United States Department of Agriculture

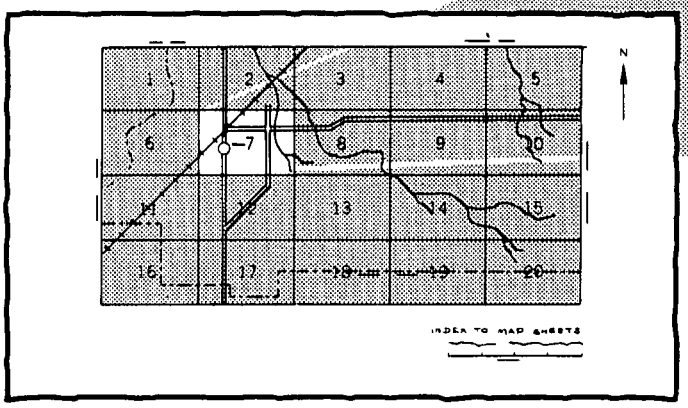
Soil Conservation Service

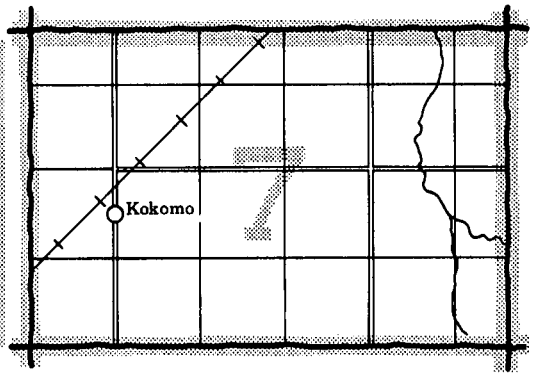
In cooperation with the Iowa Agriculture and Home Economics Experiment Station, the Cooperative Extension Service, Iowa State University, and the Department of Soil Conservation, State of Iowa

Soil Survey of Hardin County, Iowa

HOW TO USE

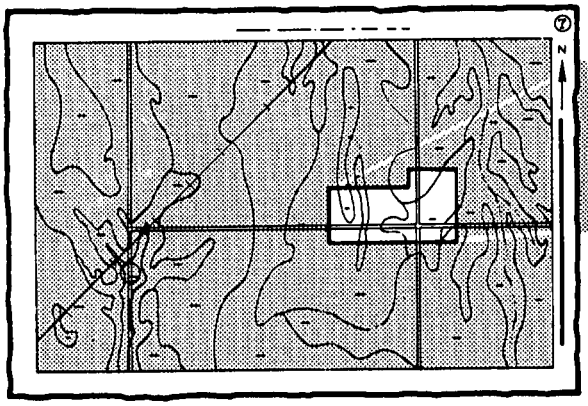
1. Locate your area of interest on the "Index to Map Sheets"

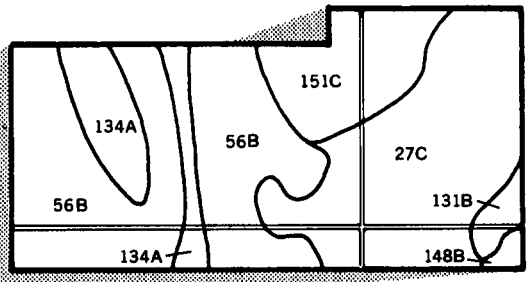




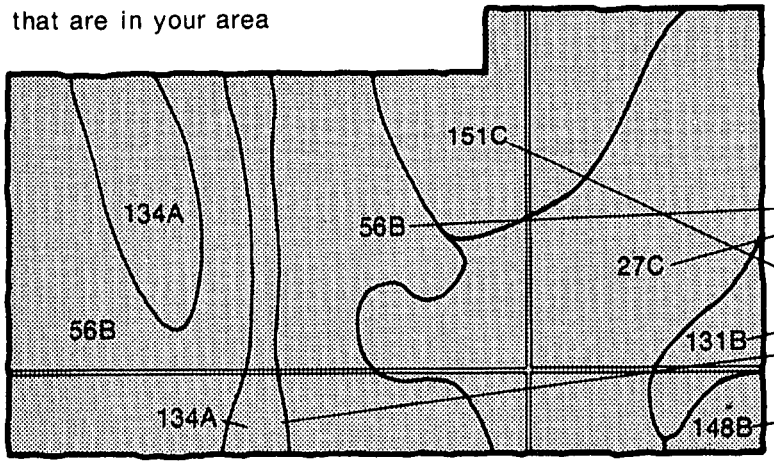
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area

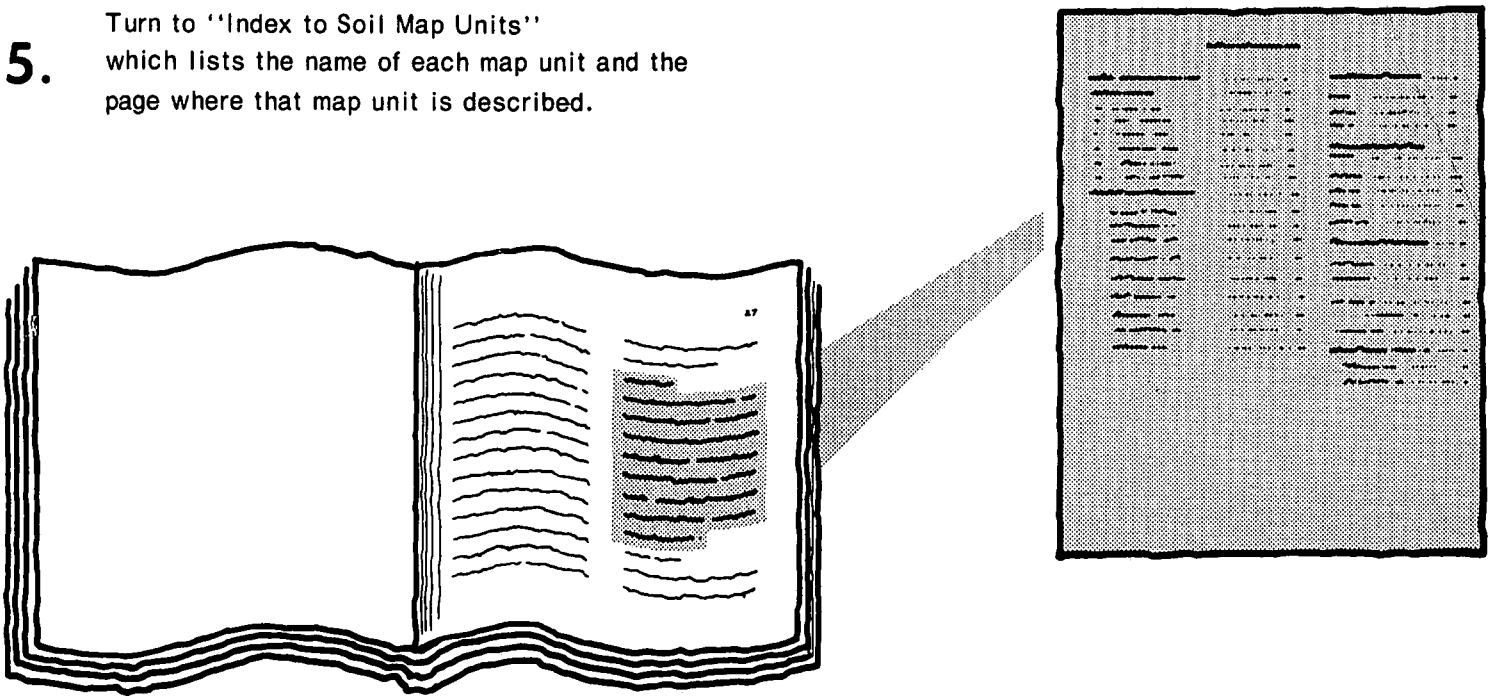


Symbols

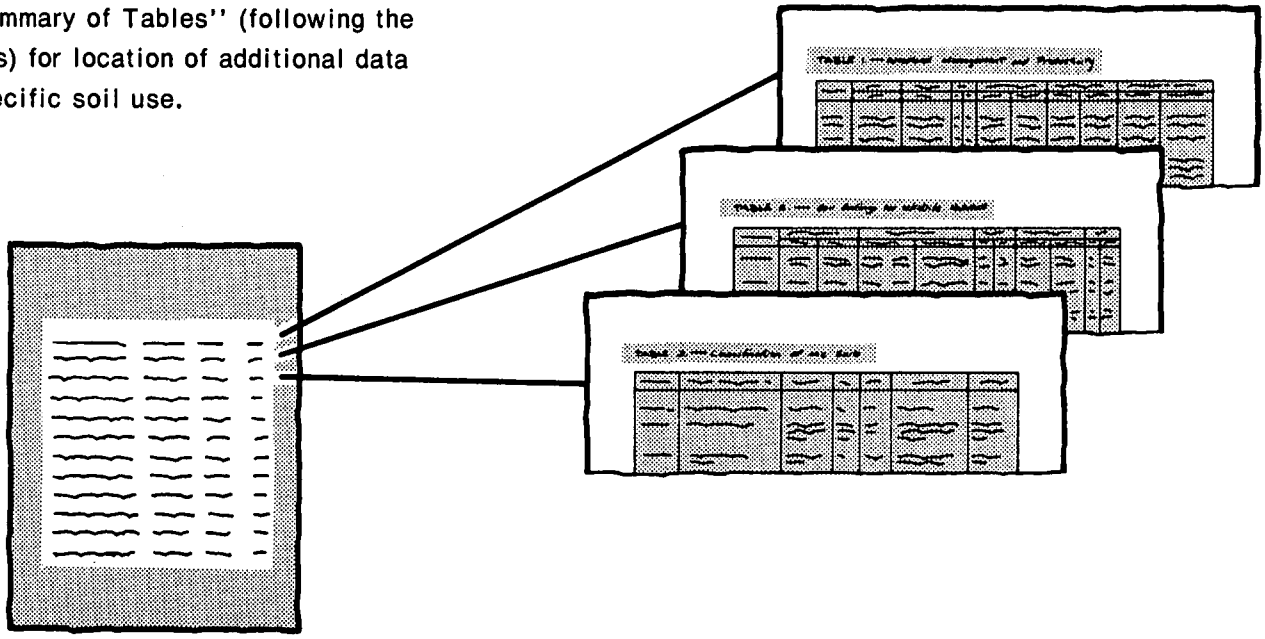
- 27C
- 56B
- 131B
- 134A
- 148B
- 151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

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, or age.

Major fieldwork for this soil survey was completed in the period 1976-1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station, the Cooperative Extension Service, Iowa State University, and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Hardin County Soil Conservation District. Funds appropriated by Hardin 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: Greenbelt area along the Iowa River. Hayden soils are predominant on the side slopes.

Contents

Soil Series

Issued April 1985

Index to Map Units

Summary of Tables

Preface

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

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure 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 Hardin County, Iowa

By Kermit D. Voy, Soil Conservation Service

Fieldwork by Kermit D. Voy, Norman L. Johnson, Thomas J. O'Connor, and James C. Sanner, Soil Conservation Service

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

HARDIN COUNTY is in the central part of Iowa (fig. 1). It has an area of 367,168 acres, or 576 square miles. Eldora, the county seat, is in the east-central part of the county. It is about 60 miles northeast of Des Moines, the state capitol.

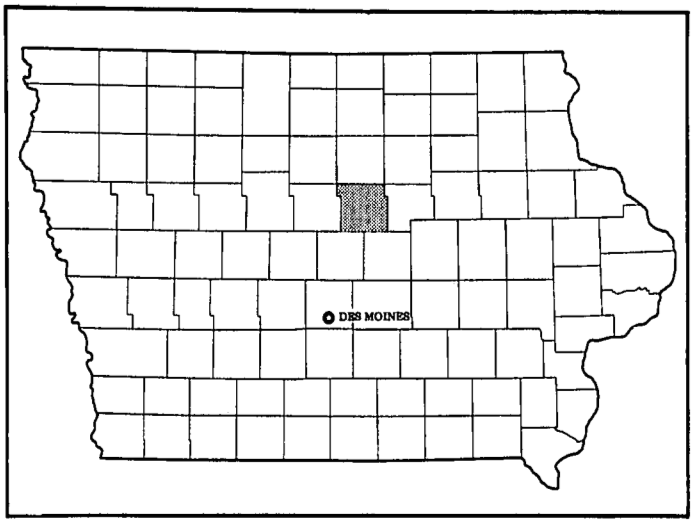


Figure 1.—Location of Hardin County in Iowa.

The county is agricultural. Corn, soybeans, pasture, hay, and oats are the principal crops. Corn and soybeans are the most important crops sold, although much of the corn is fed to livestock. The raising of hogs and the feeding of beef cattle are the principal livestock enterprises.

Most of the soils in Hardin County formed under prairie vegetation and are dark and fertile. The soils on the uplands near the Iowa River and its major tributaries formed under trees and are lighter colored. The climate is subhumid and continental. Winters are cold, summers are warm, and the growing season is long enough for crops to mature.

The first soil survey of Hardin County was published in 1923 (*9*). This survey updates the first survey and provides additional information and larger maps that show more detail.

General Nature of the Survey Area

This section gives general information concerning the county. It includes a brief discussion of the climate, relief and drainage, history and development, farming, and transportation facilities.

Climate

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

In Hardin County winters are cold, and summers are quite hot with occasional cool spells. Precipitation during the winter frequently occurs as snowstorms. Precipitation during the warm months is chiefly showers, but rainfall is often heavy when warm, moist air moves in from the south. Total annual rainfall is normally adequate for growing corn, soybeans, and small grains.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Eldora, Iowa in the period 1957 to 1978. 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 19 degrees F, and the average daily minimum temperature is 10 degrees. The lowest temperature on record, which occurred at Eldora on January 13, 1974, is -27 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at Eldora on July 15, 1977, is 101 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 32.8 inches. Of this, 24 inches, or 75 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 20 inches. The heaviest 1-day rainfall during the period of record was 5.25 inches at Eldora on July 8, 1969. Thunderstorms occur on about 45 days each year, and most occur in summer.

The average seasonal snowfall is 33 inches. The greatest snow depth at any one time during the period of record was 27 inches. On an average of 43 days, at least 1 inch of snow is 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 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in spring.

Relief and Drainage

Most of the soils of Hardin County are nearly level to gently sloping or moderately sloping. Moderately sloping to moderately steep soils occur principally in the southeastern part of the county. Large areas of steeper soils are mainly along the Iowa River and the south fork of the Iowa River.

The Iowa River and its tributaries drain more than 90 percent of Hardin County. About 10 square miles in the southwestern corner of the county are drained by a small tributary of the Skunk River. About 30 square miles in the northeastern part of the county are drained by tributaries of the Cedar River.

The soils in about 32 percent of Hardin County are poorly drained or very poorly drained. Some of these soils, particularly those in the western three-fourths of the county, formed in old lakebeds or swamp basins that have little natural drainage. In these areas, drainage ditches provide outlets for drains installed underground. Many of the naturally poorly drained and very poorly drained soils throughout the county have been drained sufficiently for crop production. Other areas have insufficient underground and surface drainage for wetter than average years, and crops are sometimes damaged. Because of the increased size of farm machinery, wetness has become more of a problem in tillage. For this reason, some previously drained areas now need additional subsurface drainage to speed up soil drying following prolonged wet seasons.

History and Development

The first settlers came into the territory that makes up Hardin County about 1850. The county was organized about 1853. At the time of settlement much of the county was covered with native prairie, and trees grew along the rivers and streams. The prairie in the western three-fourths of the county was interspersed with marsh and shallow ponds. In time, drainage ditches and large tile systems were constructed to drain the marshes, and today nearly all of this area is suitable for grain production. Much of the original woodland on the gently sloping areas adjacent to the stream valleys in the eastern and northern parts of the county has been removed. In recent years more and more of this land also has been used for grain production and pasture. Many of the steeper slopes along the Iowa River and its larger tributaries are still wooded, although nearly all of these areas have been logged.

Farming

Most of Hardin County is farmland. The land is used mostly for corn and soybeans, but some acreage is in pasture, oats, hay, sweet corn, and woodland. Soybeans and corn are sold as cash crops. The acreage used for corn is increasing. The principal livestock enterprises are raising hogs and feeding beef cattle.

For some years the farms in the county have been decreasing in number and increasing in size. In 1981 the county had a total of 1,180 farms, according to the Iowa

Crop and Livestock Reporting Service. The average farm was 295 acres.

Transportation Facilities

State and county highways throughout Hardin County provide routes for auto traffic and for the transportation of farm products. Interstate 35 runs outside the western border. U.S. Highway 65, running dominantly north and south, and State Highway 175, running east and west, intersect near the center of the county. U.S. Highway 20 is on or near the northern border. These routes are connected to all parts of the county by concrete or crushed rock roads. There are also many gravel or asphalt roads, which enable farmers to come to trading centers throughout the year. Railroads or motor freight lines serve every trading center in the county. Municipal airports are at Eldora and Iowa Falls. Scheduled airlines transportation is available within an hour's drive of the county. Bus transportation is available to communities along the major highways.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

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, acidity, 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 do not affect use and management. These soils 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 soils are called 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 soils 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

The general soil map at the back of this publication shows broad areas called associations that have a distinctive pattern of soils, relief, and drainage. Each association is a unique natural landscape. Typically, it 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.

Descriptions of the general soil map units follow.

1. Coland-Saude-Spillville association

Nearly level to moderately sloping, poorly drained to well drained soils that formed in loamy and sandy alluvial sediment; on flood plains and terraces

This association is on flood plains and terraces that are generally underlain by sand and gravel at depths of 2 to 5 feet or more. Narrow escarpments in areas where the terraces join the flood plains are steeper than other parts of the association and are shallower to sand and gravel. Many of the sand and gravel pits in the county are in this association. Slopes range from 0 to 9 percent.

This association makes up about 9 percent of the county. It is about 26 percent Coland soils, 14 percent Saude soils, 11 percent Spillville soils, and about 49 percent soils of minor extent (fig. 2).

The nearly level, poorly drained Coland soils are on flood plains. The nearly level to moderately sloping, well drained Saude soils are on terraces. The nearly level, moderately well drained to somewhat poorly drained Spillville soils are on flood plains.

Typically, the surface layer of the Coland soils is black clay loam about 13 inches thick. The subsurface layer also is about 13 inches thick. It is black, friable clay loam in the upper part and very dark gray, mottled clay loam in the lower part. The next layer is very dark gray, friable clay loam about 14 inches thick. The substratum to a depth of about 60 inches is very dark gray loam.

Typically, the surface layer of the Saude soils is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown, friable loam in the upper part and strong brown, very friable loamy sand in the lower part. The substratum to a depth of 60 inches is strong brown, loose sand and a few gravel.

Typically, the surface layer of the Spillville soils is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 44 inches thick. The substratum to a depth of about 60 inches is dark grayish brown loam.

The most extensive soils of minor extent in this association are the Flagler, Hanlon, Lawler, Marshan, and Waukee soils. These soils formed in alluvial sediment. The somewhat excessively drained Flagler soils are on stream terraces and terrace escarpments. The moderately well drained Hanlon soils are in positions on the landscape similar to those of the Spillville soils. The somewhat poorly drained Lawler soils and the poorly drained Marshan soils are on stream terraces. They are moderately deep over sand and gravel. The well drained Waukee soils are similar to Saude soils.

Most areas of this association except those on the most frequently flooded stream bottoms are used for cultivated crops. The soils are suited to this use. Drainage or protection from flooding is the principal management need. On the wet soils both drainage and flood protection are needed. The available water capacity is moderate to low in some of the soils. These soils are slightly droughty unless summer rains are frequent.

2. Harps-Nicollet-Webster association

Nearly level, poorly drained and somewhat poorly drained soils that formed in glacial drift; on uplands

This association is dominated by nearly level soils on broad flats on uplands. The flats are interspersed with depressional areas that range from a fraction of an acre to 80 acres. Gently sloping soils on ridges are intermingled throughout the association. Because the area does not have a natural drainage system, manmade ditches are common. Much of the area consisted of marshes and intermittent ponds before artificial drainage was installed. Slopes range from 0 to 3 percent.

