty clay loam (about 31 percent clay); many fine distinct light brownish gray (2.5Y 6/2) and common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium and fine subangular blocky structure; friable; common faint clay films on faces of pedis; few very fine roots; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Bt4—36 to 42 inches; brown (10YR 5/3) silty clay loam (about 29 percent clay); many fine and medium distinct light brownish gray (2.5Y 6/2) and common fine distinct yellowish brown (10YR 5/6 and 5/8) and strong brown (7.5YR 5/6 and 5/8) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of pedis; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BC—42 to 52 inches; mottled brown (10YR 5/3), yellowish brown (10YR 5/4), and light brownish gray (2.5Y 6/2) silt loam (about 26 percent clay); common fine distinct yellowish brown (10YR 5/6 and 5/8) and strong brown (7.5YR 5/6 and 5/8) mottles; weak fine prismatic structure; friable; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; diffuse wavy boundary.

C—52 to 60 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silt loam (about 25 percent clay); common fine distinct yellowish brown (10YR 5/6 and 5/8) and strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure; friable; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The solum ranges from 42 to more than 60 inches in thickness. Free carbonates are below a depth of 60 inches. In most pedons glacial till or stratified coarse textures are below a depth of 60 inches, but in a few pedons one or the other is at a depth of 40 inches. The depth to mottles with chroma of 2 varies with landscape position and past erosion.

The Ap horizon is 6 to 9 inches thick. It has value of 3 to 5 and chroma of 2 or 3. Some pedons in uncultivated areas have an E horizon that is 6 to 8



inches thick, but in cultivated areas it has been incorporated into the Ap horizon. Some pedons that have not been eroded have a BE horizon. The Bt horizon has value of 4 to 6 and chroma of 2 to 6 and is mottled. In the upper 10 inches it has chroma of 3 or 4. It is 27 to 35 percent clay, by weight. The C horizon has value of 4 to 6 and chroma of 2 to 6.

## Russell Series

The Russell series consists of well drained, moderately permeable soils on convex side slopes on uplands. These soils formed in loess and in the underlying glacial till under native vegetation of deciduous trees. Slopes range from 9 to 18 percent.

Typical pedon of Russell silt loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 595 feet north and 765 feet east of the center of sec. 16, T. 77 N., R. 1 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam (about 25 percent clay), pale brown (10YR 6/3) dry; mixed with about 20 percent streaks and pockets of yellowish brown (10YR 5/4) silty clay loam subsoil material; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; slightly acid; abrupt smooth boundary.

Bt1—8 to 15 inches; yellowish brown (10YR 5/4) silty clay loam (about 31 percent clay); brown (10YR 4/3) coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; many faint clay films on faces of peds; few very fine roots concentrated along faces of peds; few fine and very fine tubular pores; slightly acid; clear smooth boundary.

Bt2—15 to 20 inches; yellowish brown (10YR 5/4) silty clay loam (about 29 percent clay); brown (10YR 4/3) coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; common faint clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; common fine and very fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt3—20 to 28 inches; yellowish brown (10YR 5/4) silt loam (about 25 percent clay); moderate fine and very fine subangular blocky structure; friable; few faint clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots concentrated

along faces of peds and in pores; common fine and very fine tubular pores; common fine and very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

2Bt4—28 to 36 inches; yellowish brown (10YR 5/4 and 5/6) loam (about 22 percent clay); weak fine prismatic and subangular blocky structure; firm; few faint clay films on faces of peds; few white (10YR 8/1) dry silt coats; very few very fine roots concentrated along faces of peds and in pores; common fine and very fine tubular pores; common fine and very fine black (10YR 2/1) concretions (iron and manganese oxides); about 2 percent gravel; medium acid; gradual smooth boundary.

2BC—36 to 44 inches; yellowish brown (10YR 5/4) loam (about 20 percent clay); many fine and medium distinct strong brown (7.5YR 5/6 and 5/8) and light brownish gray (2.5Y 6/2) and few fine prominent reddish brown (5YR 4/4) mottles; weak fine prismatic structure; firm; few faint clay films in pores; common fine and very fine tubular pores; common fine and very fine black (10YR 2/1) concretions (iron and manganese oxides); about 2 percent gravel; medium acid; gradual smooth boundary.

2C—44 to 60 inches; yellowish brown (10YR 5/4) loam (about 20 percent clay); many fine and medium distinct strong brown (7.5YR 5/6 and 5/8) and light brownish gray (2.5Y 6/2) and few fine prominent reddish brown (5YR 4/4) and yellowish red (5YR 4/6) mottles; massive with vertical parting; firm; few faint clay films in pores; common fine and very fine tubular pores; common fine and very fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent gravel; slightly acid.

The solum ranges from 36 to 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till ranges from 24 to 40 inches.

The Ap horizon is 6 to 9 inches thick. It has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam. Uneroded or slightly eroded pedons have a BE horizon that is as much as 6 inches thick. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. In some pedons high or low chroma mottles are in the Bt horizon immediately above the 2B horizon. The Bt horizon is 22 to 35 percent clay. The 2B horizon has colors like those of the Bt horizon. It is loam or clay loam. The 2C horizon has hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 4 to 6 and has mottles or mottled colors that have chroma of 2. It is loam or clay loam.

## Shaffton Series

The Shaffton series consists of somewhat poorly drained soils on high bottom lands. These soils formed in alluvium under native vegetation of prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Shaffton loam, rarely flooded, 0 to 2 percent slopes, in a cultivated field; 2,090 feet south and 1,190 feet west of the northeast corner of sec. 5, T. 76 N., R. 2 W.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) loam (about 20 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; medium acid; abrupt smooth boundary.
- A1—8 to 15 inches; very dark gray (10YR 3/1) loam (about 20 percent clay), gray (10YR 5/1) dry; weak very fine subangular blocky and granular structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.
- A2—15 to 20 inches; very dark grayish brown (10YR 3/2) loam (about 20 percent clay), grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark gray (10YR 3/1) worm casts; slightly acid; clear wavy boundary.
- Bw1—20 to 28 inches; dark brown (10YR 3/3) and dark grayish brown (10YR 4/2) loam (about 18 percent clay); few fine distinct strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; gradual wavy boundary.
- Bw2—28 to 32 inches; grayish brown (2.5Y 5/2) loam (about 16 percent clay); common fine distinct brown (10YR 5/3) and yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; slightly acid; gradual wavy boundary.
- Bw3—32 to 39 inches; grayish brown (2.5Y 5/2) loam (about 15 percent clay); common fine distinct yellowish brown (10YR 5/6) and few fine prominent reddish brown (5YR 4/4) and yellowish red (5YR

5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; common fine and very fine tubular pores; slightly acid; gradual wavy boundary.

- BC—39 to 48 inches; grayish brown (2.5Y 5/2) sandy loam (about 10 percent clay); common fine and medium prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; very few very fine roots; common very fine tubular pores; slightly acid; gradual wavy boundary.
- C—48 to 60 inches; grayish brown (2.5Y 5/2) sandy loam (about 10 percent clay); common fine prominent reddish brown (5YR 4/4) and yellowish red (5YR 4/6) mottles; massive; very friable; common very fine tubular pores; slightly acid.

The solum ranges from 30 to 50 inches in thickness. The mollic epipedon is 10 to 20 inches thick. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 10 to 20 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. It is loam or silt loam and is high in sand content. The Cg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 6 and is mottled. It is sand, loamy sand, sandy loam, loam, or silt loam and, in some pedons, is stratified with these textures.

## Sparta Series

The Sparta series consists of excessively drained, rapidly permeable soils on stream terraces and uplands. These soils formed in sandy material under native vegetation of prairie grasses. Slopes range from 0 to 14 percent.

Typical pedon of Sparta loamy fine sand, 2 to 5 percent slopes, in a cultivated field; 2,160 feet south and 820 feet east of the northwest corner of sec. 24, T. 77 N., R. 4 W.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy fine sand (about 83 percent sand), grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; very friable; common very fine roots; medium acid; clear smooth boundary.
- A—7 to 12 inches; very dark grayish brown (10YR 3/2) loamy fine sand (about 83 percent sand), grayish brown (10YR 5/2) dry; weak coarse and medium subangular blocky structure; very friable; few very fine roots; few very fine tubular pores; medium acid; gradual smooth boundary.

AB—12 to 18 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loamy fine sand (about 81 percent sand), grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak coarse and medium subangular blocky structure; very friable; few very fine roots; few very fine tubular pores; slightly acid; gradual smooth boundary.

Bw1—18 to 24 inches; dark brown (10YR 3/3) loamy fine sand (about 86 percent sand); weak coarse and medium subangular blocky structure; very friable; few very fine roots; few very fine tubular pores; slightly acid; gradual smooth boundary.

Bw2—24 to 33 inches; brown (10YR 4/3) loamy fine sand (about 84 percent sand); weak coarse and medium subangular blocky structure; very friable; few very fine tubular pores; slightly acid; gradual smooth boundary.

C—33 to 60 inches; light yellowish brown (10YR 6/4) fine sand (about 94 percent sand); single grained; loose; brown (7.5YR 4/4) loamy sand lamellae less than 6 inches thick; medium acid.

The solum ranges from 24 to 40 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 10 to 24 inches thick.