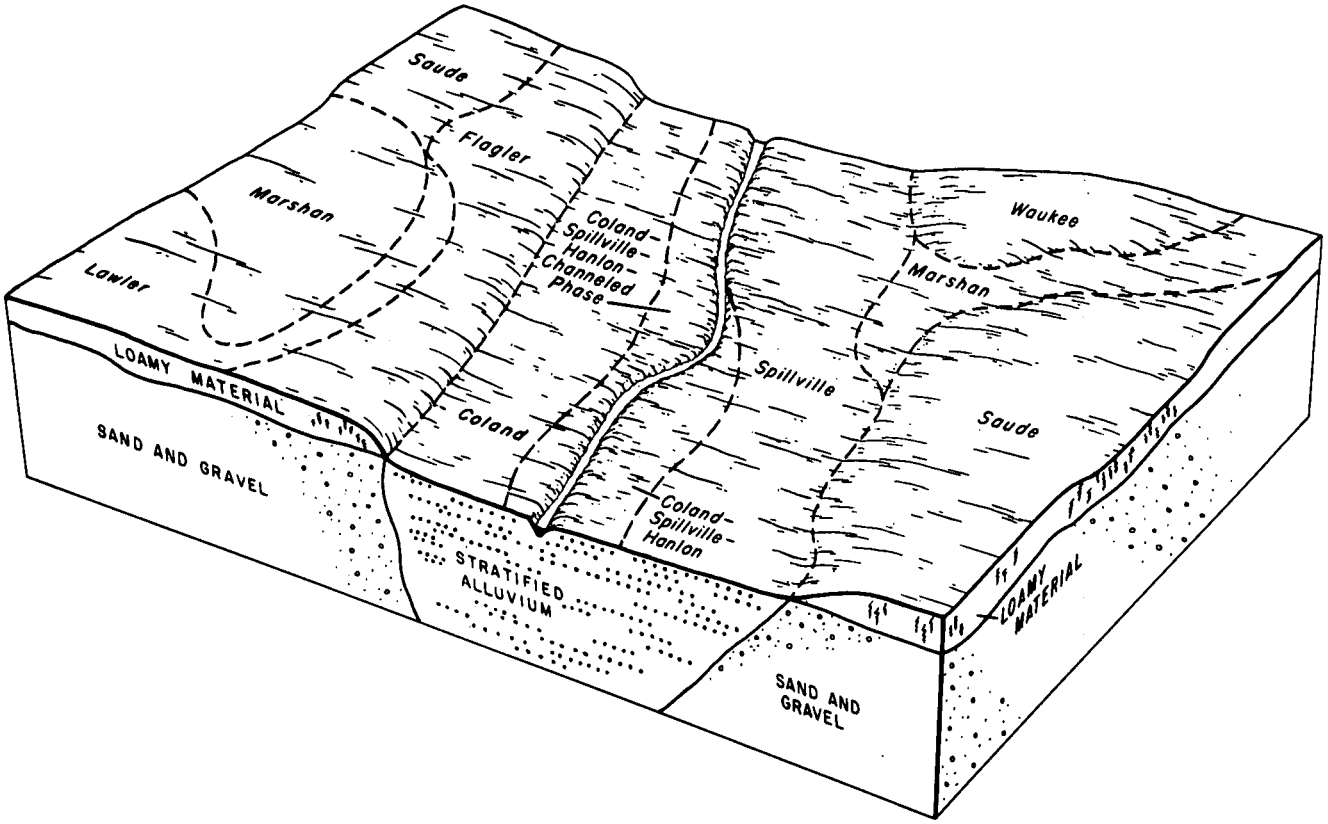


Figure 2.—Pattern of soils and parent material in the Coland-Saude-Spillville association.

This association makes up about 13 percent of the county. It is about 35 percent Harps soils, 20 percent Nicollet soils, 15 percent Webster soils, and 30 percent soils of minor extent (fig. 3).

The poorly drained Harps soils are on rims around depressional areas. The nearly level, somewhat poorly drained Nicollet soils are on low ridges and the lower parts of side slopes. The poorly drained Webster soils are on flats and swales on uplands.

Typically, the surface layer of the Harps soils is black, calcareous loam about 8 inches thick. The subsurface layer is black to very dark gray and dark gray, mottled loam about 15 inches thick. The subsoil is olive gray, mottled loam about 13 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled loam.

Typically, the surface layer of the Nicollet soils is black loam about 9 inches thick. The subsurface layer is black and very dark grayish brown clay loam about 13 inches thick. The subsoil is dark grayish brown and olive brown, mottled, friable loam about 12 inches thick. The substratum to a depth of 60 inches is olive loam.

Typically, the surface layer of the Webster soils is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil is about 16 inches thick. It is olive gray silty clay loam and clay loam in the upper part and olive, mottled loam in the lower part. The substratum to a depth of 60 inches is olive gray and light olive gray, mottled loam and sandy loam.

The most extensive soils of minor extent in this association are the Canisteo, Okoboji, Storden, and Terril soils. These soils formed in glacial sediment or glacial till. Canisteo soils are similar to Harps soils. They are on flats on uplands and in low gradient swales. The very poorly drained Okoboji soils are in depressions. The well drained Storden soils are on knolls and side slopes. The moderately well drained Terril soils are in drainageways on uplands and on foot slopes typically below moderately sloping to strongly sloping side slopes.

Nearly all areas of this association are used for cultivated crops. Most of the soils are very well suited to row crops (fig. 4). Erosion control on the sloping soils and drainage of the wet soils are the principal management needs. The Harps and Canisteo soils are high in lime content and have special fertility deficiencies.

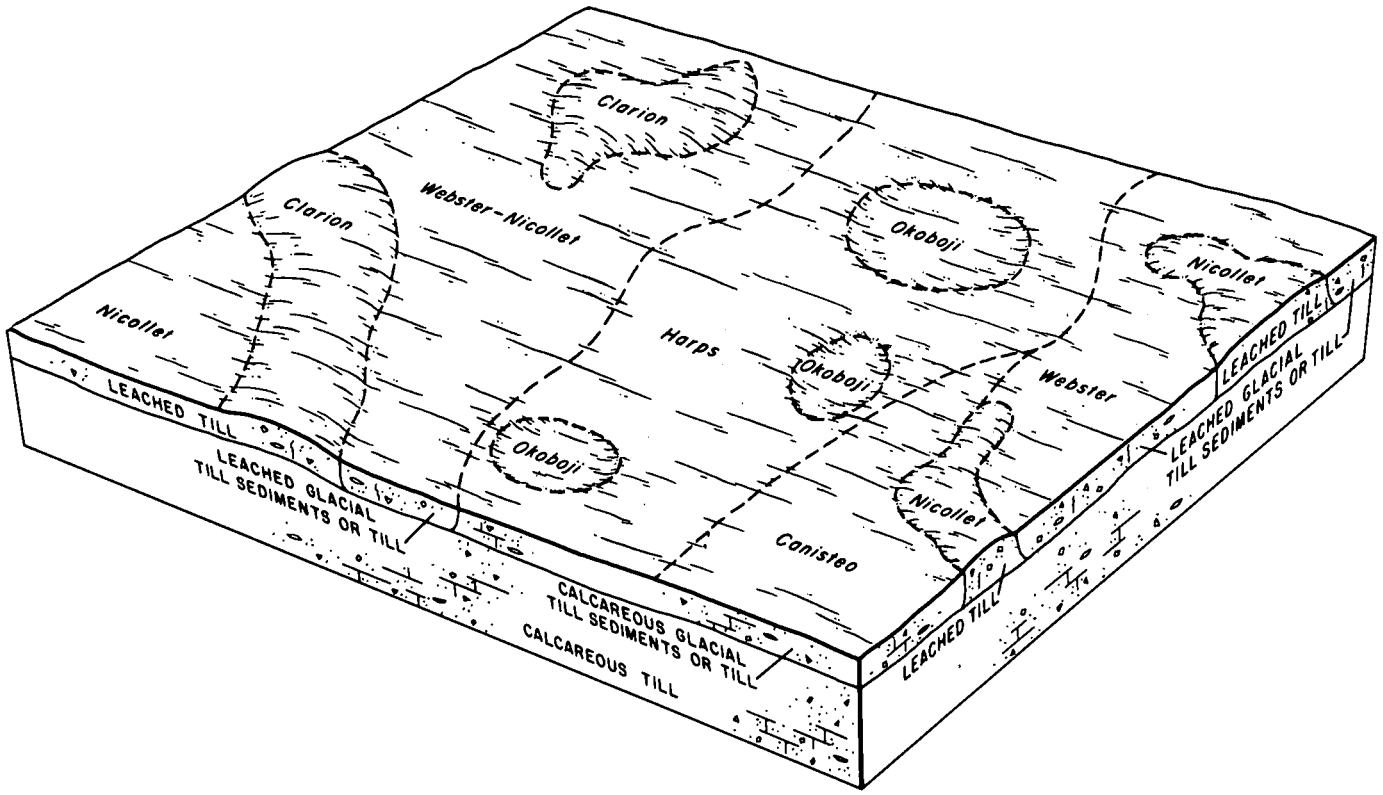


Figure 3.—Pattern of soils and parent material in the Harps-Nicollet-Webster association.

3. Clarion-Nicollet-Webster association

Nearly level to strongly sloping, well drained, somewhat poorly drained, and poorly drained soils that formed in glacial drift; on uplands

This association is dominated by nearly level and gently sloping soils intermingled with moderately sloping soils on ridges. A few areas are strongly sloping. Some areas are interspersed with depressions that range from a fraction of an acre to several acres. Many of the poorly drained areas were subject to intermittent ponding before artificial drainage was installed. Slopes range from 0 to 14 percent.

This association makes up about 54 percent of the county. It is about 40 percent Clarion soils, 15 percent Nicollet soils, 10 percent Webster soils, and about 35 percent soils of minor extent (fig. 5).

The well drained Clarion soils are on ridge crests and side slopes on uplands. The somewhat poorly drained Nicollet soils are on low ridges and on the lower part of side slopes. The poorly drained Webster soils are on flats and swales on uplands.

Typically, the surface layer of the Clarion soils is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 10 inches thick. The subsoil is about 25 inches thick. It is brown, dark yellowish brown, and yellowish brown, friable loam. The substratum to a depth of about 60 inches is light olive brown, mottled, friable loam.

Typically, the surface layer of the Nicollet soils is black loam about 9 inches thick. The subsurface layer is black and very dark grayish brown clay loam about 13 inches thick. The subsoil is dark grayish brown and olive brown, friable loam about 12 inches thick. The substratum to a depth of 60 inches is olive loam.

Typically, the surface layer of the Webster soils is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The friable subsoil is about 16 inches thick. It is olive gray silty clay loam and clay loam in the upper part and olive, mottled loam in the lower part. The substratum to a depth of about 60 inches is olive gray and light olive gray, mottled loam and sandy loam.

Some soils of minor extent in this association are the Canisteo, Harps, Okoboji, Storden, and Terril soils. The poorly drained, calcareous Canisteo soils are on flats on uplands and in low gradient waterways. The very poorly drained Okoboji soils are in most of the large depressions.

Nearly all areas of this association are used for cultivated crops. The soils are very well suited to row

Figure 4.—Nearly level field of corn in the Harps-Nicollet-Webster association.

crops if they are adequately drained. Drainage of excess water is the principal management need. The Webster and Nicollet soils are wet unless drainage has been installed, and the soils in the depressions are often ponded unless an outlet has been provided. A combination of tile and ditches is frequently used. The Canisteo soils, which are of minor extent, are high in lime content and have special fertility deficiencies.

4. Rockton-Kensett-Tilfer association

Nearly level to moderately sloping, well drained, somewhat poorly drained, and poorly drained soils that formed in loamy deposits overlying bedrock; on benches

This association is dominated by broad, nearly level benches that are just above the flood plain of the Iowa River. Moderately sloping soils are near the escarpments and on a few ridges and side slopes. The benches are underlain by shattered limestone bedrock between depths of about 20 and 40 inches. Slopes range from 0 to 9 percent.

This association makes up about 1 percent of the county. It is about 70 percent Rockton soils, 10 percent Kensett soils, 10 percent Tilfer soils, and about 10 percent soils of minor extent (fig. 6).

The nearly level to moderately sloping, well drained Rockton soils are on sloping flats, ridge crests, and side slopes. The nearly level, somewhat poorly drained Kensett soils are on flats and low foot slopes. The nearly level Tilfer soils are poorly drained.

Typically, the surface layer of the Rockton soils is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 11 inches thick. The subsoil is brown, friable loam about 5 inches thick. The substratum is limestone bedrock that is shattered in the upper part.

Typically, the surface layer of the Kensett soils is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 11 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown, friable loam in the upper part and olive brown, friable loam in the lower part. The substratum is limestone bedrock that is shattered in the upper part.

Typically, the surface layer of the Tilfer soils is black, calcareous loam about 8 inches thick. The subsurface layer is black silty clay loam about 9 inches thick. The mottled subsoil is about 9 inches thick. It is dark grayish brown, firm silty clay loam in the upper part and olive gray, friable silty clay loam in the lower part. The

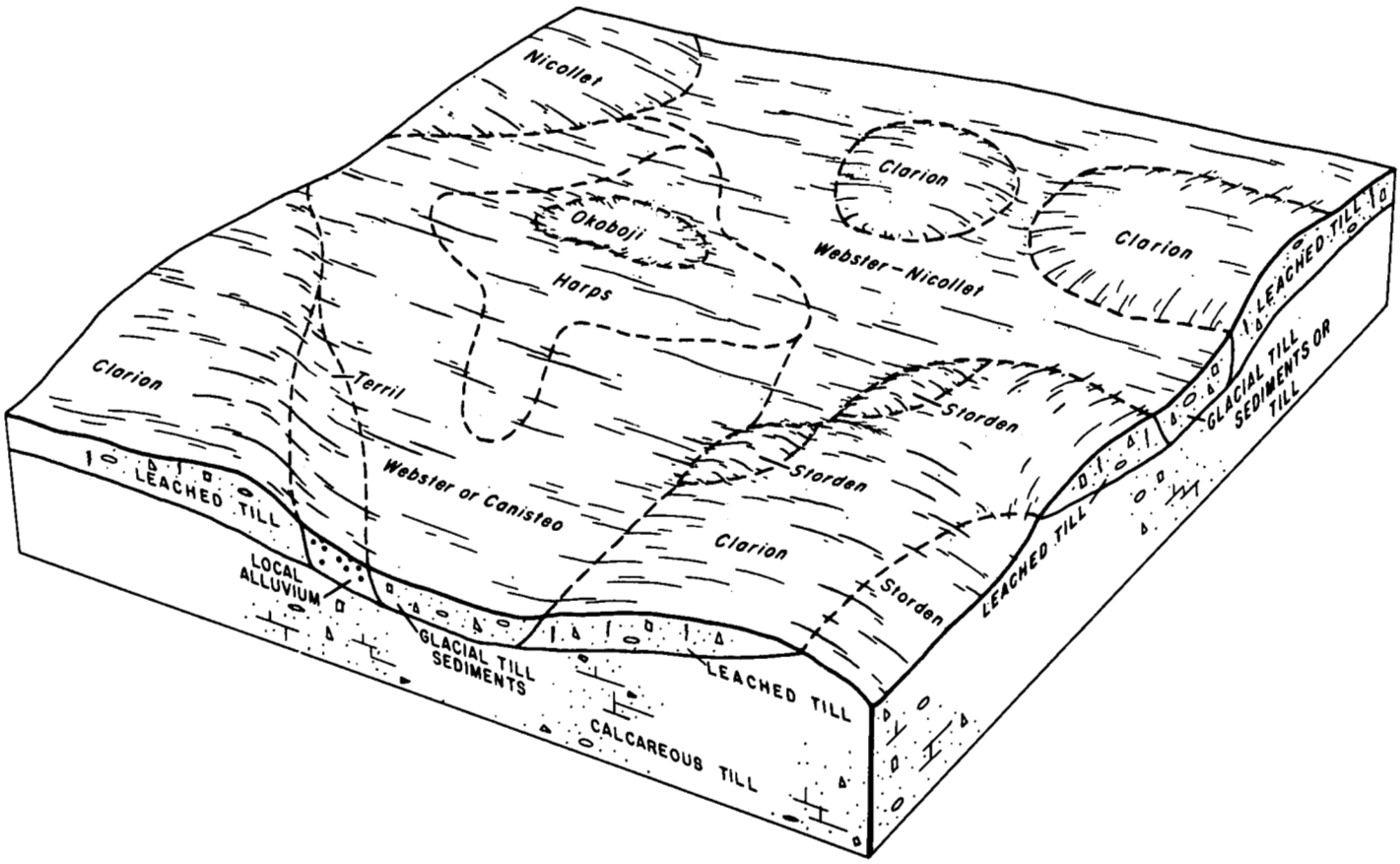


Figure 5.—Pattern of soils and parent material in the Clarion-Nicollet-Webster association.

substratum is limestone bedrock that is shattered in the upper part.

The most extensive soils of minor extent in this association are the Coland and Terril soils. The poorly drained Coland soils formed in alluvial sediment and are on bottom lands. The moderately well drained Terril soils formed in local alluvial sediment and are on foot slopes and in waterways.

Nearly all areas of this association are used for cultivated crops. Several hundred acres in the Iowa Falls area have been developed as housing tracts and light industry sites. Erosion control on the sloping soils and drainage of the Tilfer soils are the principal management needs for crop production. Tile drains are difficult to install in the Tilfer soils because depth over limestone bedrock is only moderate. Excavation of the bedrock to install tile drains is difficult.

5. Hayden-Lester-Le Sueur association

Nearly level to very steep, well drained and somewhat poorly drained soils that formed in glacial drift; on uplands.

This association is dominated by nearly level and gently sloping soils that are dissected by narrow valleys having strongly sloping to very steep side slopes. Slopes range from 0 to 50 percent.

This association makes up about 3 percent of the county. It is about 40 percent Hayden soils, 40 percent Lester soils, 8 percent Le Sueur soils, and 12 percent soils of minor extent (fig. 7).

The well drained, gently sloping to very steep Hayden and Lester soils are on ridge crests and side slopes. The somewhat poorly drained, nearly level Le Sueur soils are on divides.

Typically, the surface layer of the Hayden soils is very dark brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil is about 30 inches thick. It is brown, friable clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is light olive brown and grayish brown loam.

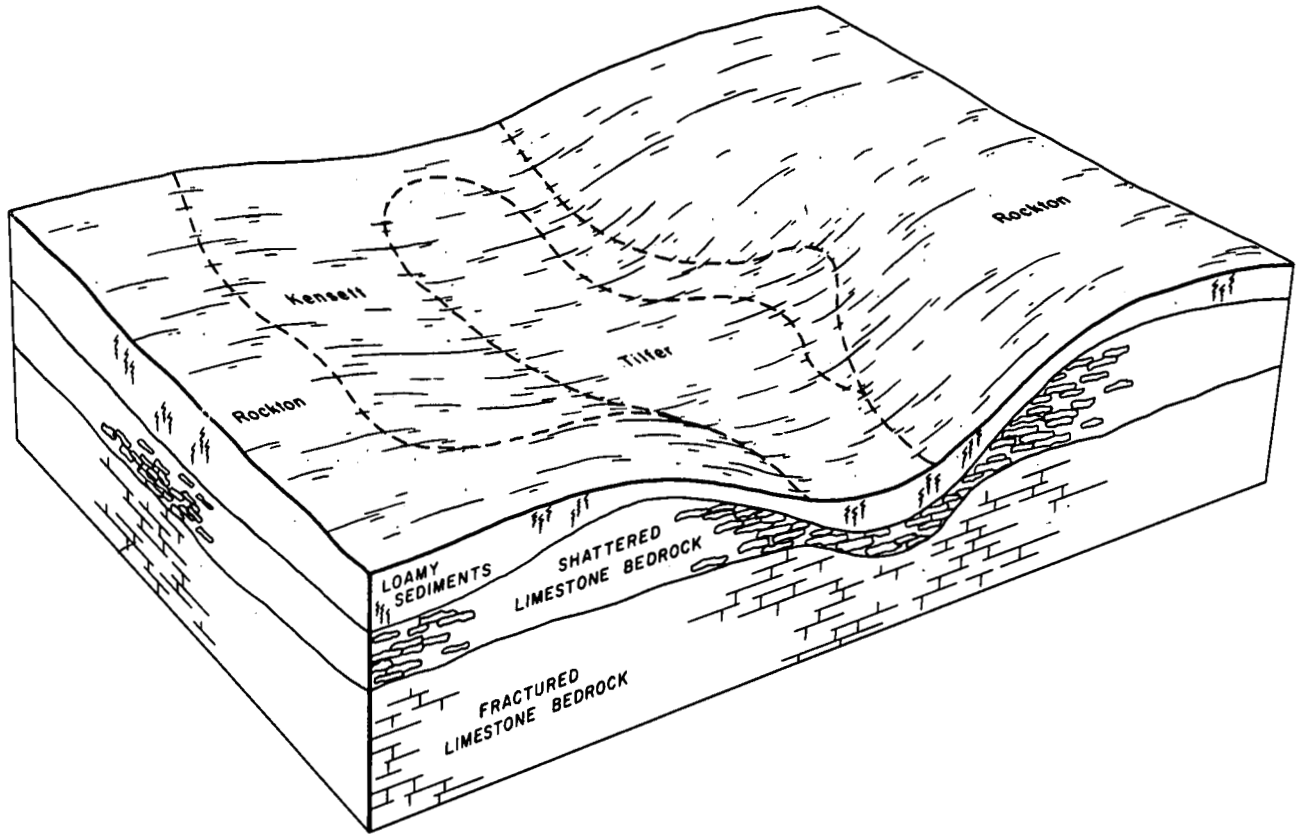


Figure 6.—Pattern of soils and parent material in the Rockton-Kensett-Tilfer association.

Typically, the surface layer of the Lester soils is dark brown loam about 8 inches thick. Plowing has mixed the subsurface layer and dark yellowish brown subsoil material into the surface layer. The subsoil is about 35 inches thick. It is dark yellowish brown, friable clay loam and sandy clay loam in the upper part and yellowish brown, friable clay loam and sandy loam in the lower part. The substratum to a depth of 60 inches is light olive brown loam.

The surface layer of the Le Sueur soils is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 25 inches thick. It is light olive brown, mottled, firm clay loam. The substratum to a depth of 60 inches is mottled, yellowish brown and gray to grayish brown loam.

The most extensive soils of minor extent in this association are the Coland, Nicollet, Terril, and Webster soils. The poorly drained Coland soils are on the lowest part of the landscape adjacent to the waterways. The somewhat poorly drained, nearly level Nicollet soils are on ridge crests. The moderately well drained Terril soils are on foot slopes at a slightly higher elevation than the Coland soils. The poorly drained, nearly level Webster soils are in shallow swales.

Many areas of this association are in woodland. The moderately steep to very steep side slopes are nearly all in woods or pasture (fig. 8). Many areas of the moderately sloping to moderately steep soils could be used for crops; because they are small and are dissected by steep waterways, however, they are managed with the steeper soils.

About 60 percent of this association is used for cultivated crops. The nearly level to moderately sloping soils are suited to row crops. Erosion control on the sloping soils is the principal management need. Small areas of wet soils benefit from tile drainage.

6. Dinsdale-Muscatine-Garwin association

Nearly level to strongly sloping, well drained to poorly drained soils that formed in loess or in loess and the underlying glacial till; on uplands

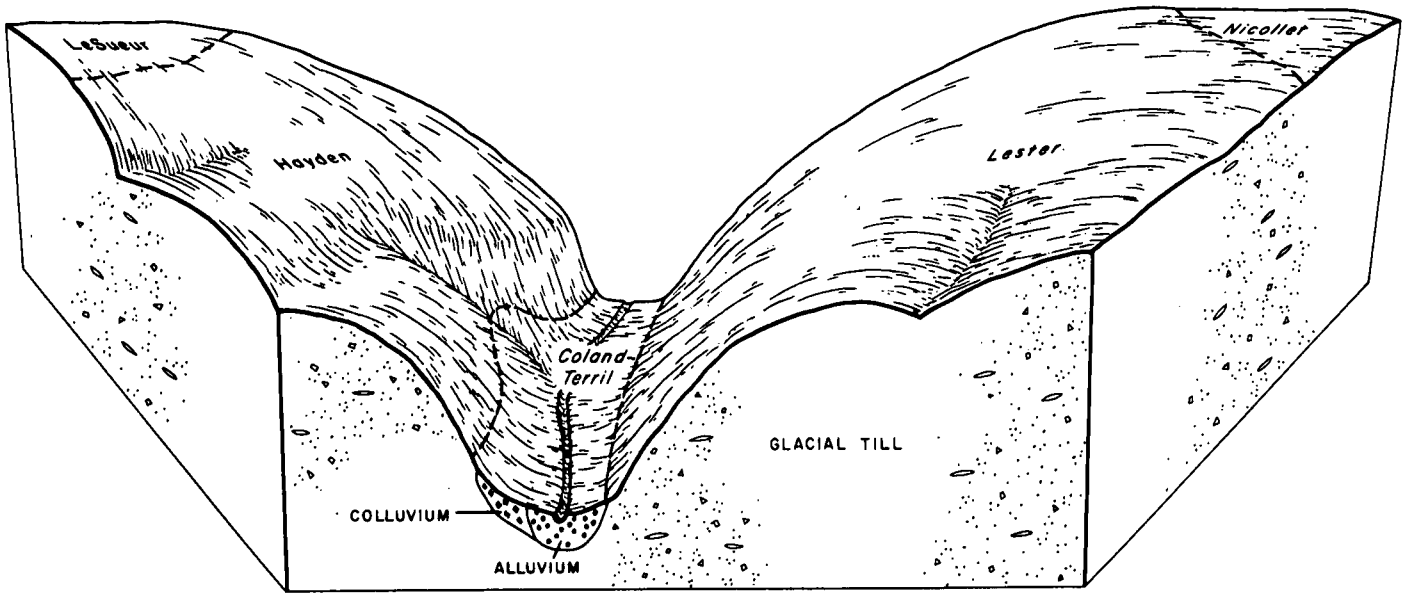


Figure 7.—Pattern of soils and parent material in the Hayden-Lester-Le Sueur association.

Figure 8.—An area along the Iowa River in the Hayden-Lester-Le Sueur association.

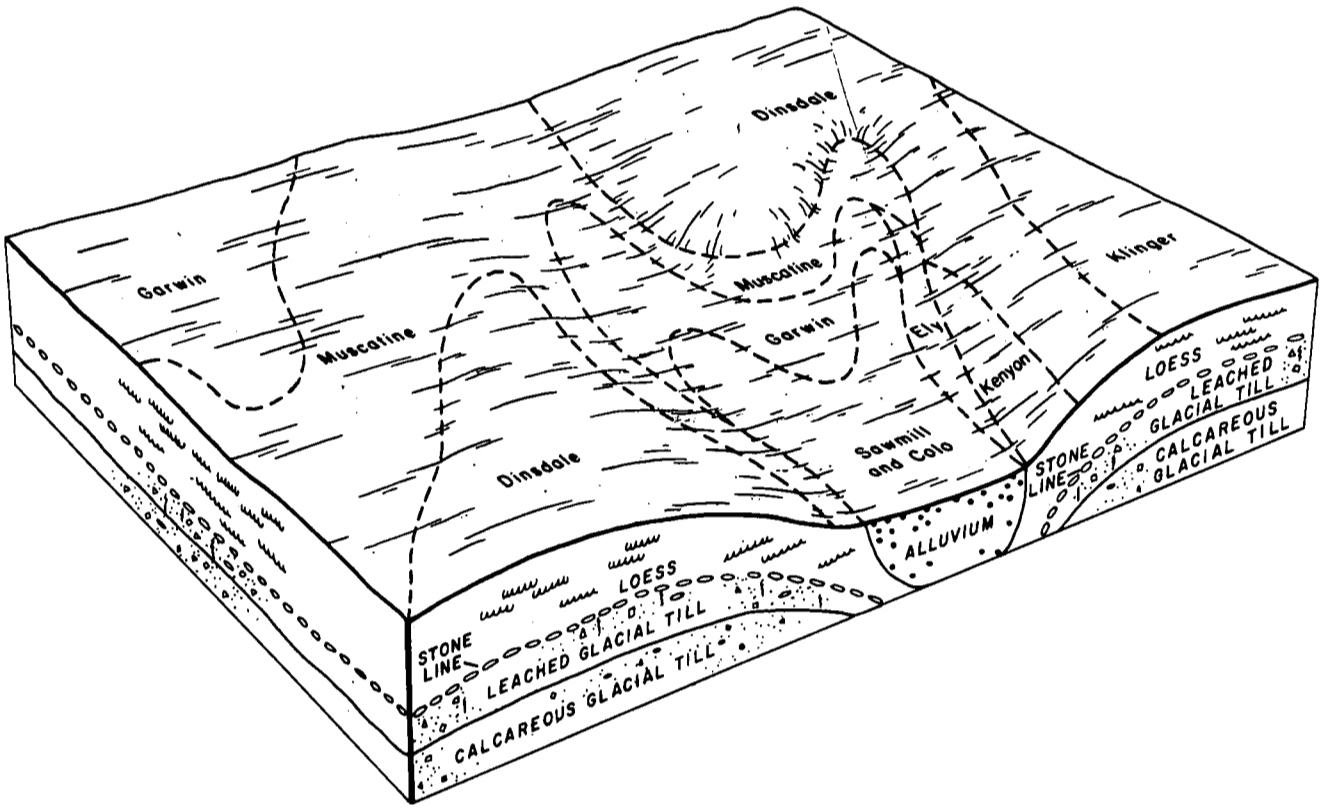


Figure 9.—Pattern of soils and parent material in the Dinsdale-Muscatine-Garwin association.

This association is dominated by gently sloping soils on ridges and nearly level soils on broad flats on uplands and low gradient waterways that form an integrated drainage system. The moderately sloping and strongly sloping soils are on side slopes and ridges near some of the major drainageways of the area. Slopes range from 0 to 14 percent.

This association makes up about 4 percent of the county. It is about 25 percent Dinsdale soils, 20 percent Muscatine soils, 10 percent Garwin soils, and 45 percent soils of minor extent (fig. 9).

The well drained or moderately well drained Dinsdale soils are on gently sloping to strongly sloping ridge crests and side slopes. The somewhat poorly drained Muscatine soils are on nearly level and gently sloping ridge crests and gently sloping side slopes. The poorly drained Garwin soils are on nearly level drainageways and broad flats on the uplands.

Typically, the surface layer of the Dinsdale soils is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 28 inches thick. It is brown, friable silty clay loam in the upper part; yellowish brown, friable silty clay loam in the middle part; and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled loam.

Typically, the surface layer of the Muscatine soils is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 15 inches thick. The subsoil is about 27 inches thick. It is dark grayish brown, friable silty clay loam in the upper part and grayish brown, friable silt loam in the lower part. The substratum to a depth of about 60 inches is grayish brown silt loam.

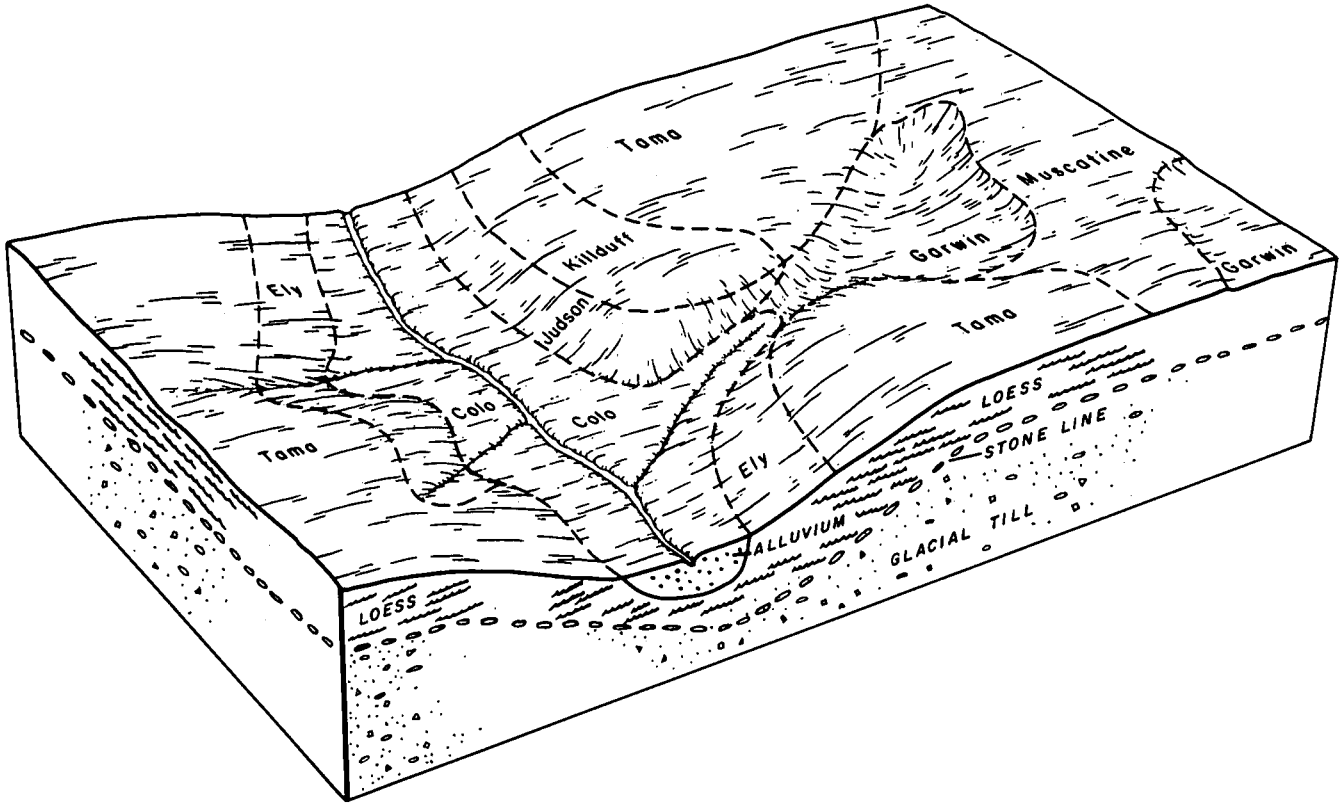


Figure 10.—Pattern of soils and parent material in the Tama-Colo association.

Typically, the surface layer of the Garwin soils is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 15 inches thick. The subsoil is about 19 inches thick. It is dark gray and olive gray, friable silty clay loam in the upper part and olive gray and gray, friable silt loam in the lower part. The substratum to a depth of about 60 inches is light olive gray silt loam.

The most extensive soils of minor extent in this association are the Colo, Ely, Harpster, Kenyon, Klinger, and Sawmill soils. The poorly drained Colo and Sawmill soils are on the lowest part of the landscape adjacent to the waterways. The somewhat poorly drained Ely soils are at a slightly higher elevation. The calcareous, poorly drained Harpster soils are in shallow waterways. The moderately well drained Kenyon soils are on ridge crests and side slopes. The somewhat poorly drained Klinger soils are on broad ridges and side slopes on uplands.

Nearly all areas of this association are used for cultivated crops. The soils are well suited to row crops. Erosion control on the sloping soils and tile drainage of the wet soils are the principal management needs.

7. Tama-Colo association

Nearly level to strongly sloping, well drained and poorly drained soils that formed in loess and silty alluvial sediment; on uplands and flood plains

This association is dominated by gently sloping to strongly sloping soils on ridgetops and side slopes and nearly level and gently sloping soils on associated valley floors. The association has a well developed drainage system. Slopes range from 0 to 14 percent.

This association makes up 13 percent of the county. It is about 42 percent Tama soils, 13 percent Colo soils, and 45 percent soils of minor extent (fig. 10).

The gently sloping to strongly sloping, well drained Tama soils are on ridge crests and side slopes. The nearly level and gently sloping, poorly drained Colo soils are along streams and waterways in narrow valleys on uplands (fig. 11).

Typically, the surface layer of the Tama soils is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 30 inches thick. It is brown and yellowish brown, friable silty

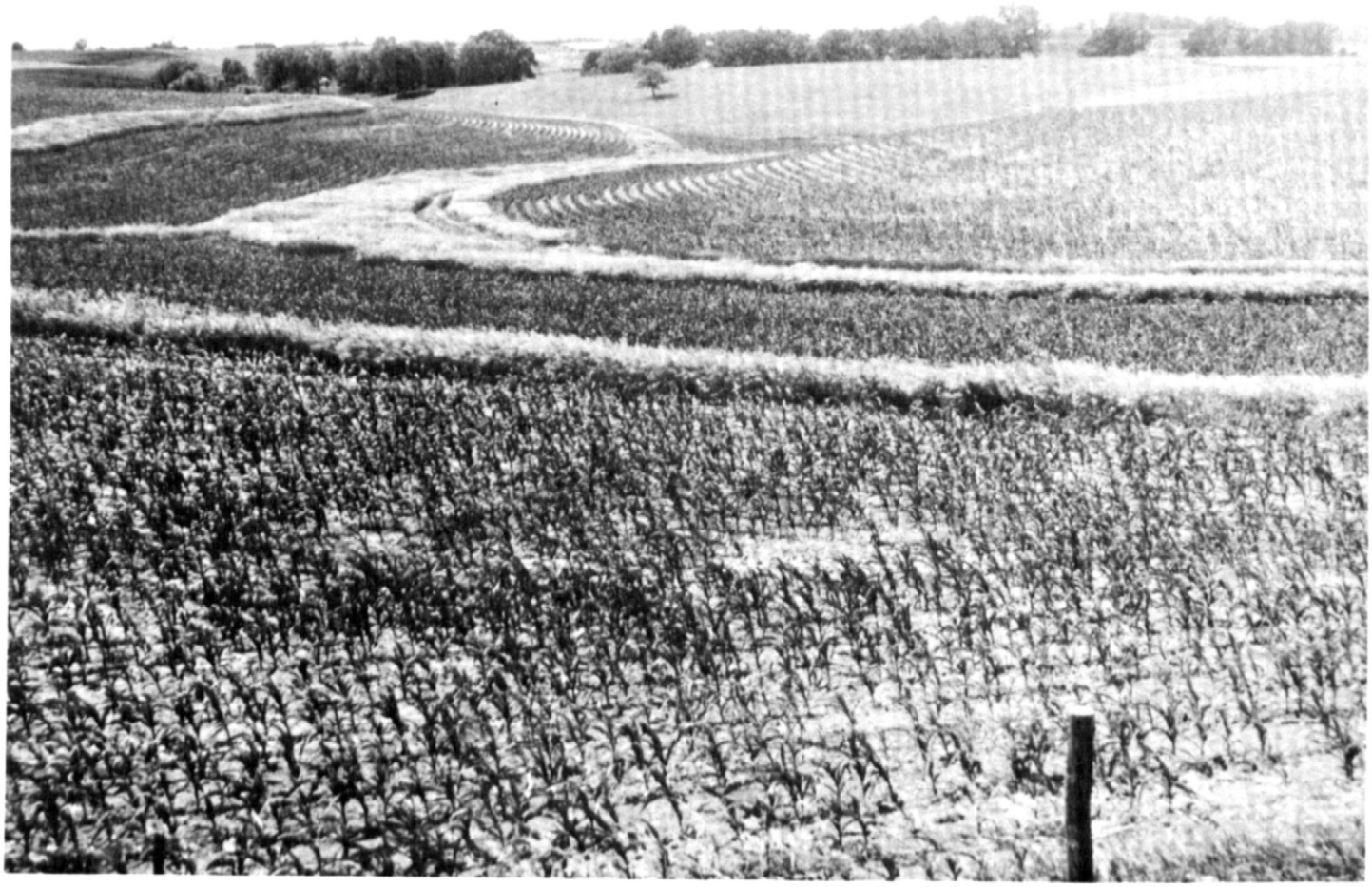


Figure 11.—Gently sloping to strongly sloping soils in the Tama-Colo association. The poorly drained Colo soils are along the waterways, and the Tama soils are on the sloping ridges.

clay loam and silt loam. The substratum to a depth of 60 inches is yellowish brown silt loam.

Typically, the surface layer of the Colo soils is black silty clay loam about 11 inches thick. The subsurface layer is black, friable silty clay loam and very dark gray, firm silty clay loam about 35 inches thick. The substratum to a depth of about 60 inches is olive gray silt loam.

The most extensive soils of minor extent in this association are the Killduff, Dinsdale, Ely, Garwin, Judson, and Muscatine soils. The well drained Killduff soils and the moderately well drained Dinsdale soils are on ridge crests and side slopes. The somewhat poorly drained Ely soils are on foot slopes and along drainageways at a higher elevation than Colo soils. The poorly drained Garwin soils are on flats and waterways on uplands. The well drained Judson soils are in coves and on foot slopes. The somewhat poorly drained Muscatine soils are on low ridges and side slopes.

Nearly all areas of this association are used for cultivated crops. Many of these soils are well suited to row crops. Erosion control on the sloping soils and tile drainage of the wet soils are the principal needs.

8. Downs-Fayette-Montieth association

Gently sloping to very steep, well drained and excessively drained soils that formed in loess and residuum weathered from sandstone; on uplands

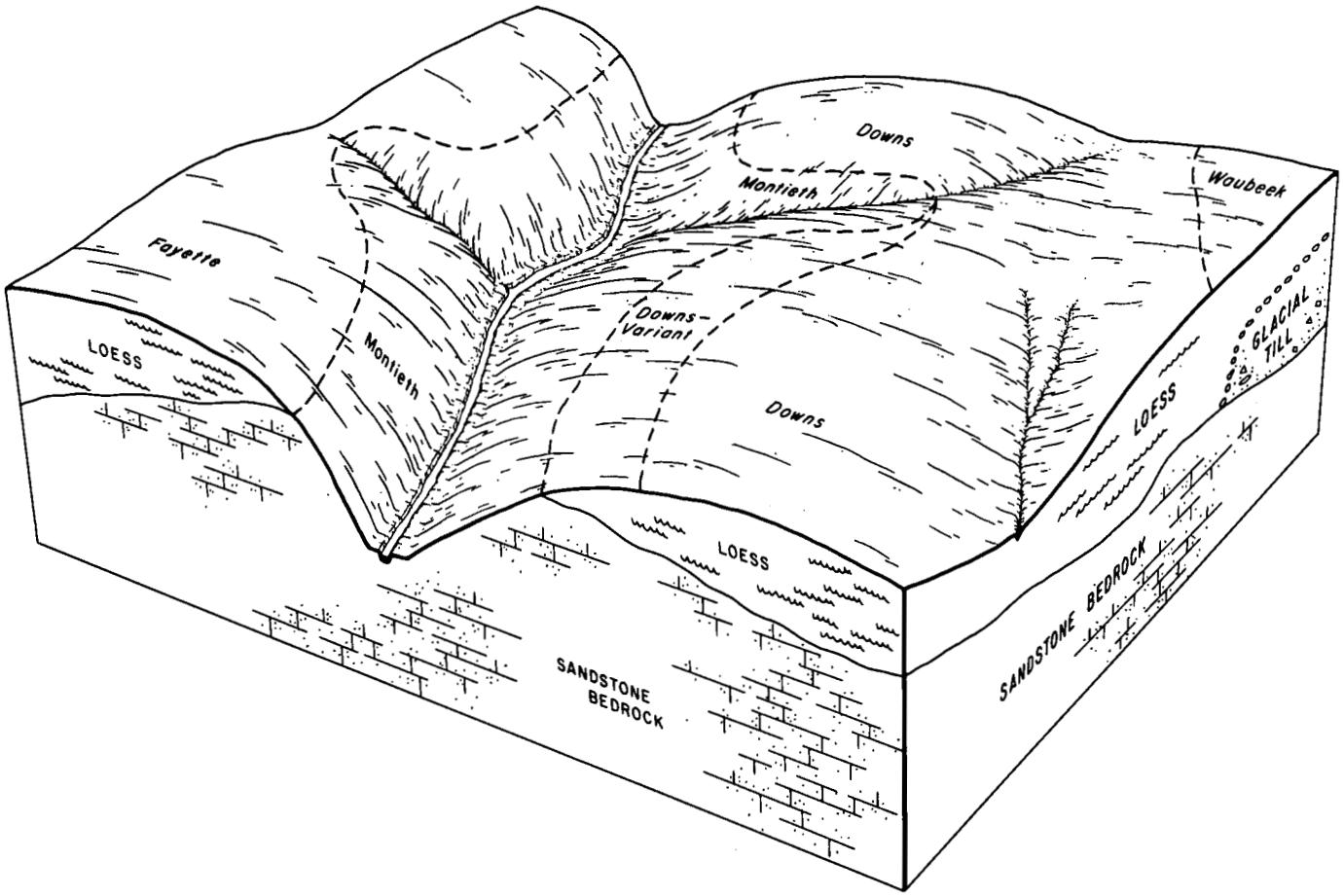


Figure 12.—Pattern of soils and parent material in the Downs-Fayette-Montieth association.

This association is dominated by gently sloping and moderately sloping soils dissected by narrow valleys that have strongly sloping to very steep side slopes. Slopes range from 2 to 40 percent.