The A horizon is 10 to 18 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is loamy sand or loamy fine sand. Most pedons have an AB horizon. It is loamy fine sand, loamy sand, or fine sand. The B horizon has value and chroma of 3 to 6. Its range in texture is similar to that of the AB horizon but includes sand and loamy sand. The C horizon has value of 4 to 6 and chroma of 3 to 6. In many pedons it has layers or lamellae in which clay and iron have accumulated below a depth of 40 inches. Its texture is sand, loamy sand, and fine sand.

## Sperry Series

The Sperry series consists of very poorly drained, slowly permeable soils in slight depressions on broad, irregular, upland divides. These soils formed in loess and silty local alluvium under native vegetation of wetland prairie grasses. Slopes range from 0 to 1 percent.

Typical pedon of Sperry silt loam, 0 to 1 percent slopes, in a cultivated field; 1,800 feet east and 200 feet north of the southwest corner of sec. 10, T. 77 N., R. 2 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), gray (10YR 5/1) dry; weak

fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

E—10 to 22 inches; dark gray (10YR 4/1) silt loam (about 22 percent clay); few very fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; weak medium and thin platy structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

Btg1—22 to 30 inches; dark gray (10YR 4/1) silty clay loam (about 38 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; few fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; strong fine and very fine subangular blocky structure; firm; few very fine roots; medium acid; clear smooth boundary.

Btg2—30 to 40 inches; gray (5Y 5/1) silty clay loam (about 38 percent clay); dark gray (10YR 4/1) coatings on faces of peds; common fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; strong fine prismatic and subangular blocky structure; firm; very few very fine roots; medium acid; gradual smooth boundary.

Btg3—40 to 48 inches; gray (5Y 5/1) silty clay loam (about 34 percent clay); few dark gray (10YR 4/1) coatings on faces of peds; common fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate fine prismatic and subangular blocky structure; firm; medium acid; gradual smooth boundary.

BCg—48 to 56 inches; gray (5Y 6/1) silty clay loam (about 30 percent clay); common fine prominent brownish yellow (10YR 6/6) and strong brown (7.5YR 6/6) mottles; weak fine prismatic structure; friable; few dark gray (10YR 4/1) coatings in vertical pores; slightly acid; gradual wavy boundary.

Cg—56 to 60 inches; gray (5Y 6/1) silty clay loam (about 28 percent clay); common fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 5/6 and 5/8) mottles; massive; friable; slightly acid.

The solum ranges from 40 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 48 to 60 inches or more. The mollic epipedon is 10 to 16 inches thick and in some pedons is interrupted by the nonmollic E horizon.

The A horizon is 8 to 12 inches thick. It has value of 2 or 3. It is silt loam or silty clay loam. The E horizon is 6 to 12 inches thick. It 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, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 or 2. Some pedons have mottled colors in one or

more Btg horizons, and all Btg horizons have mottles that have hue of 10YR or redder, value of 4 to 6, and chroma of 3 to 8. The Cg horizon has hue of 2.5Y or 5Y, value of 5 to 7, and chroma of 1 or 2.

### Spillville Series

The Spillville series consists of moderately well drained, moderately permeable soils on bottom lands and foot slopes below upland side slopes. These soils formed in loamy alluvium under native vegetation of prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Spillville loam, 0 to 2 percent slopes, in a cultivated field; 1,365 feet north and 175 feet east of the center of sec. 8, T. 78 N., R. 2 W.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) loam (about 20 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common very fine random pores; few fine pebbles; neutral; abrupt smooth boundary.
- A1—8 to 16 inches; very dark brown (10YR 2/2) loam (about 18 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; very few medium fine and few very fine roots; common very fine tubular pores; neutral; clear smooth boundary.
- A2—16 to 30 inches; very dark brown (10YR 2/2) loam (about 20 percent clay), dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; very few medium and fine and few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.
- A3—30 to 38 inches; very dark grayish brown (10YR 3/2) loam (about 25 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine subangular blocky structure; friable; very few medium and fine and few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.
- A4—38 to 50 inches; very dark grayish brown (10YR 3/2) loam (about 20 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine subangular blocky structure; friable; very few medium and fine and few very fine roots; common very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); neutral; gradual smooth boundary.
- C—50 to 60 inches; dark grayish brown (10YR 4/2) loam (about 22 percent clay), brown (10YR 5/3) dry; common fine faint dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; weak

medium and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; common very fine black (10YR 2/1) accumulations (iron and manganese oxides); neutral.

The solum ranges from 30 to 56 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 36 inches or more in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. Below a depth of 36 inches, the A horizon is loam, clay loam, or sandy loam. The C horizon has a range in texture like that of the lower part of the A horizon. It has hue of 10YR or 2.5Y and chroma of 1 to 3 and is mottled. Evident textural stratification varies, but most pedons are stratified in at least part of the C horizon.

### Stronghurst Series

The Stronghurst series consists of somewhat poorly drained, moderately permeable soils on upland ridgetops. These soils formed in loess under native vegetation of deciduous trees. Slopes range from 0 to 3 percent.

Typical pedon of Stronghurst silt loam, 0 to 3 percent slopes, in a cultivated field; 1,250 feet east and 1,840 feet south of the northwest corner of sec. 34, T. 76 N., R. 3 W.

- Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam (about 20 percent clay), light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; friable; common very fine roots; common fine and very fine tubular pores; few grayish brown (10YR 5/2) worm casts; neutral; abrupt smooth boundary.
- E—8 to 13 inches; grayish brown (10YR 5/2) silt loam (about 21 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; weak medium and thin platy structure; friable; common very fine roots; common fine and very fine tubular pores; common dark grayish brown (10YR 4/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; abrupt smooth boundary.
- BE—13 to 17 inches; brown (10YR 5/3) silty clay loam (about 29 percent clay); common fine distinct brown (7.5YR 5/4) and strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few faint grayish brown (10YR 5/2) clay films on faces of peds; common white (10YR 8/1) dry silt coats; common very fine roots; common fine and

very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

- Btg1**—17 to 24 inches; brown (10YR 5/3) silty clay loam (about 35 percent clay); common fine distinct light gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; common white (10YR 8/1) dry silt coats; common very fine roots concentrated along vertical faces of peds; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
- Btg2**—24 to 30 inches; mottled light gray (10YR 6/1) and yellowish brown (10YR 5/6 and 5/8) silty clay loam (about 35 percent clay); few fine prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; friable; many faint grayish brown (2.5Y 5/2) clay films on faces of peds; common white (10YR 8/1) dry silt coats; few very fine roots concentrated along vertical faces of peds; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.
- Btg3**—30 to 37 inches; mottled light gray (10YR 6/1) and yellowish brown (10YR 5/6 and 5/8) silty clay loam (about 34 percent clay); common fine prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles; weak medium prismatic and subangular blocky structure; friable; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; few very fine roots concentrated along vertical faces of peds; few fine and very fine tubular pores; common fine black concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.
- BCg**—37 to 48 inches; light gray (10YR 6/1) silty clay loam (about 29 percent clay); many fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6 and 5/8) mottles; weak medium prismatic structure; friable; few faint clay films on faces of peds; few fine and very fine tubular pores; common fine black concretions (iron and manganese oxides); medium acid; gradual wavy boundary.
- Cg**—48 to 60 inches; light gray (10YR 6/1) silt loam (about 26 percent clay); many fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 5/8) mottles; massive with vertical parting;

friable; few fine and very fine tubular pores; common fine black concretions (iron and manganese oxides); medium acid.

The solum ranges from 42 to more than 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 48 to more than 60 inches.

The Ap horizon is 7 to 9 inches thick. It has value of 4 or 5 and chroma of 1 or 2. In undisturbed pedons the E horizon is 4 to 10 inches thick, but in cultivated pedons part of the E horizon is incorporated into the Ap horizon. The E horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4 and is mottled throughout. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4.

### Tama Series

The Tama series consists of well drained, moderately permeable soils on upland ridgetops and side slopes and on high terraces. These soils formed in loess under native vegetation of prairie grasses. Slopes range from 2 to 14 percent.

Typical pedon of Tama silt loam, 2 to 5 percent slopes, in a cultivated field; 2,080 feet west and 80 feet south of the northeast corner of sec. 27, T. 78 N., R. 1 W.

- Ap**—0 to 8 inches; very dark brown (10YR 2/2) silt loam (about 26 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; medium acid; clear smooth boundary.
- A**—8 to 15 inches; very dark brown (10YR 2/2) silt loam (about 26 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.
- BA**—15 to 20 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) silty clay loam (about 28 percent clay); very dark grayish brown (10YR 3/2) faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few very dark brown (10YR 2/2) worm casts; medium acid; clear smooth boundary.
- Bt1**—20 to 24 inches; brown (10YR 4/3) and yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); weak fine and very fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; few very fine roots;

common very fine tubular pores; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; medium acid; clear wavy boundary.

Bt2—24 to 30 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); weak fine and very fine subangular blocky structure; friable; many faint brown (10YR 4/3) clay films on faces of peds; few patchy light gray (10YR 7/2) dry silt and very fine sand coats; few very fine roots; common very fine tubular pores; few brown (10YR 4/3) worm casts; very few very fine strong brown (7.5YR 5/6) stains (iron oxides); medium acid; clear wavy boundary.