This association makes up about 3 percent of the county. It is about 40 percent Downs soils, 18 percent Fayette soils, 7 percent Montieth soils, and about 35 percent soils of minor extent (fig. 12).

The gently sloping to strongly sloping, well drained Downs and Fayette soils are on ridgetops and side slopes. The moderately steep to very steep, excessively drained Montieth soils are on side slopes parallel to drainageways.

Typically, the surface layer of the Downs soils is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is brown and yellowish brown, friable silty clay loam and silt loam about 37 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silt loam.

Typically, the surface layer of the Fayette soils is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is yellowish brown, friable silty clay loam about 41 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Typically, the surface layer of the Montieth soils is dark grayish brown sandy loam about 4 inches thick. The subsurface layer is brown loamy sand about 6 inches thick. The subsoil is strong brown, very friable loamy

Figure 13.—Light colored soils in the Downs-Fayette-Montleth association.

sand and sand about 18 inches thick. Weakly cemented sandstone is at a depth of about 28 inches.

The most extensive soils of minor extent in this association are the Waubeek and Downs Variant soils. The Waubeek soils, which are on ridge crests and side slopes, developed in 20 to 40 inches of loess and the underlying glacial till. Downs Variant soils developed in 20 to 40 inches of loess and residuum weathered from the underlying sandstone bedrock.

Many areas of this association are in woodland. The moderately steep to very steep side slopes are nearly all used for woods or wooded pasture. Many soils on the more gently sloping areas could be used for crops. They are managed with the steeper soils, however, because they are small and are dissected by steep waterways.

Small areas of this association are used for cultivated crops. The gently sloping to moderately sloping soils are suited to row crops (fig. 13). Erosion control on the sloping soils is the principal management need.

Detailed Soil Map Units

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 underlying material, 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 underlying material. 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, Clarion loam, 2 to 5 percent slopes, is one of several phases in the Clarion 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 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. Webster-Nicollet complex, 1 to 3 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, quarries, 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.

Descriptions of the detailed soil map units follow.

6—Okoboji silty clay loam, 0 to 1 percent slopes. This level, very poorly drained soil is in depressional areas on uplands. It is subject to ponding by runoff from adjacent areas. Most areas range from 2 to 20 acres.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black, mottled silty clay loam about 21 inches thick. The subsoil is about 15 inches thick. It is black and olive gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the surface layer is mucky silt loam.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harps soil. This soil is along the edges of depressions at a slightly higher elevation than Okoboji soils. It has a very high lime content and appears much grayer when dry.

Available water capacity is high in this Okoboji soil, and permeability is moderately slow. A seasonal high water table is near or above the surface. Runoff does not occur until the depressional area is filled with water. The surface layer is about 10 percent organic matter. Reaction of the surface layer and the upper part of the subsoil is typically neutral. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses for hay and pasture if excess water is removed. It is poorly suited to legumes.

Wetness and ponding are the chief limitations to cultivation of this soil. Shallow ditches and tile drains that have open intakes help to remove excess surface water.

Young plants drown if they are covered with water for long periods, and replanting is necessary. Tile lines commonly are spaced closer together in this soil than in many of the adjacent wet soils.

This Okoboji soil is in capability subclass IIIw.

7—Wiota silt loam, 0 to 2 percent slopes. This nearly level, well drained and moderately well drained soil is on terraces and alluvial fans. Individual areas typically range from 4 to 20 acres, but a few areas are much larger.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is very dark gray and very dark grayish brown silty clay loam about 14 inches thick. The subsoil is about 26 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Available water capacity is high in this Wiota soil, and permeability is moderate. Surface runoff is slow. The surface layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil but varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Areas adjacent to foot slopes receive runoff in places, but diversions help to prevent runoff from adjacent side slopes.

This Wiota soil is in capability class I.

7B—Wiota silt loam, 2 to 5 percent slopes. This gently sloping, well drained and moderately well drained soil is on terraces and alluvial fans. Individual areas generally range from 4 to 20 acres.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is very dark gray and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 26 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Available water capacity is high in this Wiota soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 4 percent content of organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Diversions help to prevent runoff from adjacent side slopes.

This Wiota soil is in capability subclass IIe.

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained and moderately well drained soil is in drainageways on uplands and on foot slopes below the steeper side slopes. Individual areas generally are long and narrow and range from about 3 to 15 acres.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown to black silty clay loam about 27 inches thick. The subsoil extends to a depth of about 60 inches. It is very dark grayish brown and brown, friable silty clay loam in the upper part and dark yellowish brown and yellowish brown, friable silty clay loam in the lower part. In some small areas the slopes range from 5 to 9 percent. In other small areas the soil is somewhat poorly drained.

Available water capacity is high in this Judson soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 5 percent organic matter. Reaction ranges from medium acid to slightly acid in the subsoil but varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Individual areas are generally small and are cropped with adjacent soils. Some areas are subject to runoff from the side slopes on uplands. Runoff causes siltation or erosion, and in places where the runoff water concentrates, the formation of gullies. Diversion terraces help to prevent runoff from the adjacent side slopes and reduce siltation. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration and reduces erosion.

This Judson soil is in capability subclass IIe.

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes. These gently sloping soils are along waterways and on foot slopes in narrow valleys. The Colo soil is subject to flooding from adjacent streams or to runoff from soils in higher positions on the landscape. Individual areas generally range from 15 to 75 acres and are made up of about equal amounts of each soil. The poorly drained Colo soil typically is in the center of the drainageway, and the somewhat poorly drained Ely soil is on higher lying areas adjacent to the hillsides. Areas are typically long and narrow. The two soils occur as bands so narrow that it is not practical to separate them in mapping.

Typically, the surface layer of the Colo soil is black silty clay loam about 11 inches thick. The subsurface layer is black, friable silty clay loam about 29 inches thick. The next layer is very dark gray, firm silty clay loam about 6 inches thick. The substratum to a depth of about 60 inches is olive gray silt loam. In a few areas the substratum is sandy loam.

Typically, the surface layer of the Ely soil is black silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 21 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown, friable silty clay loam in the upper part and grayish brown, mottled silty clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, brownish gray and strong brown silt loam. In a few small areas the soils are moderately sloping.

Available water capacity is high in these Colo and Ely soils, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet in the Colo soil and at a depth of 2 to 4 feet in the Ely soil. Surface runoff is slow on the Colo soil and medium on the Ely soil. The surface layer of these soils is about 6 percent organic matter. Reaction is typically neutral or slightly acid throughout in the Colo soil. Reaction is slightly acid or medium acid throughout in the subsoil of the Ely soil and varies widely in the surface layer as a result of local liming practices. The subsoil of the Colo soil is medium in available phosphorus and potassium, and the subsoil of the Ely soil is very low in available phosphorus and potassium.

Most areas of these soils are cultivated, but some areas are in pasture or grassed waterways.

These soils are well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Small individual areas are cropped with adjacent soils in most places. Maintaining grassed waterways is an effective method of controlling erosion and preventing the formation of gullies. Some areas that receive runoff from the side slopes are subject to siltation. Other areas are subject to short duration flooding from small streams. Diversions and channel improvements can provide flood protection and divert runoff from adjacent side slopes. Artificial drainage helps to improve the timeliness of tillage operations and maintain tilth.

The use of these soils for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

These Colo and Ely soils are in capability subclass IIw.

20C2—Killduff silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained or moderately well drained soil is on convex ridges and side slopes on uplands. Individual areas generally are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. Plowing has mixed yellowish brown subsoil material into the surface layer. The subsoil is about 39 inches thick. It is yellowish brown, friable silty clay loam and silt loam mottled with grayish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silt loam. In some small severely eroded areas the surface layer is yellowish brown. In other somewhat poorly drained areas the surface layer is darker.

Available water capacity is high in this Killduff soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is typically slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium to low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans. Contouring, stripcropping, or terracing is needed to help control erosion. If terraced, this soil can be used for row crops at least half of the time without serious soil loss. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration and reduces erosion. All crop residue should be returned to maintain tilth.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Killduff soil is in capability subclass IIIe.

20D3—Killduff silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained and moderately well drained soil is on convex side slopes and ridge crests on uplands. Individual areas generally range from 4 to 20 acres.

Typically, the surface layer is brown silty clay loam about 7 inches thick. Plowing has mixed yellowish brown subsoil material into the surface layer. The subsoil is about 35 inches thick. It is yellowish brown, friable silty clay loam and silt loam mottled with grayish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silt loam. In some moderately eroded areas the surface layer is dark brown. In other narrow, somewhat poorly drained areas the surface layer is darker.

Available water capacity is high in this Killduff soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent of organic matter. Reaction is typically slightly acid in the subsoil but varies

widely in the surface layer as a result of local liming practices. The subsoil is medium to low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to hay and pasture, and it is suited to occasional, but not regular, cultivation. Terraces can be used on this soil, but they are not well suited. Low fertility and low content of organic matter adversely affect plant growth, especially in the terrace channels. Contouring, stripcropping, and tillage methods that leave mulch on the surface are alternatives to terraces. The low level of organic matter should be considered in the use of fertilizers and herbicides.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Killduff soil is in capability subclass IVe.

20E3—Killduff silty clay loam, 14 to 18 percent slopes, severely eroded. This moderately steep, well drained and moderately well drained soil is on convex side slopes and ridge crests on uplands. Individual areas generally range from 4 to 20 acres.

Typically, the surface layer is brown silty clay loam about 7 inches thick. Plowing has mixed yellowish brown subsoil material into the surface layer. The subsoil is about 33 inches thick. It is yellowish brown, friable silty clay loam and silt loam mottled with grayish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silt loam. In small areas along waterways and gullies, the slopes are steeper.

Available water capacity is high in this Killduff soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent organic matter. Reaction is typically slightly acid in the subsoil but varies widely in the surface layer as a result of local liming practices. The subsoil is medium to low in available phosphorus and very low in available potassium.

Some areas of this soil are cultivated with adjacent, less sloping soils; however, the soil is generally unsuited to cultivated crops because of steepness of slope and the hazard of further erosion. This soil is better suited to hay and permanent pasture than to most other uses. Hay and grain harvesting is difficult because of slope.

The use of this soil for hay and pasture is an effective means of controlling erosion. Terraces are not well suited to this soil because of the slope steepness and the low content of organic matter that restricts plant growth, especially in the terrace channels. In places grassed waterways need to be tiled or reshaped and seeded to permanent vegetation.

This Killduff soil is in capability subclass VIe.

27B—Terril loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is in drainageways on uplands and on foot slopes. Typically, it is below moderately sloping to strongly sloping side slopes. Most individual areas are long and narrow and range from 5 to 15 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown loam about 24 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable loam and sandy loam about 15 inches thick. The substratum to a depth of 60 inches is light olive brown loam. Some small areas are moderately sloping. A few small areas of somewhat poorly drained soils are along drainageways. Other small areas of soils are underlain by sand and gravel.

Available water capacity is high in this Terril soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 5 percent organic matter. Reaction is neutral or slightly acid in the surface layer and subsoil. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. It is subject to sheet and gully erosion if runoff water concentrates. Some areas are subject to excessive runoff from adjacent cultivated areas at a higher elevation, and in some years crops are damaged by short duration run-on and sedimentation. The use of conservation tillage, a system that leaves crop residue on the surface, in addition to contouring and terracing of the soils upslope, helps to control erosion and reduce local runoff and sedimentation on this soil.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Terril soil is in capability subclass IIe.

55—Nicollet loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on low, slightly convex ridges and slightly concave or flat, lower slopes on uplands. Individual areas generally range from 3 to 40 acres.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is black and very dark grayish brown clay loam about 13 inches thick. The subsoil is dark grayish brown and olive brown, mottled, friable loam about 12 inches thick. The substratum to a depth of about 60 inches is olive loam. In some places small areas of soils have better internal drainage.

Available water capacity is high in this Nicollet soil, and permeability is moderate. Surface runoff is medium.

A seasonal high water table is at a depth of 2.5 to 5 feet. The surface layer is about 6 percent organic matter. Reaction is slightly acid or neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and low to very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans. If the soil is used for cultivated crops, erosion is a very slight hazard on the more sloping areas. Improving the drainage may be beneficial because of the fluctuating water table. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, helps to prevent soil loss caused by wind erosion. Returning crop residue helps to maintain good tilth.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is wet causes surface compaction and decreases infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Nicollet soil is in capability class I.

62C2—Storden loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained, calcareous soil is on knolls and convex side slopes that border waterways and streams on uplands. Slopes are typically short. Individual areas are irregular in shape and generally range from 3 to 12 acres.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. Plowing has mixed yellowish brown substratum material into the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, mottled, friable loam. In some places layers of sandy loam are in the substratum.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of Clarion soil. This soil is near waterways and on slope crests. It is noncalcareous.

Available water capacity is high in this Storden soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans. In places the formation of gullies is a hazard. The use of conservation practices, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year; contour farming; terracing; crop rotation; and stripcropping, can significantly reduce soil erosion. Adequate erosion control is difficult in many places because of the short irregular slopes. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility and tilth and increase water infiltration.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Storden soil is in capability subclass IIIe.

62D2—Storden loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained, calcareous soil is on knolls and convex side slopes that border waterways and streams on uplands. Slopes are typically short. Individual areas are irregular in shape and generally range from 3 to 10 acres.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. Plowing has mixed yellowish brown substratum material into the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, mottled, friable loam. In some places layers of sandy loam are in the substratum. In many areas that have not been plowed, the surface layer is thin and very dark gray.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Clarion soil. This soil is near waterways and on slope crests. It is noncalcareous.

Available water capacity is high in this Storden soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans (fig. 14). In places the formation of gullies is a hazard. Soil loss can be reduced if a combination of conservation practices is used. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, and stripcropping, significantly reduces soil erosion. Adequate erosion control is difficult in many places because of the short, irregular slopes. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility and tilth and increase water infiltration.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Storden soil is in capability subclass IIIe.

62E2—Storden loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained, calcareous soil is on knolls and convex side slopes that border waterways and streams on uplands.

Figure 14.—Soybeans on eroded Storden soil.

Slopes are typically short. Individual areas are irregular in shape and generally range from 3 to 10 acres.

Typically, the surface layer is brown loam about 7 inches thick. Plowing has mixed yellowish brown substratum material into the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, mottled, friable loam. In places layers of sandy loam are in the substratum. In many areas that have not been plowed, the surface layer is thin and very dark gray.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Clarion soil. This soil is near waterways and on slope crests. It is noncalcareous. Also included and making up about 5 percent of the map unit are small areas of excessively drained, gravelly Salida soils. The Salida soils are in positions on the landscape similar to those of Storden soil.

Available water capacity is high in this Storden soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Although some areas of this soil are cultivated with adjacent, less sloping soils, this soil is poorly suited to

cultivated crops because of slope. It is better suited to hay and permanent pasture than to most other uses. Hay and grain harvesting is difficult because of slope. Close grazing of the pasture by livestock reduces the effectiveness of meadow crops in controlling erosion. If this soil is used for cultivated crops, the hazard of erosion is very severe. The use of conservation tillage, a system that leaves crop residue on the surface, together with contouring, helps to prevent excessive soil loss in areas where the soil is used for occasional row crops. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. The reduced level of organic matter resulting from erosion and the calcareous surface soil should be considered if herbicides are used.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in continued poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This Storden soil is in capability subclass IVe.

62G2—Storden loam, 18 to 40 percent slopes, moderately eroded. This steep to very steep, well drained, calcareous soil is on convex side slopes on uplands. Individual areas are long and narrow and generally range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, mottled, friable loam. In some places layers of sandy loam are in the substratum. In other areas the surface layer is sandy loam.

Available water capacity is high in this Storden soil, and permeability is moderate. Because surface runoff is rapid, however, the moisture available for plants may be limited. The surface layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Nearly all areas of this soil are in pasture and woodland. Some areas are suited to pasture if grazing is controlled. Many other areas are poorly suited to pasture and are better suited to woodland, wildlife habitat, or to recreational uses. The use of farm machinery is hazardous because of steepness of slopes, the rough topography, and gullies. Renovation of pasture generally is impractical unless special machinery is used.

This Storden soil is in capability subclass VIIe.

73C—Salida gravelly coarse sandy loam, 5 to 9 percent slopes. This moderately sloping, excessively drained, calcareous soil is on knolls, convex ridges, and side slopes on the uplands and on terrace escarpments. Most areas are 3 to 8 acres.

Typically, the surface layer is very dark brown gravelly coarse sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown gravelly coarse sandy loam about 3 inches thick. The subsoil is brown gravelly loamy coarse sand about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown and brown coarse sand and gravelly coarse sand.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Zenor soils. These soils, which are noncalcareous and less droughty than Salida soils, are along the outer edge of the soil delineations. Also included and making up about 5 percent of the map unit are small areas of well drained Storden soils. The included Storden soils are in positions on the landscape similar to those of Salida soil.

Available water capacity is very low in this Salida soil, and permeability is very rapid. Surface runoff is slow. The plow layer is about 1 percent organic matter. Reaction is moderately alkaline to neutral in the surface layer and subsoil and mildly alkaline or moderately alkaline in the substratum. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is poorly suited to corn and soybeans; because it often occurs in small areas associated with better suited soils, however, it is often used for corn and soybeans. This soil is better suited to grasses and legumes for hay and pasture than to cultivated crops. Close grazing of pasture by livestock decreases the effectiveness of meadow crops in controlling erosion. Crop production is limited almost every year because of the lack of available moisture during dry periods. Unless rains are frequent, crop losses due to drought are to be expected. If this soil is used for cultivated crops, water erosion and wind erosion are hazards. Blowing sand grains damage the young plants on the Salida soil and adjacent soils. The use of contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface greatly reduces soil loss and crop damage. The low level of organic matter and the coarse texture of the surface soil need to be considered in the use of herbicides.

This Salida soil is in capability subclass IVs.

73E—Salida gravelly coarse sandy loam, 9 to 18 percent slopes. This moderately sloping, excessively drained, calcareous soil is on knolls, convex ridges, and side slopes on the uplands and on terrace escarpments. Most areas are 3 to 10 acres, but a few areas are larger.

Typically, the surface layer is very dark brown gravelly coarse sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown gravelly loamy coarse sand about 3 inches thick. The subsoil is brown gravelly coarse sand about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown and brown gravelly coarse sand. In small eroded areas the surface layer is brown.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of well drained Storden soils. These loam soils are in positions on the landscape similar to those of Salida soil.

Available water capacity is very low in this Salida soil, and permeability is very rapid. Surface runoff is medium. The plow layer is about 1 percent organic matter. Reaction is moderately alkaline to neutral in the surface layer and subsoil and mildly alkaline or moderately alkaline in the substratum. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are used for small grains and hay or pasture. This soil is generally unsuited to cultivated crops. It is better suited to grasses and legumes for hay and pasture. Close grazing of the pasture by livestock decreases the effectiveness of the meadow crops in controlling erosion. Crop production is limited almost every year because of the lack of available moisture during dry periods. If this soil is used for cultivated crops, water erosion and wind erosion are hazards. Blowing sand grains damage young plants on the Salida soil and adjacent soils. The use of this soil for pasture or hay is an effective means of controlling erosion. Overgrazing or grazing when this soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Salida soil is in capability subclass VIs.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridge crests and side slopes on uplands. Individual areas generally are 3 to 10 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 52 inches thick. It is brown and yellowish brown, friable loam in the upper part and light olive brown, mottled, firm loam in the lower part. The substratum is multicolored loam. In some small severely eroded areas the plow layer is brown.

Available water capacity is high in this Kenyon soil, and permeability is moderate. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans. It is well suited to small grains and grasses and legumes for hay and pasture. Contouring, stripcropping, or terracing helps to control erosion in cultivated fields. In addition, the use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, reduces erosion and increases water infiltration. Grassed waterways are needed to prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Kenyon soil is in capability subclass IIIe.

83E2—Kenyon loam, 9 to 18 percent slopes, moderately eroded. This strongly sloping and moderately steep, moderately well drained soil is on convex ridge crests and side slopes on uplands. Individual areas typically range from 5 to 10 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 35 inches thick. It is brown and yellowish brown, friable loam in the upper part and light olive brown, mottled, firm loam in the lower part. The substratum is multicolored loam. In small severely eroded areas the plow layer is brown.

Available water capacity is high in this Kenyon soil, and permeability is moderate. Surface runoff is rapid. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Areas of this soil are used for corn, hay, and pasture. This soil is poorly suited to cultivated crops, but it is suited to small grains and grasses and legumes for hay or pasture.

This soil is best suited to trees or grasses and legumes. If the soil is cultivated, the hazard of erosion is severe. To control the erosion, the soil should be tilled on the contour and stripcropped and half of the area left in meadow. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration and helps to control runoff. Grassed waterways are needed to prevent the formation of gullies. Slopes are too steep for terracing. Returning all crop residue helps to maintain tilth.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Kenyon soil is in capability subclass IVe.

90—Okoboji mucky silt loam, 0 to 1 percent slopes. This level, very poorly drained soil is in depressional areas on uplands. It is subject to ponding by runoff from adjacent areas. Most areas are about 2 to 20 acres.

Typically, the surface layer is black mucky silt loam about 10 inches thick. The subsurface layer is black, mottled silty clay loam about 20 inches thick. The subsoil is black and olive gray, mottled, friable silty clay loam about 15 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the plow layer is silty clay loam.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harps soil. This soil is along the edges of the depressional Okoboji soil and is at a slightly higher elevation. It has a very high lime content and is much grayer when dry.

Available water capacity is high in this Okoboji soil, and permeability is moderately slow. A seasonal high water table is near or above the surface. Runoff does not occur until the depressional area is filled with water. The surface layer is about 15 percent organic matter. Reaction of the plow layer and subsoil is typically neutral. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses for hay and pasture if excess water is removed. It is poorly suited to legumes.