Bt3—30 to 34 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); weak medium and fine subangular blocky structure; friable; common faint clay films on faces of peds; few patchy light gray (10YR 7/2) dry silt and very fine sand coats; common very fine tubular pores; few fine strong brown (7.5YR 5/6) stains (iron oxide); few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Bt4—34 to 42 inches; yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); few fine distinct brownish yellow (10YR 6/6) and light brownish gray (2.5Y 6/2) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of peds; few patchy light gray (10YR 7/2) dry silt and very fine sand coats; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BC—42 to 50 inches; mottled yellowish brown (10YR 5/4) and light brownish gray (2.5Y 6/2) silty clay loam (about 28 percent clay); common fine distinct brownish yellow (10YR 6/6) mottles; weak fine prismatic structure; friable; few faint clay films in pores; few patchy light gray (10YR 7/2) dry silt and very fine sand coats; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

C—50 to 60 inches; mottled yellowish brown (10YR 5/4) and light brownish gray (2.5Y 6/2) silt loam (about 25 percent clay); common fine distinct brownish yellow (10YR 6/6) mottles; very weak medium and fine prismatic structure; friable; few very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The solum ranges from 42 to more than 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The depth to stratified coarse textures ranges from 40 to more than 60 inches. The mollic epipedon is 10 to 16 inches thick.

The A horizon is 10 to 16 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Most pedons have an AB or BA horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is 27 to 34 percent clay, by weight. The C horizon has value of 4 or 5 and chroma of 2 to 6. In most pedons lower chromas are also present in mottles or mottled colors below a depth of about 30 inches. These mottles and mottled colors are related to relict weathering zones in the loess and not to present drainage.

Map units 120C2, 120C3, 120D2, 120D3, 920C2, and 920C3 are taxadjuncts because the A horizon is lighter colored than is defined for this series.

### Thebes Series

The Thebes series consists of well drained soils on ridgetops and side slopes on uplands and on stream terraces. These soils formed in loess and the underlying sandy sediments under native vegetation of deciduous trees. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 2 to 14 percent.

Typical pedon of Thebes silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 1,725 feet east and 1,020 feet south of the northwest corner of sec. 20, T. 77 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam (about 21 percent clay), light brownish gray (10YR 6/2) dry; mixed with streaks and pockets of yellowish brown (10YR 5/4) silty clay loam subsoil material; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; abrupt wavy boundary.

Bt1—7 to 12 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); moderate fine and very fine subangular blocky structure; friable; common faint brown (10YR 4/3 and 5/3) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots concentrated on faces of peds and in pores; few fine and common very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

**Bt2**—12 to 18 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); moderate fine and very fine subangular blocky structure; friable; many faint brown (10YR 5/3) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots concentrated along faces of peds and in pores; few fine and common very fine tubular pores; few strong brown (7.5YR 5/6) stains (iron oxides) on faces of peds; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; gradual smooth boundary.

**Bt3**—18 to 23 inches; yellowish brown (10YR 5/4) silty clay loam (about 31 percent clay); moderate medium and fine subangular blocky structure; friable; many faint brown (10YR 5/3) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots along faces of peds and in pores; common fine and very fine tubular pores; few strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) stains (iron oxides) on faces of peds; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; gradual wavy boundary.

**Bt4**—23 to 28 inches; yellowish brown (10YR 5/4) silty clay loam (about 28 percent clay); moderate fine prismatic and subangular blocky structure; friable; common faint brown (10YR 5/3) clay films on faces of peds; few white (10YR 8/1) dry silt coats; few very fine roots concentrated along faces of peds and in pores; few fine and common very fine tubular pores; few strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) stains (iron oxides) on faces of peds; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; clear wavy boundary.

**2BC**—28 to 33 inches; yellowish brown (10YR 5/4) loam with a few thin sandy loam and loamy sand lenses (about 18 percent clay); weak medium and fine prismatic structure; friable; few faint clay films on faces of peds; very few very fine roots concentrated in pores; few fine and common very fine tubular pores; few strong brown (7.5YR 5/6 and 5/8) stains (iron oxides); strongly acid; gradual wavy boundary.

**2C**—33 to 60 inches; yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) stratified loamy sand and sand (about 80 percent sand); single grained; loose; common strong brown (7.5YR 5/8) and few yellowish brown (10YR 5/4) sandy loam lamellae; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid.

The solum thickness ranges from 20 to 40 inches. It is the same as or a few inches more than the depth to the underlying loamy sand or sand. Free carbonates are below a depth of 60 inches.

The Ap horizon is 6 to 9 inches thick. It has value of 4 or 5 and chroma of 2 to 4. Undisturbed pedons have a very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2) A horizon that is 2 to 6 inches thick. Some pedons have an E horizon that has value of 4 or 5 and chroma of 2 or 3. The Bt horizon is 14 to 24 inches thick. It is silty clay loam grading, in some pedons, to silt loam or loam in the lower part. It has value and chroma of 4 or 5. The 2BC and 2C horizons have a stratified texture and increase in sand content with depth. The 2C horizon is loamy sand and sand but has thin layers of finer textures.

### Toolesboro Series

The Toolesboro series consists of poorly drained soils on bottom lands. These soils formed in loamy and sandy alluvium under native vegetation of prairie grasses. Permeability is moderately rapid in the solum and very rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Toolesboro sandy loam, 0 to 2 percent slopes, in a cultivated field; 2,360 feet east and 175 feet south of the northwest corner of sec. 19, T. 76 N., R. 2 W.

**Ap**—0 to 8 inches; black (10YR 2/1) sandy loam (about 15 percent clay), dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.

**AB**—8 to 12 inches; very dark gray (10YR 3/1) sandy loam (about 10 percent clay); few fine faint dark grayish brown (2.5Y 4/2) mottles; weak very fine subangular blocky and granular structure; friable; few very fine roots; few very fine tubular pores; few light olive brown (2.5Y 5/4) worm casts; neutral; clear wavy boundary.

**Bw1**—12 to 17 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) sandy loam (about 10 percent clay); common fine and medium distinct yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; very friable; few very fine roots; few very fine tubular pores; few very dark gray (10YR 3/1) worm casts and root channels; neutral; clear wavy boundary.

**Bw2**—17 to 25 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) sandy loam (about

12 percent clay); common fine and medium distinct strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; very friable; few very fine roots; few very fine tubular pores; very few very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) worm casts and root channels; neutral; gradual wavy boundary.

Bw3—25 to 34 inches; mottled grayish brown (2.5Y 5/2) and gray (10YR 5/1) coarse sandy loam (about 16 percent clay); many fine prominent strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; very friable; neutral; clear wavy boundary.

BC—34 to 41 inches; mottled dark gray (10YR 4/1) and strong brown (7.5YR 5/6) coarse sandy loam (about 12 percent clay); weak medium subangular blocky structure; very friable; neutral; gradual wavy boundary.

C1—41 to 48 inches; mottled dark gray (10YR 4/1) and brown (7.5YR 5/4) loamy coarse sand (about 9 percent clay); single grained; loose; neutral; gradual wavy boundary.

C2—48 to 60 inches; brown (7.5YR 5/4) coarse sand (about 96 percent sand); single grained; loose; neutral.

The solum ranges from 30 to 50 inches in thickness. The mollic epipedon is 10 to 14 inches thick. Free carbonates, if any, are below a depth of 60 inches. Gravel content typically increases with depth and is 5 percent or less in the solum. Coarse and very coarse sand content generally increases irregularly with depth.

The A horizon is 10 to 14 inches thick. It has hue of 10YR or 7.5YR and chroma of 1 or 2. It is sandy loam or loam. The B horizon has value of 3 to 5 and chroma of 1 to 6. It is sandy loam or loam in the upper part and grades to loamy sand or coarse sandy loam in the lower part. The C horizon is loamy coarse sand, coarse sand, or sand.

### Traer Series

The Traer series consists of poorly drained, slowly permeable soils on broad, upland ridgetops. These soils formed in loess under native vegetation of deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Traer silt loam, 0 to 2 percent slopes, in a cultivated field; 1,585 feet east and 790 feet north of the southwest corner of sec. 24, T. 77 N., R. 1 W.

Ap—0 to 11 inches; dark gray (10YR 4/1) silt loam (about 19 percent clay), light brownish gray (10YR

6/2) dry; weak medium platy and fine and very fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; few light brownish gray (2.5Y 6/2) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; abrupt smooth boundary.

E—11 to 17 inches; light brownish gray (2.5Y 6/2) silt loam (about 20 percent clay); brown (10YR 5/3) coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure; friable; few very fine roots; common fine and very fine tubular pores; few dark gray (10YR 4/1) worm casts; common fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.

BE—17 to 21 inches; grayish brown (2.5Y 5/2) silty clay loam (about 27 percent clay); brown (10YR 5/3) coatings on faces of peds; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common white (10YR 8/1) dry silt coats; few very fine roots; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Btg1—21 to 27 inches; mottled, grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay loam (about 39 percent clay); grayish brown (2.5Y 5/2) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; moderate medium and fine angular blocky and subangular blocky structure; firm; many faint clay films on faces of peds and in pores; common white (10YR 8/1) dry silt coats; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Btg2—27 to 32 inches; mottled, grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and dark yellowish brown (10YR 4/6) silty clay loam (about 38 percent clay); grayish brown (10YR 5/2) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; moderate fine prismatic and angular blocky structure; firm; many faint clay films on faces of peds and in pores; few white (10YR 8/1) dry silt coats; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Btg3—32 to 38 inches; mottled, grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay loam



(about 37 percent clay); grayish brown (10YR 5/2) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; weak fine prismatic and angular blocky structure; friable; common faint clay films on faces of peds and in pores; few white (10YR 8/1) dry silt coats; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

Btg4—38 to 46 inches; grayish brown (2.5Y 5/2) silty clay loam (about 30 percent clay); many fine prominent yellowish brown (10YR 5/4 and 5/6) and common fine prominent strong brown (7.5YR 5/6) mottles; weak fine prismatic and angular blocky structure; friable; few faint clay films on faces of peds and in pores; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

BCg—46 to 54 inches; mottled, light brownish gray (2.5Y 6/2), brownish yellow (10YR 6/6), and yellowish brown (10YR 5/6) silty clay loam (about 28 percent clay); few fine prominent yellowish brown (10YR 5/4) and brown (7.5YR 5/4) mottles; weak medium and fine prismatic structure; friable; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

Cg—54 to 60 inches; mottled, brownish yellow (10YR 6/6) and light brownish gray (2.5Y 6/2) silt loam (about 26 percent clay); common fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; massive; friable; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The solum ranges from 40 to 60 inches in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 48 to more than 60 inches.

The Ap horizon is 6 to 12 inches thick. It has value of 4 and chroma of 1 or 2. Undisturbed pedons have an A horizon that is 2 to 5 inches thick and that has value of 3 and chroma of 1 or 2. The E horizon is 3 to 8 inches thick. It has value of 5 or 6 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It has mottles that have hue of 10YR to 7.5YR and high chroma. Most pedons have a BCg horizon. The Cg horizon has hue of 10YR, 2.5Y, or

5Y, value of 4 to 6, and chroma of 2 to 6. It has mottles that have hue of 10YR to 7.5YR and high chroma.

## Tuskeego Series

The Tuskeego series consists of poorly drained soils on stream terraces. These soils formed in silty alluvium under native vegetation of prairie grasses and deciduous trees. Permeability is slow in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Tuskeego silt loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field; 1,390 feet east and 175 feet north of the southwest corner of sec. 26, T. 78 N., R. 3 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few very fine random pores; medium acid; abrupt smooth boundary.

E1—9 to 16 inches; gray (10YR 5/1) silt loam (about 22 percent clay); weak thin platy structure; friable; few very fine roots; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) pore fillings; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

E2—16 to 21 inches; gray (10YR 5/1) silt loam (about 24 percent clay); few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak thin platy structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) pore fillings; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

Btg1—21 to 27 inches; gray (10YR 5/1) silty clay loam (about 35 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots; common fine and very fine tubular pores; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); medium acid; clear smooth boundary.

Btg2—27 to 36 inches; gray (5Y 5/1) silty clay loam (about 37 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown

(7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; common faint dark gray (10YR 4/1) clay films on faces of peds and in pores; few very fine roots; common fine and very fine tubular pores; few very dark gray (10YR 3/1) pore fillings; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

**Btg3**—36 to 43 inches; gray (5Y 5/1) silty clay loam (about 30 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds and in pores; common fine and very fine tubular pores; few very dark gray (10YR 3/1) pore fillings; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

**BCg**—43 to 55 inches; gray (5Y 6/1) silt loam (about 25 percent clay); common fine and medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few faint very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds and in pores; common fine and very fine tubular pores; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

**Cg**—55 to 60 inches; gray (5Y 6/1) loamy sand stratified with silt loam strata (about 10 percent clay); common fine and medium prominent yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; massive; friable; few fine and very fine tubular pores; few fine and very fine black (10YR 2/1) accumulations (iron and manganese oxides); neutral.

The solum ranges from 48 to 60 inches or more in thickness. Free carbonates, if any, are below a depth of 60 inches. Stratified textures are below a depth of 48 inches.

The A horizon is 6 to 10 inches thick. It has value of 3 and chroma of 1 or 2. The E horizon is 8 to 12 inches thick. It has value of 4 to 6 and chroma of 1 or 2. Some pedons have a BE horizon. The Bt horizon is 20 to 40 inches thick. It has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 1 or 2, but hue ranges to 5Y in the lower part. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 to 4. It is typically loamy sand or sand and has strata of silt loam.

## Udolpho Series

The Udolpho series consists of poorly drained soils on stream terraces and uplands. These soils formed in loamy alluvium underlain by sandy alluvium under native vegetation of mixed prairie grasses and deciduous trees. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Udolpho loam, 32 to 40 inches to sand, 0 to 2 percent slopes, in a cultivated field; 1,155 feet east and 195 feet north of the southwest corner of sec. 32, T. 77 N., R. 4 W.

**Ap**—0 to 9 inches; very dark gray (10YR 3/1) loam (about 18 percent clay), gray (10YR 5/1) dry; weak fine granular structure; friable; few very fine roots; few and very fine random pores; neutral; abrupt smooth boundary.

**E**—9 to 14 inches; grayish brown (2.5Y 5/2) loam (about 15 percent clay); common fine prominent yellowish brown (10YR 5/4 and 5/6) mottles; weak medium and thin platy structure; friable; few very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

**Btg1**—14 to 23 inches; grayish brown (2.5Y 5/2) clay loam (about 30 percent clay); common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; few very dark grayish brown (2.5Y 3/2) very fine sand and silt coatings on vertical faces of peds; few very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

**Btg2**—23 to 28 inches; gray (5Y 5/1) clay loam (about 32 percent clay); few fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common faint dark grayish brown (2.5Y 4/2) and gray (5Y 5/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

**2BCg**—28 to 32 inches; gray (5Y 5/1) sandy loam (about 18 percent clay); few fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few brown (7.5YR

4/4 concretions (iron oxides); medium acid; gradual wavy boundary.

2Cg1—32 to 39 inches; gray (5Y 5/1) stratified loamy sand and sand (about 8 percent clay); few fine prominent yellowish brown (10YR 5/4 and 5/6) mottles; single grained; loose; very few very fine roots; few very fine tubular pores; medium acid; clear wavy boundary.

2Cg2—39 to 60 inches; gray (5Y 6/1) stratified sand and coarse sand that has a few sandy loam and loamy sand lenses (less than 5 percent clay); single grained; loose; medium acid.

The solum ranges from 32 to 40 inches in thickness. In most places it is the same as the depth to the underlying sands. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 6 to 10 inches thick. It has value of 2 or 3. It is loam or silt loam. The E horizon is 3 to 6 inches thick, but in some pedons most or all of the E horizon has been incorporated into the Ap horizon. The E horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 1 or 2. It is loam or silt loam. The Btg horizon has value of 4 or 5. It is loam, clay loam, silt loam, or silty clay loam. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4. It is sand or loamy sand. In some pedons it has thin strata of finer textures.

## Vesser Series

The Vesser series consists of poorly drained, moderately permeable soils on foot slopes and high bottom lands. These soils formed in silty alluvium under native vegetation of prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Vesser silt loam, 2 to 5 percent slopes, in a cultivated field; 1,780 feet east and 420 feet north of the center of sec. 3, T. 77 N., R. 1 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; few very fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

A—7 to 14 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few very fine roots; common very fine tubular pores; common dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) worm casts; medium acid; clear smooth boundary.

E1—14 to 18 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam (about 20 percent clay); weak medium platy structure; friable; few very fine roots; common very fine tubular pores; common very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; common 1- to 2-mm and 2- to 5-mm and few 5- to 10-mm black (10YR 2/1) and yellowish brown (10YR 5/4) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

E2—18 to 26 inches; gray (10YR 5/1) silt loam (about 20 percent clay); weak medium platy structure; friable; few very fine roots; common very fine tubular pores; few dark gray (10YR 4/1) worm casts and pore fillings; common 1- to 2-mm and 2- to 5-mm and few 5- to 10-mm black (10YR 2/1) and yellowish brown (10YR 5/4) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Btg1—26 to 33 inches; gray (10YR 5/1) silty clay loam (about 28 percent clay); common fine distinct yellowish brown (10YR 5/4 and 5/6) and strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few faint very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; common 1- to 2-mm and 2- to 5-mm and few 5- to 10-mm black (10YR 2/1) and yellowish brown (10YR 5/4) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Btg2—33 to 48 inches; gray (10YR 5/1) silty clay loam (about 34 percent clay); many fine distinct yellowish brown (10YR 5/4 and 5/6) and strong brown (7.5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; common faint very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; common very fine tubular pores; common 1- to 2-mm and 2- to 5-mm and few 5- to 10-mm black (10YR 2/1) and yellowish brown (10YR 5/4) concretions and common very fine black (10YR 2/1) accumulations (iron and manganese oxides); slightly acid; gradual smooth boundary.

Btg3—48 to 60 inches; gray (10YR 5/1) silty clay loam (about 32 percent clay); many fine distinct yellowish brown (10YR 5/4 and 5/6) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few faint very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) clay films on faces of peds; common very fine tubular pores; common very fine black (10YR 2/1)

accumulations (iron and manganese oxides); slightly acid; neutral; gradual smooth boundary.

The solum is more than 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 12 to 20 inches thick.

The A horizon is 12 to 18 inches thick. It has value of 3 and chroma of 1 or 2. The E horizon is 12 to 20 inches thick. It has value of 3 to 5 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The Btg horizon is silty clay loam, but in some pedons sand content increases with depth and texture ranges to clay loam below a depth of 48 inches.