Wetness and ponding are the chief limitations to cultivation of this soil. Shallow ditches and tile drains that have open intakes help to remove excess surface water. Young plants drown if they are covered with water for long periods, and replanting is necessary. Tile lines are commonly spaced closer together in this soil than in many of the adjacent wet soils.

This Okoboji soil is in capability subclass IIIw.

95—Harps loam, 1 to 3 percent slopes. This nearly level, poorly drained, calcareous soil is on rims around depressional areas on uplands. Individual areas generally are 4 to 20 acres, but some areas are much larger.

Typically, the surface layer is black, calcareous loam about 8 inches thick. The subsurface layer is black to very dark gray and dark gray loam about 15 inches thick. The subsoil is olive gray, mottled, friable loam about 13 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled loam. In some small areas the lime content is not so high.

Included with this soil in mapping and making up about 5 percent of the map unit are small depressional areas of Okoboji soil that are subject to ponding. This soil has less content of lime than Harps soil.

Available water capacity is high in this Harps soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The surface layer is about 5 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed by tile drainage and plants are properly fertilized. Phosphorous and potassium deficiencies are common because of the extremely high lime content of this soil.

This Harps soil is in capability subclass IIw.

96—Turlin loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flood plains and low terraces. Individual areas generally range from about 3 to 10 acres, but a few areas are much larger.

Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is black and very dark gray loam about 19 inches thick. The subsoil is about 12 inches thick. It is dark grayish brown, mottled, firm clay loam in the upper part and light olive brown, firm clay loam in the lower part. The substratum extends to a depth of about 60 inches. It is yellowish brown, mottled coarse sandy loam in the upper part and olive gray, mottled silty clay loam in the lower part. In some small areas the soil is poorly drained.

Available water capacity is high in this Turlin soil, and permeability is moderate. A seasonal high water table is at a depth of 3 to 5 feet. Surface runoff is slow. The plow layer is about 5 percent organic matter. The subsoil is low to very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for pasture. In years of more than normal precipitation, wetness may hinder cultivation unless excessive water is removed.

This Turlin soil is in capability class I.

107—Webster silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flats, in irregularly shaped swales, and in drainageways on uplands. Individual areas generally range from 5 to 40 acres, but larger irregularly shaped areas are common.

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 14 inches thick. The subsoil is about 16 inches thick. It is olive gray, friable silty clay loam and clay loam in the upper part and olive gray, mottled, friable loam in the lower part. The substratum to a depth of about 60 inches is olive gray and light olive gray, mottled sandy loam and loam.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small areas of Canisteo and Harps soils that have a high lime content. The Harps soils appear gray when dry. Also included and

making up about 5 percent of the map unit are small, depressional areas of Okoboji soils.

Available water capacity is high in this Webster soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 2 feet. Surface runoff is slow. The surface layer is about 7 percent organic matter. Reaction is typically neutral in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most areas of this soil.

This Webster soil is in capability subclass IIw.

118—Garwin silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in shallow drainageways and on a few broad flats on uplands. Most areas range from 10 to 30 acres, but a few areas are much larger.

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 15 inches thick. The subsoil is about 18 inches thick. It is dark gray and olive gray, friable silty clay loam in the upper part and olive gray and gray, mottled, friable silt loam in the lower part. The substratum to a depth of about 60 inches is light olive gray silt loam. In some places the depth to glacial till is less than 60 inches.

Available water capacity is high in this Garwin soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 2 feet. Surface runoff is slow. The plow layer is about 7 percent organic matter. Reaction of the plow layer and subsoil is typically neutral or slightly acid. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most areas of this soil.

This Garwin soil is in capability subclass IIw.

119—Muscatine silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on lower, concave positions and low gradient, convex ridges on uplands. Individual areas generally range from 5 to 40 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 15 inches thick. The subsoil is about 27 inches thick. It is dark grayish brown, friable silty clay loam in the upper part and grayish brown, mottled, friable 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 depth to glacial till is less than 60 inches.

Available water capacity is high in this Muscatine soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. In years of more than normal precipitation, wetness commonly hinders cultivation. Tile drainage can improve the timeliness of fieldwork.

This Muscatine soil is in capability class I.

119B—Muscatine silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on lower, concave positions on uplands. Individual areas generally are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 15 inches thick. The subsoil is about 27 inches thick. It is dark grayish brown silty clay loam in the upper part and grayish brown, friable silt loam in the lower part. The substratum to a depth of about 60 inches is grayish brown silt loam. In some places the depth to glacial till is less than 60 inches.

Available water capacity is high in this Muscatine soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. It is subject to slight sheet and gully erosion if runoff water concentrates. Some areas are subject to excessive runoff from adjacent cultivated areas that are at higher elevations. The use of conservation tillage, a system that leaves crop residue on the surface, in addition to contouring and terracing of the soils upslope together with this Muscatine soil, helps to control erosion and reduce local runoff and sedimentation. In years of more than normal precipitation, wetness commonly hinders cultivation. Tile drainage can improve the timeliness of fieldwork.

This Muscatine soil is in capability subclass IIe.

120B—Tama silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridge crests and side slopes on uplands. Individual areas generally are long and narrow. They range from about 10 to 50 acres, but a few areas are much larger.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 30 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of somewhat poorly drained soils. These soils are near waterways and in lower lying areas.

Available water capacity is high in this Tama soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 4 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Areas of this soil are used intensively for cultivated crops. This soil is well suited to cultivated crops and small grains, and to grasses and legumes for hay or pasture. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to tilling on the contour, stripcropping, and terracing, is needed to reduce soil loss through erosion.

This Tama soil is in capability subclass IIe.

120C—Tama silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridge crests and convex side slopes that border waterways and streams on uplands. Individual areas are long and narrow. They generally range from 4 to 25 acres, but a few areas are much larger.

Typically, the surface layer is black and very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 30 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some small eroded areas the surface layer is thinner.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Ely soils. These soils are downslope and along waterways. They have a thicker surface layer, grayer B horizons, and poorer internal drainage than Tama soils.

Available water capacity is high in this Tama soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 4 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Areas of this soil are mostly cultivated and are used intensively for row crops. This soil is moderately suited to corn and soybeans if these crops are used in the rotation system about one-half of the time. It is well suited to small grains and grasses and legumes for hay or pasture. The use of conservation tillage, in addition to contouring, stripcropping, or terracing, is needed to help control erosion in cultivated fields. Conservation tillage, a practice that leaves crop residue on the surface throughout the year, also increases water infiltration. Grassed waterways are needed to prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Tama soil is in capability subclass IIIe.

120C2—Tama silty clay loam, 5 to 9 percent slopes, moderately eroded. This well drained, moderately sloping soil is on convex ridges and in long, narrow bands on side slopes on the uplands. Individual areas generally range from 5 to 50 acres.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 30 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some small uneroded areas the surface and subsurface layers are thicker. In a few small areas glacial till is between depths of 30 and 40 inches.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Ely soils. These soils are downslope and along waterways. They have a thicker surface layer, grayer B horizons, and poorer internal drainage than Tama soils.

Available water capacity is high in this Tama soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

This soil is moderately suited to corn and soybeans if these crops are used in the rotation system about one-half of the time. It is well suited to small grains and

grasses and legumes for hay or pasture. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contouring, stripcropping, or terracing, is needed to help control erosion in cultivated fields. Conservation tillage also increases water infiltration. Grassed waterways are needed to prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Tama soil is in capability subclass IIIe.

120D2—Tama silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is in long narrow bands on side slopes on the uplands. Individual areas generally range from 4 to 25 acres.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 30 inches thick. It is brown silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some areas near waterways and on slope crests, the surface layer is thicker. In other small severely eroded areas, the plow layer is brown.

Available water capacity is high in this Tama soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Areas of this soil are generally cultivated and are used intensively for row crops. This soil is moderately suited to corn and soybeans if these crops are used less than half of the time in a rotation system with oats and hay. It is well suited to small grains and grasses and legumes for hay or pasture. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contouring, stripcropping, or terracing, is needed to help control erosion on cultivated fields. Row crops can be included in the cropping system fairly often if fields are terraced and tilled on the contour. Grassed waterways are needed to prevent the formation of gullies, and in many places terrace drop inlets can be constructed. Conservation tillage also increases water infiltration.

The use of this soil for pasture and hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Tama soil is in capability subclass IIIe.

122—Sperry silt loam, 0 to 1 percent slopes. This level, very poorly drained soil is in depressional areas on uplands. It is subject to ponding by runoff from adjacent areas. Most areas are 2 to 5 acres.

Typically, the surface layer is black silt loam about 8 inches thick. The mottled subsurface layer is about 12 inches thick. It is very dark gray silt loam in the upper part, gray silt loam in the middle part, and dark gray silty clay loam in the lower part. The mottled subsoil is about 36 inches thick. It is dark gray and gray, firm silty clay in the upper part, gray and light olive gray, firm silty clay in the middle part, and gray, friable silty clay loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled silt loam. In some areas the subsurface layer is darker and has more clay.

Available water capacity is high in this Sperry soil, and permeability is slow. A seasonal high water table is within 1 foot of the surface. Runoff does not occur until the depressional areas are filled with water. The surface layer is about 4 percent organic matter. Reaction of the surface layer and subsurface layer is typically medium acid unless limed. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses for hay and pasture if excess water is removed. It is poorly suited to legumes.

Wetness and ponding are the chief limitations to cultivation of this soil. Young plants drown if they are covered with water for long periods, and replanting is necessary. Shallow ditches and tile drains that have open intakes help to remove excess water. Because the underground water movement toward the tile drains is slower in the Sperry soils than in the more permeable, adjacent wet soils, tile lines are commonly spaced closer together in the Sperry soils.

This Sperry soil is in capability subclass IIIw.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands. It is subject to flooding from adjacent streams and waterways. Individual areas are generally long and narrow. They range from 10 to 40 acres, but a few areas are much larger.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsurface layer is black, friable silty clay loam and very dark gray, firm silty clay loam about 35 inches thick. The substratum to a depth of about 60 inches is olive gray silt loam. In a few areas the substratum is sandy loam.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small areas of soils that are dissected by meandering stream channels. These soils are next to the streams and are more variable in texture and drainage class than Colo soil.

Available water capacity is high in this Colo soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically neutral or slightly acid throughout. The subsoil is medium in available phosphorus and potassium.

This soil is used for cultivated crops and permanent pasture. It is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay or pasture if it is drained and protected from flooding. This soil can be drained by tile and surface drains if adequate outlets are available. Diversions, levees, and channel improvements help to provide flood protection and to control runoff from adjacent areas. Artificial drainage helps to improve the timeliness of operations.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Colo soil is in capability subclass IIw.

135—Coland clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands (fig. 15). It is subject to flooding from adjacent streams and waterways. Most areas are long and narrow. They range from 10 to 40 acres, but a few areas are much larger.

Typically, the surface layer is black clay loam about 13 inches thick. The subsurface layer is about 13 inches thick. It is black clay loam in the upper part and very dark gray, mottled, friable clay loam in the lower part. The next layer is very dark gray, friable clay loam about 14 inches thick. The substratum to a depth of about 60 inches is very dark gray loam.

Included with this soil in mapping and making up about 10 percent of the map unit are areas of soils that are dissected by meandering stream channels. These soils are next to the streams and are more variable in texture and drainage class than Coland soil.

Available water capacity is high in this Coland soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically slightly acid or neutral throughout. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay or pasture. Tile drains function well in this soil if adequate outlets are available. This soil warms slowly in spring and tends to dry out and become cloddy and hard if worked when wet. It dries out slowly in spring because of the seasonal high water table. Returning crop residue helps to improve tilth and increase water infiltration. Areas of this soil are subject to occasional flooding. Flooding commonly takes place early in spring or is of short duration. Low lying areas and old bayous tend to pond after floods. Streambank cutting occurs in places.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and decreases infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Coland soil is in capability subclass IIw.

138B—Clarion loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on uplands. Individual areas are generally irregular in shape and range from 5 to 25 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 10 inches thick. The subsoil is about 25 inches thick. It is brown and dark yellowish brown, friable loam in the upper part and yellowish brown, mottled, friable loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In some places the surface layer is silt loam, and in other places the substratum is sandy loam. In some areas on steeper slopes and in small eroded areas, dark brown subsoil material has been mixed into the plow layer.

Available water capacity is high in this Clarion soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 4 percent organic matter. Reaction is medium acid or slightly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is cultivated, water erosion and wind erosion are hazards. The use of a combination of conservation measures, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, and stripcropping, significantly reduces soil loss. Returning crop residue helps to maintain good tilth and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Clarion soil is in capability subclass IIe.

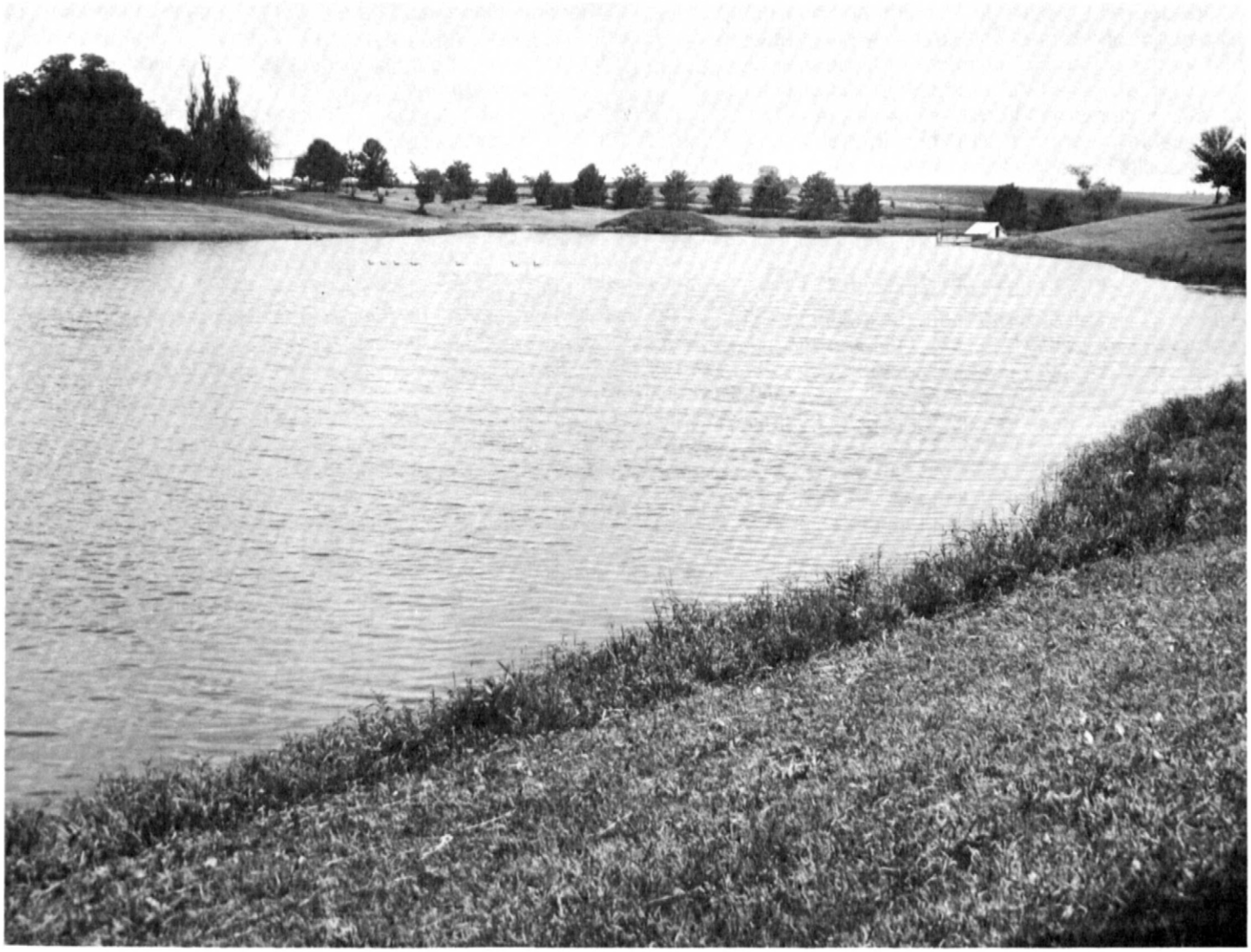


Figure 15.—Recreational lake on Coland soil.

138C2—Clarion loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on knolls and convex side slopes that border waterways and streams on uplands. Slopes typically are short. Individual areas are irregular in shape and generally range from 4 to 25 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable loam about 20 inches thick. The substratum to a depth of about 60 inches is light olive brown loam. In places it is sandy loam. Narrow areas of steeper slopes are near the waterways and on the shoulders of ridges. In uneroded areas and areas near the base of the slope the dark surface layer is thicker, and in some small severely eroded areas the plow layer is brown.

Included with this soil in mapping and making up about 10 percent of the map unit are small, moderately eroded areas of Storden soils on knobs and slope shoulders. These soils have a dark grayish brown plow layer and are calcareous.

Available water capacity is high in this Clarion soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is medium acid or slightly acid in the upper part of the subsoil and varies widely in the surface layer as a result

of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans. It is well suited to small grains and to grasses and legumes for hay and pasture. If this soil is cultivated, water erosion and wind erosion are hazards. The use of conservation tillage, contour farming, terracing, crop rotation, stripcropping, or a combination of these measures, significantly reduces soil loss. Conservation tillage, a practice that leaves crop residue on the surface throughout the year, also reduces wind erosion. Returning crop residue helps to maintain good tilth and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Clarion soil is in capability subclass IIIe.

138D2—Clarion loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on knolls and convex side slopes that border waterways and streams on uplands. Slopes typically are short. Individual areas are irregular in shape and generally range from 3 to 12 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable loam about 18 inches thick. The substratum to a depth of about 60 inches is light olive brown loam. In places the substratum is sandy loam. Narrow bands of steeper soils are near waterways and on the shoulders of ridges. In some areas the surface layer is thicker. In other small severely eroded areas the plow layer is brown.

Included with this soil in mapping and making up about 10 percent of the map unit are small severely eroded areas of Storden soils on knobs and slope shoulders. These soils have a brown plow layer and are calcareous.

Available water capacity is high in this Clarion soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is medium acid or slightly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans, and it is well suited to small grains and to grasses and legumes for hay or pasture. It is moderately eroded. If this soil is cultivated, the hazard of erosion is severe. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, stripcropping, or a combination of these measures, significantly reduces soil loss. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Clarion soil is in capability subclass IIIe.

152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, poorly drained soil is on stream terraces and outwash areas. Some low lying areas are subject to rare flooding. Individual areas range from 4 to 30 acres.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is black and very dark gray, mottled clay loam about 13 inches thick. The subsoil is about 15 inches thick. It is olive gray, friable clay loam in the upper part and mottled dark grayish brown and olive brown, friable loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is mottled loamy sand and sand that is 5 to 10 percent fine gravel. In some places the depth to sand and gravel is more than 40 inches, and in other places the depth to sand and gravel is less than 32 inches.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harcot soils. These soils have a high lime content and are gray when dry. They commonly are at a slightly higher elevation than Marshan soil.

Available water capacity is moderate in this Marshan soil. Permeability is moderate in the loamy upper part of the profile and rapid in the sandy lower part. A seasonal high water table is at a depth of 1 foot to 2.5 feet. Surface runoff is slow. The plow layer is about 7 percent organic matter. Reaction is neutral or slightly acid throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn, soybeans, small grains, hay, or pasture if it is drained. Tile and surface drains function well if adequate outlets are available. Levees are used to control flooding. Artificial drainage improves tilth and the timeliness of field operations. Tile placement is difficult in some areas because of loose, unstable sand below a depth of about 36 inches.

This Marshan soil is in capability subclass IIw.

162B—Downs silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are generally irregular in shape and range from about 5 to 30 acres.

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

dark grayish brown silt loam about 4 inches thick. The subsoil is about 37 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In some small areas the subsoil is grayer and somewhat poorly drained. In other small areas the surface layer is darker. In some areas on side slopes glacial till is between depths of 30 and 40 inches.

Available water capacity is high in this Downs soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Areas of this soil are used for cultivated crops, woodland, small grains, and grasses and legumes for hay and pasture. This soil is well suited to row crops if the crops are used in rotation with small grains and hay. If row crops are grown often in the rotation, tilling on the contour, stripcropping or terracing, and the use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, are needed to help reduce soil loss. This soil responds well to high level management.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Downs soil is in capability subclass IIe.

162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex side slopes and ridge crests on uplands. Individual areas are generally long and narrow and range from 4 to 25 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with brown. It is about 8 inches thick. Plowing has mixed the subsurface layer and brown subsoil material into the plow layer. The subsoil is about 40 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, mottled, friable silty clay loam and silt loam in the lower part. The substratum to a depth of 60 inches is yellowish brown, mottled silt loam. In some small areas the surface layer is darker, and in other severely eroded areas the surface layer is brown or yellowish brown. In some areas glacial till is between depths of 30 and 40 inches.

Available water capacity is high in this Downs soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is moderate to severe. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contouring, stripcropping, or terracing, is needed to help control erosion. Conservation tillage also increases water infiltration. Grassed waterways prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Downs soil is in capability subclass IIIe.

162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes on uplands. Individual areas are generally irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with brown. It is about 8 inches thick. Plowing has mixed the subsurface layer and brown subsoil material into the plow layer. The subsoil is about 40 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown silty clay loam and silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown silt loam. In some small areas the surface layer is darker, and in other severely eroded areas the surface layer is brown or yellowish brown. In some areas glacial till is between depths of 30 and 40 inches.