### Walford Series

The Walford series consists of poorly drained, moderately slowly permeable soils on broad, irregular upland ridgetops and in the upper part of upland drainageways. These soils formed in loess under native vegetation of prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Walford silt loam, 0 to 2 percent slopes, in a cultivated field; 2,310 feet east and 165 feet south of the northwest corner of sec. 4, T. 77 N., R. 1 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam (about 25 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; few fine and very fine random tubular pores; few very fine yellowish red (5YR 5/8) concretions (iron oxides); neutral; abrupt smooth boundary.

E—9 to 16 inches; dark grayish brown (2.5Y 4/2) silt loam (about 26 percent clay); weak medium and thin platy and fine granular structure; friable; few very fine roots; common fine and very fine tubular pores; few very dark gray (10YR 3/1) root channels; few very fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); medium acid; clear smooth boundary.

Bg—16 to 21 inches; gray (10YR 5/1) silty clay loam (about 30 percent clay); common fine and medium prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate fine and very fine subangular blocky structure; friable; common light gray (10YR 7/1) dry silt coats on faces of pedis; few very fine roots; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and

manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); medium acid; clear smooth boundary.

Btg1—21 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam (about 34 percent clay); common fine and medium prominent brownish yellow (10YR 6/6 and 6/8) and few fine faint gray (5Y 6/1) mottles; moderate fine and very fine subangular blocky structure; friable; few faint clay films on faces of pedis; common light gray (10YR 7/1) dry silt coats on faces of pedis; very few very fine roots; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); strongly acid; clear wavy boundary.

Btg2—26 to 34 inches; light olive gray (5Y 6/2) silty clay loam (about 38 percent clay); many fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; moderate medium and fine subangular blocky structure; friable; few faint clay films on faces of pedis; common light gray (10YR 7/1) dry silt coats on faces of pedis; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); medium acid; gradual wavy boundary.

BCg—34 to 44 inches; light olive gray (5Y 6/2) silty clay loam (about 33 percent clay); many fine prominent brownish yellow (10YR 6/6 and 6/8) and few fine prominent strong brown (7.5YR 5/8) mottles; weak fine prismatic and subangular blocky structure; friable; few light gray (10YR 7/1) dry silt coats on faces of pedis; common very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/6) concretions (iron oxides); slightly acid; gradual wavy boundary.

Cg—44 to 60 inches; light olive gray (5Y 6/2) silt loam (about 26 percent clay); many fine prominent brownish yellow (10YR 6/6 and 6/8) and few fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; common very fine tubular pores; common fine and medium black (10YR 2/1) concretions (iron and manganese oxides); few very fine yellowish red (5YR 5/8) concretions (iron oxides); neutral.

The solum ranges from 42 to 60 inches or more in thickness. Free carbonates are below a depth of 60 inches. The depth to glacial till or to stratified coarse textures ranges from 48 to more than 60 inches.

The Ap horizon is 7 to 9 inches thick. It has value of 3 and chroma of 1 or 2. The E horizon is 3 to 10 inches thick. It 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. It has mottles that have hue of 10YR or 7.5Y and high chroma. Most pedons have a BC horizon. The Cg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It has mottles that have redder hues and higher chromas. In some pedons the 2C horizon is above a depth of 60 inches.

### Watseka Series

The Watseka series consists of somewhat poorly drained, rapidly permeable soils on stream terraces. These soils formed in wind- or water-sorted sandy sediments under native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Watseka loamy fine sand, 0 to 2 percent slopes, in a cultivated field; 1,410 feet west and 210 feet north of the center of sec. 22, T. 77 N., R. 4 W.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand (about 10 percent clay), grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine and very fine roots; slightly acid; clear smooth boundary.
- A—9 to 15 inches; very dark grayish brown (10YR 3/2) loamy fine sand (about 8 percent clay), grayish brown (10YR 5/2) dry; weak fine subangular blocky and granular structure; very friable; common fine and very fine roots; slightly acid; gradual smooth boundary.
- BA—15 to 24 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) loamy fine sand (about 5 percent clay); weak fine subangular blocky structure; very friable; common fine and very fine roots; few very dark grayish brown (10YR 3/2) root channel fillings; neutral; gradual smooth boundary.
- Bw—24 to 30 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) fine sand (less than 5 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; loose; few fine and very fine roots; slightly acid; clear wavy boundary.
- C1—30 to 48 inches; mottled dark grayish brown (10YR 4/2), brown (10YR 4/3), and light brownish gray (10YR 6/2) fine sand (less than 5 percent clay); single grained; slightly acid; gradual wavy boundary.

C2—48 to 60 inches; mottled brown (10YR 4/3 and 5/3) and yellowish brown (10YR 5/4) stratified fine sand and sand (less than 2 percent clay); single grained; slightly acid.

The solum ranges from 24 to 40 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 3 and chroma of 1 or 2. It is loamy fine sand or loamy sand. The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2 to 4. It is loamy fine sand, fine sand, or sand. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 1 to 4. It is loamy fine sand, fine sand, or sand.

### Waubeek Series

The Waubeek series consists of well drained, moderately permeable soils on upland side slopes. These soils formed in 20 to 40 inches of loess and in the underlying glacial till under native vegetation of prairie grasses and deciduous trees. Slopes range from 5 to 14 percent.

Typical pedon of Waubeek silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 1,705 feet south and 335 feet west of the northeast corner of sec. 25, T. 78 N., R. 1 W.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay), grayish brown (10YR 5/2) dry; mixed with about 20 percent streaks and pockets of brown (10YR 4/3) silty clay loam subsoil material; weak fine and very fine granular structure; friable; few very fine roots; few very fine random tubular pores; neutral; abrupt smooth boundary.
- Bt1—7 to 12 inches; brown (10YR 4/3) silty clay loam (about 30 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine and very fine subangular blocky and granular structure; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots concentrated along faces of peds and in pores; few medium and common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.
- Bt2—12 to 19 inches; yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); moderate fine and very fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films on faces of

pedes and in pores; few light gray (10YR 7/2) dry silt coats; few very fine roots concentrated along faces of pedes and in pores; common fine and very fine tubular pores; common brown (10YR 4/3) and very dark grayish brown (10YR 3/2) worm casts; medium acid; clear smooth boundary.

Bt3—19 to 26 inches; yellowish brown (10YR 5/4) silty clay loam (about 28 percent clay); moderate fine and very fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films on faces of pedes and in pores; few light gray (10YR 7/2) dry silt coats; few very fine roots concentrated along faces of pedes and in pores; common fine and very fine tubular pores; few brown (10YR 4/3) and very dark grayish brown (10YR 3/2) worm casts; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

2Bt4—26 to 32 inches; yellowish brown (10YR 5/4) loam (about 20 percent clay); few fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine and very fine prismatic structure; friable; few faint brown (10YR 5/3) clay films on faces of pedes and in pores; few light gray (10YR 7/2) dry silt coats; few very fine roots concentrated along faces of pedes and in pores; common fine and very fine tubular pores; common very fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear smooth boundary.

2BC—32 to 45 inches; yellowish brown (10YR 5/4) loam with few thin sand lenses (about 18 percent clay); few fine distinct light brownish gray (2.5Y 6/2), strong brown (7.5YR 5/8), and yellowish red (5YR 5/8) mottles; weak fine prismatic structure; friable; few faint clay films on faces of pedes and in pores; few light gray (10YR 7/2) dry silt coats; common fine and very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2C—45 to 60 inches; yellowish brown (10YR 5/4) loam (about 26 percent clay); common fine distinct light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/8), and strong brown (7.5YR 5/8) mottles; massive; firm; few faint clay films in pores; weak very fine tubular pores; common fine black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The solum ranges from 42 to 60 inches in thickness. Free carbonates are below a depth of 40 inches. The depth to glacial till ranges from 20 to 40 inches. In

some pedons layers of sandy loam and loamy sand as much as 6 inches thick are between the loess and the glacial till.

The A horizon is 6 to 9 inches thick. It has chroma of 1 or 2. Uncultivated areas have an E horizon, but in most cultivated areas it has been incorporated into the Ap horizon. It has value of 4 and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. In some pedons it has high and low chroma mottles immediately above the 2B horizon. The 2B and 2C horizons have hue of 10YR or 7.5YR and chroma of 4 to 8, and chroma of 2 in mottles or mottled colors. They are loam or clay loam.

### Whittier Series

The Whittier series consists of well drained soils on convex ridges and side slopes on uplands and on stream terraces. These soils formed in loess and in the underlying sandy sediments under native vegetation of prairie grasses and deciduous trees. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 2 to 14 percent.

Typical pedon of Whittier silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 1,390 feet east and 480 feet south of the northwest corner of sec. 35, T. 76 N., R. 4 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) silt loam (about 22 percent clay), brown (10YR 5/3) dry; mixed with some streaks and pockets of yellowish brown (10YR 5/4) silty clay loam subsoil material; weak fine and very fine granular structure; friable; few very fine roots; common very fine random pores; medium acid; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) silty clay loam (about 32 percent clay); brown (10YR 4/3) coatings on faces of pedes; weak fine and very fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films on faces of pedes; few very fine roots; common fine and very fine tubular pores; common very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; medium acid; clear smooth boundary.

Bt2—15 to 23 inches; yellowish brown (10YR 5/4) silty clay loam (about 30 percent clay); moderate fine and very fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of pedes; few light gray (10YR 7/1) dry silt coats; few very fine roots; common fine and very fine tubular pores; medium acid; gradual wavy boundary.

Bt3—23 to 32 inches; yellowish brown (10YR 5/4) silty

clay loam (about 28 percent clay); few fine distinct light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6) mottles; moderate faint and very fine subangular blocky structure; friable; common thin brown (10YR 4/3) clay films on faces of peds; few light gray (10YR 7/1) dry silt coats; few very fine roots; common fine and very fine tubular pores; common sand grains in pores; medium acid; clear wavy boundary.

2BC1—32 to 36 inches; yellowish brown (10YR 5/4) loam (about 18 percent clay); few fine distinct light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6) mottles; weak fine prismatic and subangular blocky structure; friable; few faint clay films on faces of peds and in pores; very few very fine roots; common fine and very fine tubular pores; medium acid; clear wavy boundary.

2BC2—36 to 42 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) loamy sand (about 6 percent clay); weak medium prismatic structure; very friable; very few very fine roots; few very fine tubular pores; 1-inch yellowish brown (10YR 5/8) band at about 38 inches; medium acid; gradual wavy boundary.

2C—42 to 60 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) sand with a few thin brown (10YR 5/3) and yellowish brown (10YR 5/8) sandy loam and loamy sand lenses (about 91 percent sand); single grained; loose; medium acid.

The solum ranges from 30 to 48 inches in thickness. In most pedons it extends a few inches into the underlying loamy sand or sand. Free carbonates, if any, are below a depth of 60 inches. The depth to sandy material ranges from 24 to 40 inches.

The A horizon is 6 to 9 inches thick. The E horizon is as much as 6 inches thick, but in most pedons it has been incorporated into the Ap horizon. Some pedons have a BE horizon, but some that are eroded do not. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. The 2C horizon is stratified sand or loamy sand.

## Zook Series

The Zook series consists of poorly drained, slowly permeable soils on bottom lands. These soils formed in silty alluvium under native vegetation of wetland prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Zook silty clay, 0 to 2 percent slopes, in a cultivated field; 1,200 feet west and 400 feet south of the northeast corner of sec. 35, T. 76 N., R. 3 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay (about 42 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; few very fine roots; few very fine random pores; neutral; abrupt smooth boundary.

A1—8 to 20 inches; black (10YR 2/1) silty clay (about 40 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine subangular blocky and granular structure; firm; few very fine tubular pores; common fine yellowish red (5YR 5/6) concretions (iron oxides); neutral; gradual wavy boundary.

A2—20 to 38 inches; black (10YR 2/1) silty clay loam (about 35 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common fine yellowish red (5YR 5/6) concretions (iron oxides); neutral; gradual wavy boundary.

Bg—38 to 50 inches; black (10YR 2/1) silty clay loam (about 36 percent clay), dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; firm; few very fine roots; common fine and very fine tubular pores; common fine yellowish red (5YR 5/6) concretions (iron oxides); neutral; clear wavy boundary.

BCg—50 to 58 inches; dark gray (5YR 4/1) and gray (5Y 5/1) silt loam (about 22 percent clay); black (10YR 2/1) and very dark gray (10YR 3/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic and subangular blocky structure; friable; very few very fine roots; common fine and very fine tubular pores; neutral; clear wavy boundary.

Cg—58 to 60 inches; light olive gray (5Y 6/2) silt loam (about 20 percent clay); common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; few very fine tubular pores; few dark gray (5Y 4/1) coatings in root channels; common fine black (10YR 2/1) concretions (iron and manganese oxides); mildly alkaline.

The solum ranges from 36 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches. The A and Bg horizons are silty clay loam or silty clay and typically contain 36 to 45 percent clay, by weight. But in some pedons the A horizon in the upper part ranges to 32 percent clay, by weight. The mollic epipedon ranges from 36 to 50 inches in thickness.

The A horizon is 36 to 50 inches thick. It is neutral in hue or has hue of 10YR. It has value of 2 or 3. The Bg horizon has hue of 10YR to 5Y and value of 2 or 3. Some pedons do not have a BCg horizon. The Cg

horizon has a color range like that of the B horizon. Below a depth of 58 inches it is silty clay loam or silt loam.

## Zwingle Series

The Zwingle series consists of poorly drained, very slowly permeable soils on stream terraces. These soils formed in silty and clayey alluvium under native vegetation of deciduous trees. Slopes range from 2 to 9 percent.

These soils are taxadjuncts to the Zwingle series because the clay content of the Bt and Btg horizons is less than is definitive for the Zwingle series.

Typical pedon of Zwingle silt loam, 2 to 9 percent slopes, in woodland; 1,530 feet east and 1,050 feet north of the southwest corner of sec. 17, T. 77 N., R. 1 E.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam (about 22 percent clay), gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few medium and common very fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

E—4 to 8 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) silt loam (about 20 percent clay); few fine distinct light brownish gray (10YR 6/2) mottles; weak medium and thin platy structure; friable; few very fine roots; common very fine tubular pores; medium acid; abrupt smooth boundary.

Bt1—8 to 15 inches; brown (7.5YR 5/4) silty clay loam (about 35 percent clay); few fine faint reddish brown (5YR 4/4) mottles; moderate fine and very fine subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; few very fine tubular pores; very strongly acid; clear smooth boundary.

Bt2—15 to 22 inches; brown (7.5YR 5/2) silty clay loam (about 38 percent clay); few fine faint grayish brown (2.5Y 5/2) mottles; moderate medium and fine subangular blocky structure; firm; common clay films on faces of peds; few medium and very fine

roots; few very fine tubular pores; very strongly acid; clear smooth boundary.

Btg1—22 to 35 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silty clay loam (about 35 percent clay); common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots; few very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); very strongly acid; abrupt smooth boundary.

Btg2—35 to 48 inches; mottled brown (10YR 5/3) and light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); brown (10YR 4/3 and 5/3) coatings on faces of peds; common very fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots; few very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); strongly acid; abrupt smooth boundary.

Btg3—48 to 60 inches; mottled reddish brown (5YR 5/3) and brown (7.5YR 4/4) silty clay loam (about 38 percent clay); few fine distinct light brownish gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots; few very fine tubular pores; few very fine black (10YR 2/1) accumulations (iron and manganese oxides); neutral.

The solum ranges from 36 to 60 inches in thickness. Free carbonates, if any, are below a depth of 60 inches.

The A horizon is 1 to 4 inches thick. It has value of 3 and chroma of 1 or 2. Some pedons have an Ap horizon that is 6 to 8 inches thick and has value of 4 or 5 and chroma of 2. The A and Ap horizons are silt loam, but in a few places the Ap horizon is silty clay loam. The E horizon is as much as 8 inches thick. It has chroma of 1 or 2. The Bt horizon has dominant hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. Some pedons have strata in the Bt horizon that have hue of 2.5Y or 5Y. The Btg horizon has dominant hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 to 3. Some pedons have a 2Cg horizon.



# Formation of the Soils

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This section describes the factors that affected the formation of soils in Muscatine County. 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; the length of time that the forces of soil formation have acted on the soil material; and human activities.

## Factors of Soil Formation

Climate and vegetation are the active factors of soil formation. They act on parent material that has accumulated through weathering of rocks and slowly change it into a natural body that has genetically related horizons. Relief conditions the effects of climate and vegetation. The parent material affects the kind of soil profile that forms and the rate at which it forms. In extreme cases it almost entirely determines profile formation. Finally, time is needed for the effect of the other factors to change parent material into a soil. It may be short or long, but some time is required for soil horizons to form. A long time is required for distinct horizons to develop.

The factors of soil formation are so closely interrelated in their effects on the soil that few conclusions can be made regarding the effect of any one factor unless conditions are specified for the others (26).

## Parent Material

Nearly all the soils in Muscatine County formed in materials that were transported from other places by wind, water, or glaciation. Some soils formed in materials weathered from bedrock and in organic sediments. The most extensive parent materials in the county are loess, alluvium, eolian sands, and glacial drift.

*Loess*, a silty material deposited by wind, is the most extensive parent material in the county. It is the surficial material on uplands and high terraces in about 56 percent of the county. It is also the most uniform parent material in the county. However, it varies in areas adjacent to the Cedar and Mississippi Rivers, where the silt content is higher and the clay content is lower.

The loess also varies in thickness. On a broad ridgetop in the eastern part of the county, the loess is more than 19 feet thick. In most places the loess is thicker on broad, stable ridgetops than on convex side slopes. Soils such as Downs, Fayette, and Tama soils formed where the loess is more than 40 inches thick. In about 5 percent of the loess-mantled areas, the loess is less than 40 inches thick. Pillot, Thebes, and Whittier soils, for example, formed where the loess is less than 40 inches thick, and is underlain by eolian sands. Russell and Waubeek soils formed where loess less than 40 inches thick is underlain by glacial till. Gale soils formed where loess less than 36 inches thick is underlain by sandstone residuum.

*Alluvium*, material deposited by water, is the surficial material on bottom lands and stream terraces in about 33 percent of the county. Alluvium has a variable texture, ranging from silty clay to sand. This variation is related to the velocity of water that deposited the alluvium and to the size of particles in sediment carried by water. Most of the alluvium in the smaller stream bottom lands and larger upland drainageways is silt loam or silty clay loam. It is these textures because mostly silt loam or silty clay loam soils on upland side slopes are contributing the alluvial sediment. Soils such as Radford and Colo soils formed in this alluvium of silt loam and silty clay loam.