Available water capacity is high in this Downs soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil

and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn and soybeans if these crops are used in rotation with small grains and hay. It is well suited to small grains and to grasses and legumes for hay or pasture. If this soil is cultivated, it should be tilled on the contour, stripcropped, or terraced to help control erosion. Row crops can be included in the cropping system more often if soils are terraced and tilled on the contour. Grassed waterways prevent the formation of gullies. In many places terrace drop inlets can be constructed. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration and reduces the hazard of erosion.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Downs soil is in capability subclass IIIe.

163B—Fayette silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are generally irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 41 inches thick. It is yellowish brown and light olive brown, friable silty clay loam. The substratum to a depth of about 60 inches is yellowish brown silt loam. A few small areas are somewhat poorly drained. In some small moderately eroded areas, brown subsurface material has been mixed with the surface layer.

Available water capacity is high in this Fayette soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 to 2 percent organic matter. Reaction is typically strongly acid or medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is high in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Erosion is a hazard on cultivated soils.

In areas where row crops are grown often in the rotation, the use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration. Tilling on the contour and stripcropping are needed to prevent soil loss. Returning crop residue helps to maintain tilth. This soil responds well to high level management.

The use of this soil for pasture, hay, or trees is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Fayette soil is in capability subclass IIe.

163C—Fayette silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are generally long and narrow and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. Plowing has mixed subsurface material into the plow layer in some areas. The subsoil is about 41 inches thick. It is brown and yellowish brown, friable silty clay loam in the upper part and yellowish brown and light olive brown, mottled silty clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown silt loam. In some small areas the subsoil is grayer and somewhat poorly drained. In other areas on side slopes glacial till is between depths of 30 and 40 inches.

Available water capacity is high in this Fayette soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 to 2 percent organic matter. Reaction is typically strongly acid or medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is high in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans, and it is well suited to small grains and to grasses and legumes for hay or pasture. If the soil is used for cultivated crops, erosion is a hazard. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration. Contour stripcropping and terracing help to maintain tilth. Small grains and a mixture of alfalfa and bromegrass are needed in the cropping sequence.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Fayette soil is in capability subclass IIIe.

163D—Fayette silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on convex side slopes on uplands. Individual areas are irregular in shape and generally range from 5 to 20 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. Plowing has mixed subsurface material into the surface layer in some places. The subsoil is about 38 inches thick. It is brown and yellowish brown, friable silty clay loam in the upper part and yellowish brown and light olive brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown silt loam. In small areas above the foot slopes and in waterways, the surface layer is darker, and in some moderately eroded areas on slope shoulders, the surface layer is lighter colored. In some areas glacial till is between depths of 30 and 40 inches.

Available water capacity is high in this Fayette soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 to 2 percent organic matter. Reaction is typically strongly acid or medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is high in available phosphorus and very low in available potassium.

Many areas of this soil 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 the soil is cultivated, erosion is a hazard. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to tilling on the contour, increases water infiltration. Contour stripcropping and terracing help to control runoff. The return of all crop residue helps to maintain tilth. Small grains and a mixture of alfalfa and bromegrass are needed in the cropping sequence.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Fayette soil is in capability subclass IIIe.

168B—Hayden loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on uplands. Individual areas typically are irregular in shape and range from 4 to 15 acres.

Typically, the surface layer is very dark brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 44 inches thick. It is brown and yellowish brown, friable loam in the upper part and light olive brown, friable clay loam in the lower part. The substratum to a depth of about 60 inches is light olive brown and grayish brown loam. In some small moderately sloping areas, brown subsoil material has been mixed with the plow layer.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of somewhat poorly drained Le Sueur soil. This soil is near waterways and in lower lying areas.

Available water capacity is high in this Hayden soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, erosion is a hazard. If row crops are grown often in the rotation, tilling on the contour and stripcropping or terracing, together with conservation tillage, a practice that leaves crop residue on the surface throughout the year, are needed to help reduce soil loss. These soils respond well to high level management.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation

is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Hayden soil is in capability subclass IIe.

168C—Hayden loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and convex side slopes that border waterways and streams on uplands. Slopes typically are short. Individual areas are irregular in shape and generally range from 4 to 15 acres.

Typically, the surface layer is very dark brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 42 inches thick. It is brown, friable loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum to a depth of about 60 inches is light olive brown and grayish brown loam. In a few areas brown subsoil material has been mixed with the plow layer.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of somewhat poorly drained Le Sueur soil. This soil is near waterways.

Available water capacity is high in this Hayden soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is moderate to severe. The use of conservation tillage, in addition to contouring, stripcropping, or terracing, helps to control erosion in cultivated fields. Conservation tillage, a practice that leaves crop residue on the surface throughout the year, also increases water infiltration and reduces the hazard of erosion. Grassed waterways prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Hayden soil is in capability subclass IIIe.

168G—Hayden loam, 24 to 50 percent slopes. This very steep, well drained soil is on side slopes in the valley of the Iowa River, its tributary streams, and in deep, "V" shaped, short side valleys. Individual areas are long and narrow. They generally range from 5 to 100 acres, but a few areas along the Iowa River are larger.

Typically, the surface layer is very dark brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil is about 30 inches thick. It is brown, friable clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum to a depth of about 60 inches is light olive brown and grayish brown loam. In small eroded areas the surface layer is brown.

Included with this soil in mapping and making up about 15 percent of the map unit are areas of Storden soils on convex knobs and slope shoulders. These soils have a brown surface layer and are calcareous.

Available water capacity is high in this Hayden soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil. The subsoil is medium in available phosphorus and very low in available potassium.

Areas of this soil are used for trees and pasture. This soil is generally unsuitable for cultivated crops because of the steep slopes. It is moderately suited to grasses and legumes for hay and pasture. Permanent vegetative cover is an effective means of helping to control sheet and gully erosion. Controlled grazing is necessary to prevent serious damage to vegetation.

This soil is moderately suited to trees. Small areas remain in native hardwoods. Careful consideration should be given to the location of trails or roads to be used in logging in order to reduce the possibility of erosion. Laying out the trails or roads on the contour or nearly on the contour helps to reduce erosion. Use of equipment is hazardous on this soil because of steep slopes. Special equipment can be used, but caution should be exercised in its operation. Survival of seedlings or competition from undesirable plants is not a concern.

This Hayden soil is in capability subclass VIIe.

177—Saude loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces. Individual areas generally range from 4 to 20 acres, but a few areas are much larger.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown, friable loam in

the upper part and strong brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, loose sand that has a few gravel. In some small areas the surface layer is lighter colored. In other areas the depth to sand and gravel is more than 32 inches.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small areas of somewhat poorly drained Lawler soils. These soils are in lower lying positions.

Available water capacity is low to moderate in this Saude soil. Permeability is moderate in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are used for cropland, but some areas are in pasture. This soil is moderately suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Some small areas are cropped with adjacent soils. This Saude soil is at a higher elevation than the adjacent first bottom lands and normally is not subject to flooding. The moderate available water capacity limits crop yields. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. The use of this soil for pasture or hay is an effective means of helping to control erosion.

This Saude soil is in capability subclass IIs.

177B—Saude loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream terraces. A few areas are on the uplands. Individual areas generally range from 4 to 15 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 18 inches thick. It is dark brown, friable loam in the upper part and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, loose sand that has a few gravel. In some eroded areas brown subsoil material has been mixed with the plow layer.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small areas of somewhat excessively drained Flagler soil. This soil is on higher lying, convex positions on the landscape.

Available water capacity is low to moderate in this Saude soil. Permeability is moderate in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Some small areas are cropped with adjacent soils. The Saude soil is at a higher elevation than the adjacent first bottom lands and normally is not subject to flooding. The moderate available water capacity limits crop yields. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. The use of this soil for pasture or hay is an effective means of helping to control erosion.

This Saude soil is in capability subclass IIe.

177C—Saude loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on stream terraces. A few areas are on the uplands. Individual areas generally range from 3 to 30 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 3 inches thick. The subsoil is about 17 inches thick. It is brown, friable loam in the upper part and strong brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, loose sand that has a few gravel. In some small eroded areas, brown subsoil material has been mixed into the plow layer.

Included with this soil in mapping and making up 15 percent of the map unit are a few small areas of excessively drained Flagler soils. These soils are in convex positions at a higher elevation than Saude soil.

Available water capacity is low to moderate in this Saude soil. Permeability is moderate in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 3 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Some small areas are cropped with adjacent soils. The Saude soil is at a higher elevation than the adjacent first bottom lands and normally is not subject to flooding. The moderate available water capacity limits crop yields. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. The use of this soil for pasture or hay is an effective means of helping to control erosion.

This Saude soil is in capability subclass IIIe.

178—Waukee loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces and outwash areas. Individual areas generally are 5 to 12 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 15 inches thick. The subsoil is about 22 inches thick. It is brown, friable loam in the upper part, yellowish brown, friable loam in the middle part, and brown to dark brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is dark yellowish brown, loose gravelly sand and sand. The surface layer is somewhat thicker in waterways and on foot slopes. In some small areas the surface layer is lighter colored. In other areas the depth to sand and gravel is less than 30 inches.

Available water capacity is moderate in this Waukee soil. Permeability is moderate in the solum and very rapid in the sandy substratum. Surface runoff is slow. The surface layer is about 4 percent organic matter. Reaction is typically slightly acid to medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to cultivated crops, small grains, and grasses and legumes for hay or pasture. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. The moderate available water capacity limits crop yields in some years.

This Waukee soil is in capability subclass IIs.

178B—Waukee loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream terraces and outwash areas. Individual areas generally are 3 to 8 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 10 inches thick. The subsoil is about 19 inches thick. It is brown and dark brown, friable loam in the upper part, yellowish brown, friable loam in the middle part, and brown and dark brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand and sand. In the more sloping areas the surface layer is somewhat thinner, and the depth to sand and gravel is less than 30 inches.

Available water capacity is moderate in this Waukee soil. Permeability is moderate in the solum and very rapid in the sandy substratum. Surface runoff is medium. The surface layer is about 4 percent organic matter. Reaction is typically slightly acid to medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Some small areas are cropped with adjacent soils. The Saude soil is at a higher elevation than the adjacent first bottom lands and normally is not subject to flooding. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. The use of this soil for pasture or hay is an effective means of helping to control erosion. The moderate available water capacity limits crop yields.

This Waukee soil is in capability subclass IIe.

184—Klinger silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on uplands. It is on broad ridges; on low gradient, slightly convex side slopes; and at the heads of waterways. Individual areas range from about 5 to 30 acres.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 34 inches thick. It is dark grayish brown and brown, friable silty clay loam in the upper part and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown loam.

Available water capacity is high in this Klinger soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The plow layer is about 6 percent organic matter. Reaction is typically slightly acid to medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are used intensively for row crops. This soil is well suited to cultivated crops, hay, and pasture. Tile drainage can improve the timeliness of fieldwork in years when rainfall is above normal. Returning crop residue to the surface or regularly adding other organic material helps to improve fertility and maintain good tilth.

This Klinger soil is in capability class I.

184B—Klinger silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on uplands. It is on broad ridges; on low gradient, slightly convex side slopes; and at the heads of waterways. Individual areas range from about 5 to 30 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown and brown, friable silty clay loam in the upper part and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown loam.

Available water capacity is high in this Klinger soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The plow layer is about 6 percent organic matter. Reaction is typically slightly acid to medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If the soil is used for cultivated crops, erosion is a slight hazard. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Tile drainage can improve the timeliness of fieldwork in years when rainfall is above normal. Returning crop residue to the surface or regularly adding other organic material helps to improve fertility and maintain good tilth.

This Klinger soil is in capability subclass IIe.

188—Kensett loam, 0 to 2 percent slopes. This moderately deep, nearly level, somewhat poorly drained soil is on benches along the Iowa River. Individual areas range from about 4 to 20 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 11 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown, friable loam in the upper part and olive brown, friable loam in the lower part. The substratum is shattered limestone bedrock that has earthy material between fragments. A few small areas of soils along the waterways are poorly drained. In a few areas limestone is at a somewhat shallower depth.

Available water capacity is moderate to low in this Kensett soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The surface layer is about 5 percent organic matter. Reaction is typically neutral or slightly acid throughout the profile. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. During extended dry periods, it is somewhat droughty, and in years of more than normal precipitation, wetness hinders cultivation and reduces yields. Tile drains are difficult to install because the soil is only moderately deep over limestone bedrock.

This Kensett soil is in capability subclass IIs.

201B—Coland-Terril complex, 2 to 5 percent slopes. These gently sloping soils are along waterways and on foot slopes of narrow valleys. The lower lying, poorly drained Coland soil is subject to flooding from adjacent streams or to runoff from adjacent slopes. The moderately well drained Terril soil is on foot slopes. Areas are long and narrow and typically range from 10 to 30 acres. They are about 50 percent Coland soil, about 40 percent Terril soil, and about 10 percent soils of minor extent. The two soils occur as bands so narrow that it is not practical to separate them in mapping.

Typically, the surface layer of the Coland soil is black clay loam about 10 inches thick. The subsurface layer is about 16 inches thick. It is black clay loam in the upper part and very dark gray, mottled clay loam in the lower part. The subsoil is very dark gray, friable clay loam about 14 inches thick. The substratum to a depth of about 60 inches is very dark gray loam grading to sandy loam as depth increases.

Typically, the surface layer of the Terril soil is black loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown loam about 24 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable loam about 15 inches thick. The substratum to a depth of about 60 inches is light olive brown loam. Some small areas are moderately sloping. A few small areas of soils along the drainageways are somewhat poorly drained. Other small areas on foot slopes above the stream terraces are underlain by sand and gravel.

Available water capacity is high in these Coland and Terril soils, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet in the Coland soil. Surface runoff is slow on the Coland soil and medium on the Terril soil. The plow layer is about 6 percent organic matter in the Coland soil and about 5 percent in the Terril soil. Reaction is typically neutral or slightly acid throughout in the Coland soil. Reaction ranges from neutral to medium acid in the subsoil of the Terril soil and varies widely in the surface layer as a result of local liming practices. The subsoil of the Coland soil is very low in available phosphorus and very low to low in available potassium, and the subsoil of the Terril soil is low in available phosphorus and very low in available potassium.

Many areas of these soils are cultivated. These soils are suited to corn, soybeans, and small grains, and to grasses and legumes for hay if they are properly drained and protected from flooding. Some areas immediately adjacent to the waterways are difficult to cultivate because of stream meanders and because of the frequency of flooding. Terril soil is at a higher elevation, but crops planted on this soil are sometimes damaged by excessive runoff and sedimentation from higher lying soils. The use of conservation tillage, a system that leaves crop residue on the surface, in addition to contouring, helps to control erosion and reduce the damage from runoff and sedimentation.

These soils are well suited to use as pasture. Overgrazing or grazing when the soils are wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely

deferment of grazing, and restricted use during wet periods help to keep the pasture and soils in good condition.

These Coland and Terril soils are in capability subclass IIw.

212—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom lands and low terraces along major streams. It is subject to flooding. Individual areas generally are 4 to 20 acres.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable silt loam and silty clay loam about 46 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam. Some of the small lower lying areas of soils are somewhat poorly drained.

Available water capacity is high in this Kennebec soil, and permeability is moderate. Surface runoff is slow. A seasonal high water table is at a depth of 4 to 6 feet. The surface layer is about 6 percent organic matter. Reaction is slightly acid or neutral. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for pasture.

This Kennebec soil is in capability class I.

221—Palms muck, 0 to 2 percent slopes. This level, very poorly drained soil is in depressional areas that were once old lakebeds or swamps. It is subject to ponding by runoff from adjacent areas. Individual areas generally range from 4 to 20 acres, but a few areas are larger.

Typically, the surface layer is black sapric material about 9 inches thick. The subsurface layer is black sapric material about 19 inches thick. The substratum to a depth of about 60 inches is black to olive gray silt loam in the upper part and gray silt loam in the lower part. A few areas are gently sloping.

Available water capacity is high in this Palms muck soil. Permeability is moderately slow to moderately rapid in the organic surface layer and moderate or moderately slow in the underlying material. A seasonal high water table is within one foot of the surface. Runoff does not occur until the depressional areas are filled with water. The plow layer is about 30 percent organic matter. Reaction is typically neutral in the surface layer and mildly alkaline or moderately alkaline in the substratum. This soil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses for hay and pasture if excess water is removed. It is poorly suited to legumes. Damage to crops by frost is more common on this soil than on most other soils in the county. If this soil is drained and cultivated, the rate of decomposition of the organic material increases, and the organic layer gradually subsides.

This Palms soil is in capability subclass IIIw.

225—Lawler loam, 24 to 32 inches to sand or gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces and outwash areas. Individual areas generally range from 4 to 30 acres, but a few areas are much larger.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 13 inches thick. The subsoil is about 9 inches thick. It is dark grayish brown and olive brown, mottled, friable sandy clay loam in the upper part and grayish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is multicolored, loose coarse sand that is 5 to 10 percent fine gravel. The subsurface layer is somewhat thicker in the soils adjacent to swales and waterways.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Marshan soils that are poorly drained. These soils are along waterways and in lower lying areas.

Available water capacity is moderate to low in this Lawler soil. Permeability is moderate in the loamy upper part of the profile and rapid in the sandy lower part. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The surface layer is about 5 percent organic matter. Reaction typically is medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. During extended dry periods, it is somewhat droughty, and in years of more than normal precipitation, wetness hinders cultivation and reduces yields unless excess water is removed by drainage. Spacing of tiles can be at wider intervals than usual because the installation of tile in adjacent, poorly drained soils often lowers the water table of this Lawler soil. Tile placement is difficult in some areas because of loose, unstable sand.

This Lawler soil is in capability subclass IIs.

226—Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces and outwash areas. Individual areas generally range from 4 to 30 acres, but a few areas are much larger.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 14 inches thick. The subsoil is about 16 inches thick. It is dark grayish brown and olive brown, friable sandy clay loam in the upper part and

grayish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is multicolored, loose coarse sand that is 5 to 10 percent fine gravel.

Included with this soil in mapping and making up 5 to 10 percent of the map unit are a few small areas of poorly drained Marshan soils. These soils are along waterways and in lower lying areas.

Available water capacity is moderate in this Lawler soil. Permeability is moderate in the loamy upper part of the profile and rapid in the sandy lower part. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is slow. The surface layer is about 5 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. In years of more than normal precipitation, wetness hinders cultivation and reduces yields unless excess water is removed by drainage. The installation of tile in adjacent, poorly drained soils often lowers the water table of this Lawler soil. Tile placement is difficult in some areas because of loose, unstable sand below a depth of 42 inches.

This Lawler soil is in capability subclass IIs.

236B—Lester loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes on uplands. Individual areas are generally irregular in shape and range from 4 to 15 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 37 inches thick. It is dark yellowish brown, friable clay loam in the upper part and yellowish brown, friable clay loam and loam in the lower part. The substratum to a depth of about 60 inches is light olive brown loam. In some small areas the soil is moderately sloping. In other small eroded areas, dark yellowish brown subsoil material has been mixed with the plow layer.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of somewhat poorly drained Le Sueur soils. These soils are near waterways and in lower lying areas.

Available water capacity is high in this Lester soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans if these crops are used in rotation with small grains and hay. If row crops are grown often in the rotation, tilling on the contour and stripcropping or terracing, together with conservation tillage, a practice that leaves crop residue on the surface throughout the year, are needed to help reduce soil loss. This soil responds well to high level management.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Few problems should be encountered in planting new stands of trees if suitable species are selected and they are managed properly.

This Lester soil is in capability subclass IIe.

236C—Lester loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and convex side slopes that border waterways and streams on uplands. Slopes generally are short. Individual areas are irregular in shape and range from 4 to 15 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 36 inches thick. It is dark yellowish brown, friable clay loam and sandy clay loam in the upper part and yellowish brown, friable clay loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is light olive brown loam. In small eroded areas dark yellowish brown subsoil material has been mixed with the plow layer.

Available water capacity is high in this Lester soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans, and it is well suited to small grains and to grasses and legumes for hay or pasture. If this soil is cultivated, water erosion and wind erosion are hazards. The use of a combination of conservation measures, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, or stripcropping, can significantly reduce soil loss. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Few problems should be encountered in planting new stands of trees if suitable species are selected and they are managed properly.

This Lester soil is in capability subclass IIIe.

236C2—Lester loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on knobs, ridges, and convex side slopes that border waterways and streams on uplands. Slopes generally are short. Individual areas are irregular in shape and range from 4 to 15 acres.

Typically, the surface layer is dark brown loam about 8 inches thick. Plowing has mixed the subsurface layer and dark yellowish brown subsoil material into the surface layer. The subsoil is about 35 inches thick. It is dark yellowish brown; friable clay loam in the upper part and yellowish brown, friable clay loam and loam in the lower part. The substratum to a depth of about 60 inches is light olive brown loam.

Included with this soil in mapping and making up about 5 percent of the map unit are small, severely eroded areas of Storden soils on knobs and slope shoulders. These soils have a brown plow layer and are calcareous.

Available water capacity is high in this Lester soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans, and it is well suited to small grains and to grasses and legumes for hay or pasture. If this soil is cultivated, water erosion and wind erosion are hazards. The use of a combination of conservation measures, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, or stripcropping, can significantly reduce soil loss. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

If this soil is used for pasture, overgrazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Few problems should be encountered in planting new stands of trees if suitable species are selected and they are managed properly.

This Lester soil is in capability subclass IIIe.

236D2—Lester loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on narrow ridges and convex side slopes that border waterways and streams on the uplands. Slopes generally are short. Individual areas are irregular in shape and range from 5 to 15 acres.

Typically, the surface layer is dark brown loam about 8 inches thick. Plowing has mixed the subsurface layer and subsoil material into the surface layer. The subsoil is about 34 inches thick. It is dark yellowish brown, friable clay loam in the upper part and yellowish brown, friable clay loam and loam in the lower part. The substratum to a depth of about 60 inches is light olive brown loam.