On larger bottom lands the alluvium of silty clay, silty clay loam, clay loam, loam, or silt loam is in wide areas where floodwater velocity is slow. Most of these areas are distant from the stream channel. Some of these areas are adjacent to the stream channel where floodwater velocity is too slow to suspend sandy sediment. Ambraw soils, Aquolls, and Colo soils, for

example, formed in this moderately fine textured and medium textured alluvium.

Most of the sandy loam, loamy sand, and sand alluvium is adjacent to present or former stream channels where the velocity of floodwater is relatively high but decreasing. Nearly all of the sandy alluvium on the Mississippi River bottom lands is closer to the river than is the finer textured alluvium. The sandy alluvium on the Cedar River bottom lands is distributed more widely because floodwater from some of the secondary river channels carries sandy sediments. The sandy alluvium is deposited as an overbank deposit or fan where the rapidly moving water leaves the channel. For example, Fruitfield soils formed in the sandy alluvium on the Mississippi River bottom lands and Perks soils formed in the sandy alluvium on the Cedar River bottom lands. Whatever the texture of the upper part of the alluvium on the Cedar River bottom lands, in most places it is sandy within a depth of 60 inches.

Alluvium is also the dominant parent material on the Iowa-Cedar Terrace (also called Lake Calvin) that is adjacent to the Cedar River bottom lands. Generally, the sand content of the surficial alluvium decreases with increasing distance from the bottom lands. Where the alluvium is loam, silt loam, clay loam, or silty clay loam, it extends to a depth of about 32 inches, for example, in Marshan and Udolpho soils, and to a depth of nearly 60 inches, for example, in Coppock, Rowley, and Dolbee soils. The alluvium of silty clay loam and silt loam is more than 60 inches thick in Colo soils.

A narrow deposit of clayey alluvium is mainly along Pine Creek near the Mississippi River in the eastern part of the county. It is thought to be part of a larger series of alluvial deposits associated with the Mississippi River and its tributaries (20). The source of this alluvium is thought to be glacial lake sediments near the headwaters of the Mississippi River. The sediments were carried by glacial meltwater when the river level was high enough for floodwater to invade the tributary valleys. The clayey alluvium was left in the valleys by slowly receding floodwater. More recently, streams like Pine Creek cut deeper channels as the Mississippi River channel deepened. The clayey alluvium was left on high terraces as the stream channels deepened. Zwingle soils formed in this clayey alluvium.

*Eolian sands*, and loamy sand deposited by wind, is the surficial material in about 8 percent of the county. In addition eolian sands underlie the loess in about 11 percent of the county. Some sand that has been moved and deposited by wind is on the Iowa-Cedar Terrace,

and some is on uplands east of the Cedar River bottom land.

Much of the eolian sands on the Iowa-Cedar Terrace have likely been transported relatively short distances by wind. In places the sandy material has been formed into low hills or dunes. Borings near the edge of some of the dunes that are adjacent to finer textured alluvium indicate movement over the fine textured alluvium. More recent wind deposition is evident adjacent to broad areas where soil blowing has eroded cultivated soils, such as Sparta soils.

The eolian sands on uplands east of the Cedar River are intermingled with the more extensive mantle of loess. The sands mantle the landscape near the Cedar River. With increasing distance east of the Cedar River bottom lands, the relative proportion of surficial eolian sands in the landscape decreases. The sands also lie beneath the loess and, in places, protrude through the loess. Numerous borings through the loess indicate that the eolian sand continues as a substratum deposit over a broad area.

A relatively isolated deposit of eolian sands is in the southeast corner of the county. It is known locally as the Big Sand Mound.

*Glacial till*, material deposited by glacial ice, is the surficial material on uplands in about 2 percent of the county. Glacial till resulting from two episodes of glaciation are in Muscatine County. The older pre-Illinoian glacial till is in the northwest part of the county, and the younger Illinoian till is in the eastern part of the county (23).

*Bedrock residuum* is material derived from sedimentary rock that has been weathering in place. It is on upland side slopes in about 0.5 percent of the county. It is on a bedrock ridge of Pennsylvanian age that extends from the town of Muscatine to the east edge of the county. Gosport soils formed in shale residuum, and Gale soils formed in loess and the underlying sandstone residuum.

*Organic deposits* are partly decomposed plant materials that accumulate in sloughs, bogs, and sidehill seeps that remain wet most of the time. They make up less than 0.1 percent of the county. Most organic deposits are at the edge of the Cedar River bottom lands and at the lower edge of the Iowa-Cedar Terrace side slopes. One organic deposit formed in Keokuk Lake on Muscatine Island. Houghton and Palms soils formed in organic deposits.

## Climate

The climate under which Muscatine soils have

formed has continued, with some variation, for about the last 6,000 years. Weather records, tree ring analysis, and other research indicate temperature and precipitation have varied over the last 400 years (12, 13). Also, cyclic variation in climate is likely to have occurred before the last 400 years.

Evidence from a bog in northeastern Iowa indicates that the warmest and driest postglacial climate occurred between about 6,000 and 7,000 years ago (32). Before that period the climate was cool and moist enough for forest vegetation to predominate.

Climate influences the formation of soils in many ways. Precipitation and temperature affect the amount of leaching in soils and influence the kind of vegetation that grows on soils. They also affect the speed of chemical reactions and the activity of micro-organisms in soils. Climate is responsible for many of the differences between the soils of Muscatine County and the soils in other places. However, the major differences between soils within the county are caused by factors other than climate.

The effect of the general climate in the county is modified by local conditions in and around soils. For example, poorly drained Garwin and Walford soils remain colder and wetter early in the growing season than the nearby, well drained Downs and Tama soils. Sandy Chelsea and Sparta soils, for example, change temperature more rapidly as the air temperature changes than do finer textured Downs and Tama soils. This happens because they hold less soil water most of the time. These local conditions account for some of the differences in soils within the county.

### **Plant and Animal Life**

Plants and animals change soils as they utilize them in their life processes. In general, plants produce greater changes in soils than do animals. Over a long period of time different kinds of plants cause marked differences in soils. For example, Fayette and Tama soils formed in the same kind of parent material and, except for vegetation differences, under the same conditions.

Fayette soils formed under forest vegetation. They have a relatively thin, dark colored topsoil because most of the organic matter produced in a forest is from leaves and other material on the soil surface. Research in a forest in the eastern United States indicates that most of the biologic activity and most of the available nutrients in a soil under forest are near the soil surface (33).

Tama soils formed under prairie vegetation. They

have a relatively thick, dark colored topsoil because most of the organic matter produced in a prairie is from prairie grass root systems.

Prairie grasses have a large number of roots that extend several feet into the soil. The grass roots are also replaced by new roots much more often than in a tree root system, thus adding organic matter to the soil.

Vegetation also affects soil fertility. Most data indicates that soils that formed under forest vegetation have more available phosphorus in the subsoil than do soils that formed under prairie vegetation. In Fayette soils, for example, much of that available phosphorus may move down into the subsoil after the forest is removed (33). If erosion removes the relatively thin topsoil soon after forest removal, the phosphorus and other nutrients that are concentrated in the topsoil are lost.

According to surveyors' notes, about 90,800 acres in Muscatine County was forest at the time of settlement. Some of the soils on uplands that were under prairie grasses at that time, however, have some characteristics not generally found in soils that formed under prairie grasses. For example, Garwin, Muscatine, and Tama soils have a thick dark colored topsoil typical of soils that formed under prairie grasses. In many places in the county, however, Muscatine and Tama soils have gray ped coatings in the subsoil. Garwin soils increase more in clay from the topsoil to the subsoil than do Garwin soils in other counties. Muscatine soils were also found to range widely in available phosphorus in the subsoil (9). These changes in Garwin, Muscatine, and Tama soils may have occurred during one or more of the cooler and wetter climate cycles, when forest vegetation invaded the prairie and remained a long enough period of time (5).

Most effects of animals on soils are less noticeable than are those of plants. Burrowing animals are the most obvious, but the smaller animals, such as earthworms and soil insects, have a more widespread effect. Micro-organisms and plants, such as bacteria and fungi, modify plant residues into soil humus, thus releasing plant nutrients.

### **Relief**

Relief or topography influences soil formation through its affect on drainage, runoff, and erosion. Relief or topography includes slope gradient and aspect as well as landscape position. Both surface and internal drainage are affected by topography. Most poorly drained soils, such as Tuskeego and Walford soils, are nearly level. Excess water runs off slowly or not at all

and saturates the soil. In contrast, water runs very rapidly off steep Exette soils. Most of the time more water is available on nearly level soils than on steep soils for leaching and for making chemical and biological reactions. Nearly level soils generally have a thicker topsoil with more organic matter and a more clayey subsoil than steep soils that formed in the same parent material.

Erosion on soils under similar management also increases as slope increases. For example, most steep Exette soils that are cultivated are severely eroded.

Slope aspect and landscape position also influence soil development. However, their effects are generally less than the effect of slope gradient, south-facing slopes tending to be warmer and drier than north-facing slopes. In most places different kinds or amounts of native vegetation grow on south-facing slopes compared to north-facing slopes. Research on cultivated soils indicates more plant-available water on north-facing slopes than on south-facing slopes. It also indicates more plant-available water on foot slopes and back slopes than in other landscape positions (16).