Included with this soil in mapping and making up about 10 percent of the map unit are small, severely eroded areas of Storden soils on knobs and slope shoulders. These soils have a brown plow layer and are calcareous.

Available water capacity is high in this Lester soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to cultivated crops, and it is well suited to woodland, small grains, and to grasses and legumes for hay or pasture. If this soil is cultivated, water erosion and wind erosion are hazards. The use of a combination of conservation methods, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, or stripcropping, can significantly reduce soil loss. Wind erosion can be reduced by conservation tillage or by leaving all crop residue on the surface. Returning crop residue or the regular addition of other forms of organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Few problems should be encountered in planting new stands of trees if suitable species are selected and they are managed properly.

This Lester soil is in capability subclass IIIe.

236F—Lester loam, 14 to 24 percent slopes. This moderately steep and steep, well drained soil is on short, convex side slopes. It is adjacent to and parallel to flood plains and along small streams and waterways. Individual areas are irregular in shape. They generally range from 5 to 20 acres, but a few areas are larger.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 30 inches

thick. It is dark yellowish brown, friable clay loam in the upper part and yellowish brown, friable clay loam and loam in the lower part. The substratum to a depth of about 60 inches is light olive brown loam. In small eroded areas the surface layer is dark yellowish brown.

Included with this soil in mapping and making up about 5 percent of the map unit are severely eroded areas of Storden soils on small, convex knobs and slope shoulders. These soils have a brown plow layer and are calcareous.

Available water capacity is high in this Lester soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are in permanent pasture. This soil is generally unsuitable for cultivated crops, but it is moderately suited to trees. It is better suited to grasses and legumes for pasture than to other uses. Because of slope, low productivity, and the severe hazard of erosion, this soil is not suited to cultivation. Soil loss can be reduced significantly if a good vegetative cover is maintained.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and decreases water infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is moderately suited to trees. Small areas remain in native hardwoods. Careful consideration should be given to the location of trails or roads to be used in logging on this soil in order to reduce the possibility of erosion. Laying out trails or roads on the contour or nearly on the contour helps to reduce soil erosion. Use of equipment is hazardous on this soil because of steep slopes. Special equipment can be used, but caution should be exercised in its operation. Survival of seedlings or competition from undesirable plants is not a concern.

This Lester soil is in capability subclass VIe.

284—Flagler sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on stream terraces. A few areas are on uplands. Most areas are 3 to 15 acres, but a few areas are larger.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is very dark brown sandy loam about 9 inches thick. The subsoil is about 20 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and brown to dark brown, very friable loamy sand that has many gravel in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand that has a few gravel. In a few small areas the surface layer is gravelly sand. In some places calcareous sand and gravel are between depths of 36 and 60 inches.

Available water capacity is low to moderate in this Flagler soil. Permeability is moderately rapid in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low to low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Crop production is limited in many years because of lack of available moisture to supply the crops during extended dry periods. Unless rains are timely, crop losses due to drought are frequent. If this soil is used for cultivated crops, wind erosion is a hazard. Blowing sand grains from Flagler soil damage young plants on the Flagler soil and adjacent soils. Conservation tillage that leaves as much plant residue on the surface as possible greatly reduces crop damage and soil loss.

This Flagler soil is in capability subclass IIIs.

284B—Flagler sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on stream terraces. A few areas are on the uplands. Most areas are 3 to 15 acres, but a few areas are larger.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 15 inches thick. It is brown, friable sandy loam in the upper part and brown, very friable loamy sand that has many gravel in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand that has a few gravel. In a few small areas the surface layer is gravelly sand. In some places calcareous sand and gravel are between depths of 36 and 60 inches.

Available water capacity is low to moderate in this Flagler soil. Permeability is moderately rapid in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low to low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Crop production is limited in many years because of lack of available moisture to supply the crops during extended dry periods. Unless rains are timely, crop losses due to drought are frequent. If this soil is used for cultivated crops, wind erosion and

water erosion are hazards. Blowing sand grains from Flagler soil damage young plants on the Flagler soil and adjacent soils. Using contour farming where practical, in addition to conservation tillage, a practice which leaves as much plant residue on the surface as possible, greatly reduces crop damage and soil loss.

This Flagler soil is in capability subclass IIIe.

284C2—Flagler sandy loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat excessively drained soil is on stream terraces. A few areas are on the uplands. Most areas range from 3 to 15 acres, but a few areas are larger.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 13 inches thick. It is brown, friable sandy loam in the upper part and brown, very friable loamy sand that has many gravel in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand that has a few gravel. In a few small areas the surface layer is gravelly sand. In other uneroded areas and areas near the base of the slope, the surface layer is dark and thicker. In some places calcareous sand and gravel are between depths of 36 and 60 inches.

Available water capacity is low in this Flagler soil. Permeability is moderately rapid in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is medium. The plow layer is about 1 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low to low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Crop production is limited in many years because of lack of available moisture to supply the crops during extended dry periods. Unless rains are timely, crop losses due to drought are frequent. If this soil is used for cultivated crops, wind erosion and water erosion are hazards. Blowing sand grains from Flagler soil damage young plants on the Flagler soil and adjacent soils. Using contour farming where practical, in addition to conservation tillage, a practice which leaves as much plant residue on the surface as possible, greatly reduces crop damage and soil loss.

This Flagler soil is in capability subclass IIIe.

291—Atterberry silt loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on the uplands. It is at the heads of drainageways, on low gradient side slopes, and on ridges. Individual areas range from 4 to 15 acres.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 32 inches thick. It is dark grayish brown, friable silty clay loam in the upper part, mottled grayish brown and light olive brown, firm silty clay loam in the middle part, and mottled grayish brown and strong brown, firm silty clay loam in the lower part. The substratum to a depth of about 60 inches is mottled silt loam that is underlain by mottled loam. In a few areas glacial till is at a depth of about 36 inches.

Available water capacity is high in this Atterberry soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The surface layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay or pasture. It has a seasonal high water table, especially in spring. Tile drainage can improve the timeliness of fieldwork in years when the rainfall is above normal. Returning crop residue to the surface or regularly adding other organic material helps to improve fertility and maintain good tilth.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Atterberry soil is in capability class I.

325—Le Sueur silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low, slightly convex ridges and slightly concave, or flat lower slopes on uplands. Individual areas are irregular in shape and range from 4 to 20 acres.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 25 inches thick. It is light olive brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is mottled yellowish brown and gray to grayish brown loam. In some areas along drainageways the surface layer is thicker and poorly drained.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of well drained Lester soils. These soils are on low ridges.

Available water capacity is high in this Le Sueur soil, and permeability is moderate. Surface runoff is medium. A seasonal high water table is at a depth of 2 to 4 feet. The surface layer is about 3 percent organic matter. Reaction is strongly acid or very strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is medium in

available phosphorus and low to very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay or pasture. It has a seasonal high water table, especially in spring. Tile drainage can improve the timeliness of fieldwork in years when the rainfall is above normal. Returning crop residue to the surface or regularly adding other organic matter helps to improve fertility and maintain good tilth.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Le Sueur soil is in capability class I.

329—Webster-Nicollet complex, 1 to 3 percent slopes. These nearly level, poorly drained and somewhat poorly drained soils are on uplands. Individual areas, which range from 5 to 50 acres, are very irregular in shape and typically are closely associated with well drained soils. They are 45 to 55 percent Webster soil and 30 to 40 percent Nicollet soil. The Webster soil is on flats and in swales, and the Nicollet soil is on low ridges and lower side slopes. Both soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Typically, the Webster soil has a surface layer of black silty clay loam about 8 inches thick. The subsurface layer is black and dark gray silty clay loam about 14 inches thick. The subsoil is about 16 inches thick. It is friable, olive gray silty clay loam in the upper part, olive gray clay loam in the middle part, and olive, friable loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled loam and sandy loam.

Typically, the Nicollet soil has a surface layer of black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown clay loam about 13 inches thick. The subsoil is brown and olive brown, friable loam about 12 inches thick. The substratum to a depth of about 60 inches is olive loam.

Included with these soils in mapping and making up 5 to 15 percent of the unit are small areas of Clarion and Okoboji soils. The well drained Clarion soils are on low, convex ridges upslope from Nicollet and Webster soils. The very poorly drained Okoboji soils are in depressional areas.

Available water capacity is high in these Webster and Nicollet soils, and permeability is moderate. Webster soil has a seasonal high water table at a depth of 1 foot to 2 feet, and surface runoff is slow. Nicollet soil has a seasonal high water table at a depth of 2.5 to 5 feet, and surface runoff is medium. The surface layer of the Webster soil is about 7 percent organic matter, and the surface layer of the Nicollet soil is about 6 percent organic matter. Reaction is typically neutral in the surface layer and upper part of the subsoil in the Webster soil, and it is slightly acid or medium acid in the Nicollet soil. The subsoil of both soils is usually very low in available phosphorus and potassium.

Most areas of these soils are cultivated. These soils are well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most of the Webster soils in this map unit.

If these soils are used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

These Webster and Nicollet soils are in capability subclass IIw.

335—Harcot loam, 0 to 2 percent slopes. This nearly level, poorly drained, calcareous soil is on stream terraces and outwash areas. This soil is subject to flooding. Individual areas are irregular in shape. They range from 10 to 60 acres, but some areas are much larger.

Typically, the surface layer is black, calcareous loam about 8 inches thick. The subsurface layer is black and very dark gray, mottled loam about 14 inches thick. The subsoil is about 15 inches thick. It is grayish brown and olive gray, mottled, friable loam. The mottled substratum to a depth of about 60 inches is olive gray sand in the upper part and light olive gray fine sand in the lower part. In small depressional areas the surface layer is thicker, and the soil is ponded in wet seasons.

Available water capacity is moderate in this Harcot soil. Permeability is moderate in the loamy upper part of the profile and very rapid in the sandy lower part. Surface runoff is slow. A seasonal high water table is at a depth of 1 foot to 2 feet. The plow layer is about 5 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed and adequate fertilizer is applied. Excess lime in this soil reduces the availability of phosphorus and potassium to plants. Tile placement is difficult in some areas because of the loose, unstable sandy substratum.

This Harcot soil is in capability subclass IIw.

377B—Dinsdale silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained and moderately well drained soil is on long, convex side slopes and ridge crests on uplands. Individual areas generally range from 10 to 40 acres, but some areas are much larger.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 28 inches thick. It is brown, friable silty clay loam in the upper part, yellowish brown, friable silty clay loam in the middle part, and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In a few areas the soil is moderately sloping. In other small eroded areas, brown subsoil material has been mixed with the plow layer.

Available water capacity is high in this Dinsdale soil, and permeability is moderate. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans if these crops are used in rotation with small grains and hay. Where row crops are grown often in the rotation, tilling on the contour and stripcropping or terracing are needed to help reduce soil loss. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, also helps to reduce erosion. This soil responds well to high level management.

This Dinsdale soil is in capability subclass IIe.

377C2—Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained and moderately well drained soil is on long side slopes and ridge crests on uplands. Individual areas generally range from 4 to 15 acres, but some areas are much larger.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer in most places. The subsoil is about 35 inches thick. It is brown, friable silty clay loam in the upper part, yellowish brown, friable silty clay loam in the middle part, and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In a few small areas on the steeper parts of the slopes, the surface layer is loam. In other severely eroded areas on the shoulders of slopes, the plow layer is brown.

Available water capacity is high in this Dinsdale soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans in rotation with small grains and to grasses and legumes for hay or pasture. To help control erosion in cultivated fields, tilling on the contour, stripcropping, or terracing is needed. The use of conservation tillage, a practice that leaves crop residue on the surface throughout the year, increases water infiltration and also reduces erosion. Grassed waterways are needed to prevent the formation of gullies. In many places terrace drop inlets can be constructed.

The use of this soil for pasture or hay is an effective means of helping to control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, increases runoff, and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Dinsdale soil is in capability subclass IIIe.

377D2—Dinsdale silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained and moderately well drained soil is on long side slopes on uplands. Individual areas generally range from 5 to 15 acres, but a few areas are much larger.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed subsoil material into the plow layer in most places. The subsoil is about 33 inches thick. It is brown, friable silty clay loam in the upper part, yellowish brown, friable silty clay loam in the middle part, and yellowish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In a few areas on the steeper parts of the slopes, the surface layer is loam. In other severely eroded areas, especially on the shoulders of slopes, the plow layer is brown.

Available water capacity is high in this Dinsdale soil, and permeability is moderate. Surface runoff is rapid. The surface layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans, and it is well suited to small grains and to grasses and legumes for hay and pasture. This soil is moderately eroded. If this soil is cultivated, the hazard of erosion is severe. Using a combination of methods, such as conservation tillage, a practice that leaves crop residue on the surface throughout the year, in addition to contour farming, terracing, crop rotation, or stripcropping, significantly reduces soil loss. Returning crop residue or regularly adding other forms of organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This Dinsdale soil is in capability subclass IIIe.

382—Maxfield silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad flats and in shallow drainageways on uplands. Most areas are about 10 to 40 acres, but a few areas are larger.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam about 6 inches thick. The subsoil is about 17 inches thick. It is olive gray, friable silty clay loam in the upper part and mottled strong brown and light olive gray, friable loam in the lower part. The substratum to a depth of about 60 inches is mottled strong brown and light olive gray loam.

Available water capacity is high in this Maxfield soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 2 feet. Surface runoff is slow. The surface layer is about 7 percent organic matter. Reaction is typically neutral or slightly acid in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most areas of this soil. Returning crop residue to the surface or regularly adding other organic material helps to improve fertility and maintain good tilth.

This Maxfield soil is in capability subclass IIw.

393C—Sparta loamy fine sand, loamy substratum, 2 to 9 percent slopes. This gently sloping to moderately sloping, excessively drained soil is on convex ridges and dunes on uplands. Most areas range from 3 to 20 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsoil is about 22 inches thick. It is brown, friable loamy fine sand in the upper part and dark yellowish brown, friable loamy fine sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sand underlain by yellowish brown loam. In some places sand is below a depth of 60 inches. In small eroded areas brown subsoil material has been mixed with the plow layer.

Included with this soil in mapping and making up about 15 percent of the map unit are areas of well drained or somewhat excessively drained Dickinson soils. These soils are on the outer edges of the soil delineation.

Available water capacity is low to moderate in this Sparta soil. Permeability is rapid in the solum and upper part of the substratum and moderate in the loamy lower part. Surface runoff is slow. The plow layer is about 1 to 1.5 percent organic matter. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. This soil is poorly suited to corn and soybeans. It is often used for corn and soybeans, however, because it usually occurs in small areas associated with better suited soils. If this soil is used for cultivated crops, wind erosion is a hazard. Blowing sand grains damage young plants on this soil and adjacent soils. Using conservation tillage, a practice that leaves as much plant residue on the surface as possible, greatly reduces crop damage and soil loss. This soil is better suited to small grains and to grasses and legumes for hay or pasture than to other uses.

This soil is moderately suited to trees, but most areas of trees are limited to groves around farmsteads. Because natural and planted seedlings do not survive well, seedlings should be spaced closely together. The surviving trees can be thinned later to achieve the desired stand density. Competing vegetation needs to be controlled by site preparation or by spraying or cutting. There are no other hazards for planting or harvesting trees.

This Sparta soil is in capability subclass IVs.

393D—Sparta loamy fine sand, loamy substratum, 9 to 14 percent slopes. This strongly sloping, excessively drained soil is on convex ridges and dunes on uplands. Most areas are 3 to 10 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 4 inches thick. The subsoil is about 20 inches thick. It is brown, friable loamy fine sand in the upper part and dark yellowish brown, friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand underlain by yellowish brown loam. In some places sand is below a depth of 60 inches. In some small eroded areas, brown subsoil material has been mixed with the plow layer. Some areas of soils on escarpments are steeper.

Included with this soil in mapping and making up about 15 percent of the map unit are areas of well drained or somewhat excessively drained Dickinson soils. These soils are on the outer edges of the soil delineation.

Available water capacity is low to moderate in this Sparta soil. Permeability is rapid in the solum and upper part of the substratum and moderate in the loamy lower part. Surface runoff is slow. The plow layer is about 1 to 1.5 percent organic matter. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Some areas of this soil are cultivated. This soil is generally unsuited to corn and soybeans. It is often used for corn and soybeans, however, because it sometimes occurs in small areas associated with better suited soils.

If this soil is used for cultivated crops, wind erosion is a hazard. Blowing sand grains damage young plants on this soil and adjacent soils. Using conservation tillage, a practice that leaves crop residue on the surface, greatly reduces crop damage and soil loss. This soil is better suited to small grains and to grasses and legumes for hay or pasture than to other uses.

This soil is moderately suited to trees, but most areas of trees are limited to groves around farmsteads. Because natural and planted seedlings do not survive well, seedlings should be spaced closely together. The surviving trees can be thinned later to achieve the desired stand density. Competing vegetation needs to be controlled by site preparation or by spraying or cutting. There are no other hazards for planting or harvesting trees.

This Sparta soil is in capability subclass VIs.

409B—Dickinson fine sandy loam, loamy substratum, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and dunes on uplands. Most areas range from 4 to 15 acres.

Typically, the surface layer is very dark brown fine sandy loam about 10 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsoil is about 34 inches thick. It is dark yellowish brown, very friable fine sandy loam in the upper part and dark yellowish brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is brown and yellowish brown sandy loam in the upper part and olive gray, mottled silt loam in the lower part. In some places loamy sand or sand is below a depth of 60 inches. In other small eroded areas, brown subsoil material has been mixed with the plow layer.

Available water capacity is moderate in this Dickinson soil. Permeability is moderately rapid in the solum and moderate in the substratum. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses for hay and pasture. If this soil is used for cultivated crops, wind erosion and water erosion are hazards. Blowing sand grains damage young plants on this soil and adjacent soils. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent crop damage and excessive soil loss. Yields are reduced in years of average or below average precipitation because the available water capacity is limited in this soil. In places small seepy areas are on the lower slopes. In these areas interceptor tile can be used to speed drying and allow for timely field operations. Care in installation of the tile is necessary so that tile lines do not become filled with sand.

This Dickinson soil is in capability subclass IIIe.

409C—Dickinson fine sandy loam, loamy substratum, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridges and dunes on uplands. Most areas are 4 to 20 acres.

Typically, the surface layer is very dark brown fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsoil is about 26 inches thick. It is dark yellowish brown, very friable fine sandy loam in the upper part and dark yellowish brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is brown and yellowish brown sandy loam in the upper part and olive gray, mottled silt loam in the lower part. In some areas loamy sand or sand is below a depth of 60 inches. In other small eroded areas, yellowish brown subsoil material has been mixed with the plow layer.

Available water capacity is moderate in this Dickinson soil. Permeability is moderately rapid in the upper part of the profile and moderate in the substratum. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, wind erosion and water erosion are hazards. Blowing sand grains damage young plants on this soil and adjacent soils. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent crop damage and excessive soil loss. Yields are reduced in years of average or below average precipitation because the available water capacity is limited in this soil. In places small seepy areas are on the lower slopes. In these areas interceptor tile can be used to speed drying and allow for timely field operations. Care in installation of the tile is necessary so that tile lines do not become filled with sand.

This Dickinson soil is in capability subclass IIIe.

415G—Montieth sandy loam, 14 to 40 percent slopes. This moderately steep to very steep, excessively drained soil is on side slopes paralleling drainageways on uplands near the Iowa River. These areas are near Steamboat Rock and Eldora. Individual areas range from 5 acres to as much as 100 acres.

Typically, the surface layer is dark grayish brown sandy loam about 4 inches thick. The subsurface layer is brown loamy sand about 6 inches thick. The subsoil is about 18 inches thick. It is strong brown, very friable

loamy sand in the upper part and strong brown, very friable sand in the lower part. Weakly cemented sandstone is at a depth of about 28 inches. In some small areas along the waterways and gullies, the slopes are steeper. A few nearly vertical bluffs are along the Iowa River.

Available water capacity is low in this Montieth soil. Permeability is moderately rapid in the surface layer and rapid to very rapid in the substratum. Surface runoff is very rapid. The surface layer is about 1 percent organic matter. Reaction is strongly acid or very strongly acid. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are used for woodland, pasture, wildlife habitat, and recreation. A few areas on the less steep slopes are cultivated. This soil is not suited to cultivated crops, and it has severe limitations for pasture and hay. Harvesting hay is difficult or nearly impossible because of slope.

This soil is severely limited for forest production. The use of equipment is hazardous because of steepness, the rough topography, and gullies. Areas now used for tree production need to be protected from grazing.

This Montieth soil is in capability subclass VIIe.

428B—Ely silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on waterways, alluvial fans, and foot slopes on uplands. Individual areas generally are long and narrow and range from 5 to 15 acres.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray silty clay loam about 21 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown, friable silty clay loam in the upper part and grayish brown, mottled, friable silty clay loam in the lower part. The substratum to a depth of about 60 inches is mottled light brownish gray and strong brown silt loam. In some places narrow areas along the waterways are poorly drained.

Available water capacity is high in this Ely soil, and permeability is moderate. A seasonal high water table is at a depth of 2 to 4 feet. Surface runoff is medium. The surface layer is about 6 percent organic matter. Reaction is slightly acid or medium acid throughout the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. It is subject to slight sheet and gully erosion if runoff water concentrates. Some areas are subject to excessive runoff from adjacent cultivated areas at a higher elevation. In some years crops are damaged by short duration run-on and sedimentation. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing of the soils upslope as well as of this soil, helps to control erosion and reduce surface runoff and sedimentation. In years of more than normal precipitation, wetness hinders cultivation and crop yields are reduced unless excess water is removed. Seepage from hillsides is one cause of wetness in this soil. A drainage system that intercepts laterally moving water is the most successful means of correcting this problem.

This Ely soil is in capability subclass IIe.