Topography affects the age of soils. In Muscatine County topography can be categorized into landscapes of different age. Soils on uplands and high stream terraces, such as Downs and Tama soils, have been developing longer than soils on alluvial terraces, such as Richwood and Rowley soils. Soils on bottom lands, such as Ambraw and Colo soils, are among the youngest soils in the county.

Topography influences soil color through its effect on soil drainage. Most soils on side slopes, such as Downs and Tama soils, have a brown or yellowish brown subsoil and do not have ground water within a depth of 6 feet. Many soils on nearly level upland ridgetops, such as Garwin and Walford soils, are mottled or gray in the subsoil and in part of the year have a water table within a depth of 2 feet or less.

### Human Activities

When Muscatine County was settled, the conditions under which the soils were forming changed. Cultivation and erosion caused the most immediate changes. Observations made during mapping of this survey indicate that even very steep Fayette soils were cultivated in a few places.

Soils that were forming under forest vegetation, such as Fayette soils, had a surface layer only 1 to 4 inches thick. In most places cultivation mixed some or all of the light-colored subsurface layer with the surface layer. The darker colored material that was the original

surface layer is not present in most of the moderately eroded Fayette soils.

In soils that were forming under prairie vegetation, such as Tama soils, the surface layer was dark colored and the combined surface and subsurface layers were as much as 16 or more inches thick. Now, in moderately eroded Tama soils, the subsurface layer is no longer dark colored and some light-colored subsoil material is mixed into the surface layer.

Erosion has changed the thickness and some of the properties of the surface layer of the soils. In most soils in the county, the clay content is higher and the content of organic matter and plant residue is lower in the subsoil than in the surface layer. Thus, if erosion continues and if more subsoil material is incorporated into the surface layer, it becomes more clayey, less fertile, and less friable than the surface layer of an uneroded soil.

The bulk density of soils has also increased because of human activities. This is often called soil compaction. Occasionally, this change is desirable, for example, to increase the weight-bearing capacity of a soil. In crop production, however, soil compaction generally reduces soil productivity and increases runoff and erosion. Soil compaction reduces the capacity of the surface layer to transmit water and air, and reduces the growth of plant roots. Reducing tillage, deferring tillage when the soils are wet, reducing equipment weight, and, where practical, keeping wheel traffic in the same travel lanes for most farming operations are ways to reduce soil compaction.

Animal waste, commercial fertilizer, and lime applications have improved the productive capacity of most soils in the county. Animal waste and commercial fertilizer are most beneficial on moderately eroded and severely eroded soils because these soils have lost large amounts of organic matter and plant materials.

Erosion is the main cause of organic matter losses on sloping soils. However, even soils that have not eroded under cultivation, such as Garwin and Muscatine soils, have less organic matter and less plant nutrients in available forms than they had under prairie vegetation. Long-term studies indicate crop rotations maintain a higher organic matter level than continuous corn (6, 22). It is not economically feasible to maintain soil organic matter at as high a level as soils have under prairie vegetation. It is practical and beneficial to reduce organic matter losses, especially on the more sloping soils, by controlling erosion, the major cause of organic matter losses. The human relationship to soils has been expressed as, "Soil sustains life if we treat it right" (4).

## Time

Time enables climate, relief, and plant and animal life to change parent material into soils. Soil development begins wherever new parent material is exposed or deposited. In the climate of Muscatine County and nearby areas, one hundred to several hundred years are needed for topsoil to form. Where parent material had been exposed for 100 years, the organic matter content in the surface layer was the same as that in the surface layer of the adjacent Tama soils (15). It is thought that a thousand years or more are needed for a subsoil to become well developed (26).

Some other soil features can develop in a relatively short time. For example, Chelsea soils and, in many places, Sparta soils have layers or lamellae in which clay and iron have accumulated. Radiocarbon dating in an investigation of Chelsea soils in Illinois indicates that more than 2,300 years is required for both clay and iron to move downward and accumulate in layers (8).

In Muscatine County some parent materials have been in place for a long time. For example, the bedrock ridge east of the town of Muscatine is thought to be of Pennsylvanian age. Gale and Gosport soils that have been forming in the sandstone and shale bedrock residuum are much younger. They are the same age or slightly older than adjacent Fayette soils that are forming in loess.

The most stable and oldest surfaces on the loess-mantled uplands are the broad ridgetops. Radiocarbon dating indicates that Garwin, Muscatine, and other soils on these ridgetops are no older than 14,000 years (24). On side slopes the soils are much younger because geologic erosion has removed soil material from side slopes. Much of this erosion may have occurred when climate and vegetation were changing, such as during the warmer and drier period about 6,000 to 7,000 years ago.

The soils on the Iowa-Cedar Terrace are also younger than those soils on stable upland ridgetops (9). This terrace was formed when the Cedar River Valley carried such large amounts of water and sediment that the flow covered the entire area between the loess-mantled uplands. This waterflow may have occurred during the late Wisconsinan period when glacial ice was melting in northern Iowa, about 12,000 to 13,000 years ago (18).

The soils on uplands range widely in age, depending on the amount of geologic erosion and of recent accelerated erosion. Except for a few severely eroded soils, such as Exette soils, upland soils are older than the soils on bottom lands. Of the soils on bottom lands,

the frequently flooded soils are youngest because they continually receive fresh deposition. The frequently flooded Aquolls and Colo soils, for example, receive deposition every time they are flooded. In most places in these soils, however, stratification is not evident in the upper part. The surface layer of these soils has a developed structure like that of the rarely flooded Colo soils.

Recently, Colo soils from many locations were investigated. In almost half of them some settlement deposition was evident, but not stratification. Also, Colo soils with and without postsettlement deposition had similar average amounts of sand, silt, clay, and organic matter in the upper 12 inches (11).

## Processes of Horizon Development

The five factors of soil formation result in horizon development or differentiation through their effect on the soil-forming processes. These processes are additions, removals, transfers, and transformations (26). These processes determine the kind of soil that forms and the progress of soil formation. The relative rates of these interacting processes determine the kind of horizons that develop in each soil.

The accumulation of organic matter generally is an early phase of horizon differentiation. It has been an important process in horizon differentiation of soils in Muscatine County. For example, where fresh soil material was exposed and then left undisturbed, the organic matter in the A horizon was nearly the same as that of the A horizon in the adjacent, cultivated Tama soils over a period of 100 years (15). The amount of organic matter that has accumulated in the surface layer of soils ranges from high to very low. In some soils the content of organic matter was fairly high but now is low because of erosion. Significant organic matter is also being removed by oxidation where artificial drainage has lowered the water table of soils, such as Palms soils, that have a very high content of organic matter. Many other substances have also been removed from the soils in the county. Calcium carbonate has been removed from the horizons of nearly all soils. Some clay has been removed from the A and E horizons of many soils, for example, Fayette and Stronghurst soils. Nitrates move downward in soils with the percolating water and are removed unless taken up by growing plants. The removal of nitrogen by percolating water is most likely to occur in sandy soils, such as Chelsea, Fruitfield, and Sparta soils.

Transfer of substances from one horizon to another is a major cause of horizon differentiation in the soils in

Muscatine County. Nearly all soils on uplands and many soils on stream terraces have more clay in the B horizon than in the A horizon. A major reason for this is that the clay has been transferred from the A horizon to the B horizon. Percolating water carries clay particles or minerals downward. Most of the water moves down in the soil pores and spaces between soil peds. In the drier B horizon, the water is drawn into the peds, leaving the clay in films in the pores and on the faces of peds. These clay films are apparent in the B horizon of many soils.

Although most transfers are related to water moving downward in soils, some are related to plants and animals. Plant nutrients, like phosphorus, transfer downward with percolating water from the A horizon into the B horizon. They are then taken up by plants and returned to the A horizon in the plant residue. Small animals also transfer soil material from one horizon to another. Earthworms, for example, transfer dark colored A horizon material into the upper part of the B horizon.

Transformations occur in all soil horizons. Some are most important in the A horizon. For example, in soils that formed under prairie grasses, such as Garwin,

Muscatine, and Tama soils, large amounts of nitrogen and other plant nutrients are associated with the soil organic matter. When these soils are cultivated and the organic matter is oxidized, the nitrogen and other nutrients are transformed into mineral form. The nitrogen may be transformed into ammonia and nitrate and may remain in the soil to be used by growing crops. If the soil is too wet, however, some nitrogen is transformed into nitrous oxide and elemental nitrogen and is lost into the atmosphere (25).

Transformations may be physical or chemical. The weathering of soil particles to smaller sizes is a physical transformation. The reduction of iron is a chemical transformation. This process, called gleying, occurs when the soil is saturated for long periods. The soil contains enough organic matter for biological activity to take place during periods of saturation. Gleying is evidenced by ferrous iron and gray colors in the soil. It is characteristic of poorly drained soils, such as Garwin soils. The content of reductive, extractable iron, or free iron, generally is lower in somewhat poorly drained soils, such as Muscatine soils.

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# Glossary

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**Ablation till.** Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

**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.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**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.

**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.

**Conservation tillage system.** 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.

**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.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**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.

**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 the activities of man or other animals 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.

**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.

**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.

**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.

**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.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**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, and fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, and silty clay loam.

**Muck.** Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

**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.

**Percs 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

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**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.

**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
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.

**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.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**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.

**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.

**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.

**Site index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

**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 underlying material. The living roots and plant

and animal activities are largely confined to the solum.

**Strippcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing 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 grained* (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.

**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.

**Unstable fill** (in tables). Risk of caving or sloughing on banks of fill material.

**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.