457—Du Page silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom lands. It is subject to flooding from adjacent streams and waterways. Individual areas range from 5 to 40 acres.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam and loam about 40 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam.

Included with this soil in mapping and making up about 15 percent of the map unit are a few small areas of sandy Hanlon soils. These soils are typically adjacent to the streams. Also included are small lower lying depressional areas that are poorly drained.

Available water capacity is high in this Du Page soil, and permeability is moderate. A seasonal high water table is at a depth of 4 to 6 feet. Surface runoff is slow. The plow layer is about 5 percent organic matter. Reaction is typically mildly alkaline. The subsoil is low in available phosphorus and very low in available potassium.

Some areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for pasture if it is adequately protected from flooding.

This Du Page soil is in capability subclass IIw.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, moderately well drained to somewhat poorly drained soil is on bottom lands. It is subject to flooding from adjacent streams and waterways. Individual areas range from 5 to 40 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 44 inches thick. The substratum to a depth of about 60 inches is dark grayish brown loam. In some small, lower lying areas the soil is more poorly drained than typical.

Available water capacity is high in this Spillville soil, and permeability is moderate. A seasonal high water table is at a depth of 3 to 5 feet. Surface runoff is slow. The plow layer is about 5 percent organic matter. Reaction is slightly acid or neutral. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for pasture if it is adequately protected from flooding.

This Spillville soil is in capability subclass IIw.

491G—Renova loam, 18 to 35 percent slopes. This steep to very steep, moderately well drained soil is on convex side slopes. It is adjacent to and parallel to flood plains and along small streams and waterways. Individual areas range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown loam about 4 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 41 inches thick. It is yellowish brown, friable sandy loam in the upper part and yellowish brown, firm loam in the middle and lower parts. The substratum is mottled, yellowish brown and grayish brown loam. Pebbles and boulders are common on the surface and in the subsoil of this soil. In some small eroded areas the surface layer is brown. In other small areas along the waterways and gullies, the slopes are steeper.

Included with this soil in mapping and making up 5 percent of the map unit are narrow areas of soils in waterways. These soils are poorly drained and somewhat poorly drained.

Available water capacity is high in this Renova soil, and permeability is moderate. Because surface runoff is rapid, however, the moisture available to plants may be limited. The surface layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer. The subsoil is low in available phosphorus and very low in available potassium.

Some areas of this soil are suited to pasture if grazing is controlled. Many areas are poorly suited to pasture, however, and are better suited to woodland, wildlife habitat, or recreation. Areas of this soil commonly are favorable for the construction of ponds to be used for water supply, gully control, or recreation. Suitable sites are in many places. The use of farm machinery is hazardous on this soil because of steepness, the rough topography, and gullies. Renovation of pasture generally is impractical unless special machinery is used.

This soil is moderately suited to trees, and small areas remain in native hardwoods. Careful consideration should be given to the location of trails or roads to be used in logging on this soil in order to reduce the possibility of erosion. Laying out trails or roads on the contour or nearly on the contour helps to reduce soil erosion. Steepness of slope somewhat restricts the operation of equipment. Special equipment can be used, but caution should be exercised in its operation. Survival of seedlings or competition from undesirable plants generally is not a concern.

This Renova soil is in capability subclass VIIe.

506—Wacousta silt loam, 0 to 1 percent slopes. This level, very poorly drained soil is in depressional areas on uplands. It is subject to ponding by runoff from adjacent areas. Individual areas are generally 5 to 20 acres, but a few areas are much larger.

Typically, the surface layer is black silt loam about 8 inches thick. The subsoil is friable to firm silty clay loam about 12 inches thick. It is black in the upper part and dark gray and olive gray in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In some areas the black subsoil is thicker.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harps soils. These soils are at a slightly higher elevation along the edges of the depressions. They have a very high lime content and are much grayer when dry.

Available water capacity is high in this Wacousta soil, and permeability is moderate. Runoff does not occur until the depressional area is filled with water. The surface layer is about 8 percent organic matter. Reaction of the surface layer and upper part of the subsoil is typically neutral. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Wetness and ponding are the chief limitations to cultivation of this soil. Young plants drown if they are covered with water for long periods, and replanting is necessry. Shallow ditches and tile drains that have open intakes help to remove excess surface water. Tile lines are commonly spaced closer together in this soil than in many of the adjacent wet soils.

This Wacousta soil is in capability subclass IIIw.

507—Canisteo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained, calcareous soil is on flats and in irregularly shaped swales and low gradient drainageways on uplands. Individual areas typically range from 5 to 60 acres.

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 12 inches thick. The subsoil is about 16 inches thick. It is dark gray, friable silty clay loam in the upper part and light olive gray, friable clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray, mottled loam and sandy loam. In some small areas the soil is not calcareous.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Harps soil that have a higher lime content than Canisteo soil. They are on rims of the depressional areas. Also included are a few small areas of Okoboji soil in depressions.

Available water capacity is high in this Canisteo soil, and permeability is moderate. A seasonal high water

table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The surface layer is about 7 percent organic matter. Reaction is mildly alkaline or moderately alkaline in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed and adequate fertilizer is used. Excess lime reduces the availability of phosphorus and potassium to plants. Tile drainage has been installed in most areas of this soil.

This Canisteo soil is in capability subclass IIw.

536—Hanlon fine sandy loam, 0 to 3 percent slopes. This nearly level to very gently sloping, moderately well drained soil is on natural levees and nearly level bottom lands. This soil is subject to flooding. Individual areas range from 3 to 10 acres.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is about 40 inches thick. It is very dark gray fine sandy loam in the upper part and very dark gray sandy loam in the lower part. The subsoil to a depth of about 60 inches is very dark grayish brown, friable sandy loam.

Included with this soil in mapping and making up about 15 percent of the map unit are areas of soils that are adjacent to streams. These soils are calcareous sandy loam.

Available water capacity is moderate in this Hanlon soil, and permeability is moderately rapid. Surface runoff is slow. A seasonal high water table is at a depth of 3 to 5 feet. The surface layer is about 3 percent organic matter. Reaction is typically slightly acid or neutral. The subsoil is very low in available phosphorus and potassium.

This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Most areas of this soil are suited to intensive row cropping if they are adequately protected from flooding. Most flooding takes place before corn is planted. Levees and dikes can provide flood protection. Tile drains function well if adequate outlets are available.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Hanlon soil is in capability subclass IIs.

595—Harpster silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained, calcareous soil is in drainageways and on broad flats on uplands. This soil is subject to ponding. Individual areas range from 5 to 20 acres, but a few long, narrow areas are much larger.

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 14 inches thick. The subsoil is olive gray, friable silty clay loam about 8 inches thick. The substratum to a depth of about 60 inches is olive gray silt loam in the upper part and mottled yellowish brown and light brownish gray, friable sandy loam in the lower part. In a few small areas the surface layer is neutral.

Available water capacity is high in this Harpster soil, and permeability is moderate. A seasonal high water table is at a depth of 0.5 foot to 2 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed and adequate fertilizer is applied. Tile drains can be installed successfully in this soil. Small areas are subject to ponding. Shallow ditches can be used to remove excess surface water. Restricted drainage delays field operations in some years. The content of lime is excessive in this soil.

This Harpster soil is in capability subclass IIw.

638C2—Clarion-Storden loams, 5 to 9 percent slopes, moderately eroded. These moderately sloping, well drained soils are on knolls, convex ridges, and side slopes that border waterways and streams on uplands. Slopes typically are short. Individual areas of these soils generally are long and irregular in shape and range from 6 to 30 acres. They are 50 to 60 percent Clarion soil, 30 to 45 percent Storden soil, and as much as 20 percent soils of minor extent. The calcareous Storden soil is on the more convex parts of knolls and ridges. The Clarion soil is on ridge crests, in shallow waterways, and on the lower part of side slopes. The two soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Typically, the surface layer of the Clarion soil is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable loam about 20 inches thick. The substratum to a depth of about 60 inches is light olive brown, friable loam. In places it is sandy loam.

Typically, the surface layer of the Storden soil is dark grayish brown loam about 8 inches thick. Plowing has mixed yellowish brown substratum material into the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, friable loam. In some places layers of sandy loam are in the substratum.

Available water capacity is high in these Clarion and Storden soils, and permeability is moderate. Surface runoff is medium. The surface layer of the Clarion soil is about 2 percent organic matter, and the surface layer of the Storden soil is about 1 percent organic matter. Reaction is typically medium acid or slightly acid in the upper part of the subsoil of the Clarion soil and mildly alkaline or moderately alkaline in the surface layer and substratum of the Storden soil. The subsoil of both soils is very low in available phosphorus and potassium.

Most areas of these soils are cultivated. These soils are suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if they are properly fertilized. Excessive lime in the Storden soil reduces the availability of phosphorus and potassium to plants. If these soils are used for cultivated crops, erosion is a moderate hazard. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. The reduced level of organic matter, resulting from erosion and the calcareous surface layer of the Storden soil, should be considered in the use of herbicides.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

These Clarion and Storden soils are in capability subclass IIIe.

638D2—Clarion-Storden loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping, well drained soils are on knolls; narrow, convex ridges; and side slopes that border waterways and streams on uplands. Slopes typically are short. Individual areas are long and narrow and range from 5 to 12 acres. They are about 50 to 60 percent Clarion soil, 30 to 45 percent Storden soil, and as much as 20 percent soils of minor extent. The calcareous Storden soil is on the more convex part of the knolls and ridges, and the Clarion soil is on the ridge crests, in shallow waterways, and on the lower part of the side slopes. The two soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Typically, the surface layer of the Clarion soil is very dark brown loam about 8 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable loam about 18 inches thick. The substratum to a depth of about 60 inches is light olive brown, friable loam. In places the substratum is sandy loam.

Typically, the surface layer of the Storden soil is dark grayish brown loam about 8 inches thick. Plowing has mixed yellowish brown substratum material into the surface layer. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, friable loam. In places layers of sandy loam are in the substratum.

Available water capacity is high in these Clarion and Storden soils, and permeability is moderate. Surface runoff is rapid. The surface layer of the Clarion soil is about 2 percent organic matter, and the plow layer of the Storden soil is about 1 percent organic matter. Reaction is medium acid or slightly acid in the upper part of the subsoil of the Clarion soil and mildly alkaline or moderately alkaline in the surface layer and substratum of the Storden soil. The subsoils of both soils are very low in available phosphorus and potassium.

Many areas of these soils are cultivated. These soils are suited to corn and soybeans in rotation with small grains and grasses and legumes for hay and pasture if they are properly fertilized. Excessive lime in the Storden soil reduces the availability of phosphorus and potassium to plants. If these soils are used for cultivated crops, the hazard of erosion is severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Close grazing of the pasture by livestock decreases the effectiveness of meadow crops in controlling erosion. The reduced level of organic matter, resulting from erosion and the calcareous surface layer of the Storden soil, should be considered in the use of herbicides.

If this soil is used for pasture, overgrazing or grazing when the soil is wet causes surface compaction and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

These Clarion and Storden soils are in capability subclass IIIe.

696—Tilfer loam, 0 to 2 percent slopes. This moderately deep, nearly level, poorly drained, calcareous soil is on benches along the Iowa River. Individual areas range from 4 to about 80 acres.

Typically, the surface layer is black, calcareous loam about 8 inches thick. The subsurface layer is black silty clay loam about 9 inches thick. The mottled subsoil is about 9 inches thick. It is dark grayish brown, firm silty clay loam in the upper part and olive gray, friable silty clay loam in the lower part. It is underlain by shattered limestone bedrock that has earthy material between the fragments. In a few small areas the depth to limestone is somewhat less than typical.

Available water capacity is moderate to low in this Tilfer soil, and permeability is moderate. A seasonal high water table ranges from the surface to a depth of 2 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed and the soil is properly fertilized. Tile drains are difficult to install because this soil is only moderately deep to limestone bedrock and excavation of the bedrock is difficult. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants.

This Tilfer soil is in capabililty subclass IIIw.

705C2—Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded. This moderately deep, moderately sloping, well drained soil is on convex side slopes and ridge crests on uplands. Individual areas range from 4 to 12 acres.

Typically, the surface layer is dark brown silt loam about 8 inches thick. It is mixed with dark yellowish brown subsoil material. The subsoil is about 29 inches thick. It is dark yellowish brown, friable silty clay loam in the upper part and yellowish brown, friable loam and sandy loam in the lower part. Weakly cemented sandstone is at a depth of 37 inches. In small steeper areas on slope shoulders, bedrock may be nearer the surface.

Included with this soil in mapping are small areas of sandy Montieth soils on slope shoulders and small areas of Fayette soils. Each soil makes up about 10 percent of the map unit.

Available water capacity is moderate in this Downs Variant soil. Permeability is moderate in the surface layer and subsoil and rapid in the sandstone substratum. The surface layer is about 1 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is moderate to severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. The low level of organic matter should be considered in the use of fertilizers and herbicides. Terraces should be carefully planned because sandstone bedrock is at a depth of about 2.5 to 3.5 feet. During extended dry periods this soil is somewhat droughty.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Downs Variant soil is in capability subclass IIIe.

705D2—Downs Variant silt loam, 9 to 14 percent slopes, moderately eroded. This moderately deep, strongly sloping, well drained soil is on convex side slopes and ridge crests on uplands. Individual areas range from 4 to 12 acres.

Typically, the surface layer is dark brown silt loam about 8 inches thick. It is mixed with dark yellowish brown subsoil material. The subsoil is about 25 inches thick. It is dark yellowish brown, friable silty clay loam in the upper part and yellowish brown, friable loam and sandy loam in the lower part. Weakly cemented sandstone is at a depth of 33 inches. In small steeper areas on slope shoulders, sandstone bedrock may be nearer the surface.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of Montieth soils. These soils are on slope shoulders.

Available water capacity is moderate in this Downs Variant soil. Permeability is moderate in the surface layer and subsoil and rapid in the sandstone substratum. The surface layer is about 1 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. This soil is suited to corn and soybeans in rotation with small grains and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Close grazing of pasture by livestock decreases the effectiveness of meadow crops in controlling erosion. The low level of organic matter should be considered in the use of fertilizers and herbicides. Terraces should be carefully planned because sandstone bedrock is at a depth of about 2.5 to 3.5 feet. During extended dry periods this soil is somewhat droughty.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Downs Variant soil is in capability subclass IIIe.

733—Calco silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained, calcareous soil is on flood plains of streams and in low drainageways on uplands. It is subject to brief flooding from adjacent streams. Individual areas are generally long and narrow and range from 10 to 80 acres.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is black silty clay loam about 26 inches thick. The subsoil is very dark

gray, friable silty clay loam about 5 inches thick. The substratum to a depth of about 60 inches is olive gray and yellowish brown loam. In a few areas the soils adjacent to streams are channeled. In a few other areas the surface layer is thin and mucky.

Available water capacity is high in this Calco soil, and permeability is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. Surface runoff is slow. The plow layer is about 6 percent organic matter. Reaction is moderately alkaline in the surface layer and moderately alkaline or mildly alkaline in the subsoil. The subsoil is very low in available phosphorus and potassium.

This soil is used for cultivated crops and hay and pasture. It is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if it is satisfactorily drained, protected from flooding, and properly fertilized. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. Adequate tile outlets are difficult to obtain in some areas. Areas immediately adjacent to streams are hard to crop because of stream meanders, frequency of flooding, and the difficulty of flood control. These areas are often left in permanent pasture.

This Calco soil is in capability subclass IIw.

771B—Waubeek silt loam, 2 to 5 percent slopes. This gently sloping, well drained and moderately well drained soil is on long, convex side slopes and ridge crests on uplands. Individual areas generally range from 5 to 15 acres, but a few areas are much larger.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. It is dark yellowish brown and yellowish brown, friable silty clay loam in the upper part; yellowish brown, firm sandy clay loam in the middle part; and mottled strong brown and light brownish gray, firm loam in the lower part. In some narrow areas near the waterways the soil is somewhat poorly drained.

Available water capacity is high in this Waubeek soil, and permeability is moderate. Surface runoff is medium. The surface layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, erosion is a hazard. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Waubeek soil is in capability subclass IIe.

771C2—Waubeek silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained and moderately well drained soil is on long, convex side slopes and ridge crests on uplands. Individual areas range from 4 to 12 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed the subsurface layer and brown subsoil material into the surface layer. The subsoil extends to a depth of about 60 inches. It is dark yellowish brown and yellowish brown, friable silty clay loam in the upper part; yellowish brown, firm sandy clay loam in the middle part; and mottled strong brown and light brownish gray, firm loam in the lower part. In areas on foot slopes and in waterways the surface layer is darker. In other areas on the shoulders of slopes the soil is loamy, severely eroded, and of less depth to the underlying glacial till.

Available water capacity is high in this Waubeek soil, and permeability is moderate. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is moderate to severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Waubeek soil is in capability subclass IIIe.

771D2—Waubeek silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained and moderately well drained soil is on long, convex side slopes and ridge crests on uplands. Individual areas range from 4 to 12 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed the subsurface layer and brown subsoil material into the surface layer. The subsoil extends to a depth of about 60 inches. It is dark yellowish brown, friable silty clay

loam in the upper part, yellowish brown, friable sandy clay loam in the middle part, and mottled strong brown and light brownish gray, firm loam in the lower part. In small areas on foot slopes and in waterways the surface layer is darker. In other small areas on the shoulders of slopes the soil is severely eroded and of less depth to the underlying glacial till.

Available water capacity is high in this Waubeek soil, and permeability is moderate. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. This soil is suited to corn and soybeans in rotation with small grains and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss if this soil is used for row crops. Harvesting of hay and small grains may be difficult because of slope. Close grazing of pasture by livestock decreases the effectiveness of meadow crops in controlling erosion. The reduced level of organic matter as a result of erosion should be considered in the application of fertilizers and herbicides.

This soil is well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

This Waubeek soil is in capability subclass IIIe.

814—Rockton loam, 0 to 2 percent slopes. This moderately deep, nearly level, well drained soil is on benches along the Iowa River. Individual areas range from 3 to 30 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 11 inches thick. The subsoil is about 9 inches thick. It is dark brown to brown, friable loam. Shattered limestone bedrock is at a depth of 28 inches. In small areas the bedrock is between depths of 40 and 50 inches. In places flags of limestone are in the plow layer.

Available water capacity is low to moderate in this Rockton soil, and permeability is moderate. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. During extended dry periods this soil is somewhat droughty.

This Rockton soil is in capability subclass IIs.

814B—Rockton loam, 2 to 5 percent slopes. This moderately deep, gently sloping, well drained soil is on ridge crests and side slopes on benches along the Iowa River. Individual areas range from 3 to 10 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 11 inches thick. The subsoil is about 5 inches thick. It is brown, friable loam. Shattered limestone bedrock is at a depth of about 24 inches. In small areas the bedrock is between depths of 40 and 50 inches. In other places flagstones are in the plow layer.

Available water capacity is low to moderate in this Rockton soil, and permeability is moderate. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, erosion is a hazard. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Terraces should be planned carefully because limestone bedrock is at a depth of about 20 to 40 inches. During extended dry periods this soil is somewhat droughty.

This Rockton soil is in capability subclass IIe.

814C2—Rockton loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on ridge crests and side slopes on benches along the Iowa River. Individual areas range from 2 to 15 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed subsurface and brown subsoil material into the surface layer. Where present, the subsurface layer is about 7 inches thick. It is brown and very dark grayish brown loam. The subsoil is brown, friable loam about 16 inches thick. Shattered limestone bedrock is at a depth of 31 inches. In small areas the bedrock is between depths of 40 and 50 inches. In places flags of limestone are in the plow layer.

Available water capacity is low to moderate in this Rockton soil, and permeability is moderate. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface

layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, the hazard of erosion is moderate to severe. The use of conservation tillage, a practice that leaves crop residue on the surface, in addition to contouring and terracing, helps to prevent excessive soil loss. Terraces should be planned carefully because limestone bedrock is at a depth of about 2 to 2.5 feet. During extended dry periods this soil is somewhat droughty.

This Rockton soil is in capability subclass IIIe.

828B—Zenor sandy loam, 1 to 5 percent slopes. This nearly level to gently sloping, somewhat excessively drained soil is on low ridges on stream terraces and on uplands. Most areas are 3 to 10 acres, but a few areas are much larger.

Typically, the surface layer is very dark brown sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is about 21 inches thick. It is brown, very friable sandy loam in the upper part and dark yellowish brown, very friable coarse loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand. In a few small eroded areas on the shoulders of slopes, the surface layer is dark grayish brown.

Available water capacity is low to moderate in this Zenor soil. Permeability is moderately rapid in the loamy upper part of the profile and rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically neutral to medium acid in the subsoil and ranges widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Crop production is limited in many years because of lack of available moisture to supply the crops during extended dry periods. Unless rains are timely, crop losses caused by drought are frequent. If this soil is used for cultivated crops, wind erosion and water erosion are hazards. Blowing sand grains damage young plants on this soil and adjacent soils. Contouring where practical and using conservation tillage, a practice that leaves as much plant residue on the surface as possible, greatly reduce crop damage and soil loss.

This Zenor soil is in capability subclass IIIe.

828C2—Zenor sandy loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat excessively drained soil is on knolls, convex ridges, and side slopes on uplands and on terrace escarpments. Most areas are 3 to 10 acres, but a few areas are larger.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. Plowing has mixed brown subsoil material into the surface layer. The subsoil is about 20 inches thick. It is brown, very friable sandy loam in the upper part and yellowish brown, very friable coarse loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand. In small eroded areas on the shoulders of slopes, the surface layer is brown.

Included with this soil in mapping are a few small areas of calcareous Storden and Salida soils. These soils are intermingled with Zenor soils. Each soil makes up about 10 percent of the map unit.

Available water capacity is low to moderate in this Zenor soil. Permeability is moderately rapid in the loamy upper part of the profile and rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 1 percent organic matter. Reaction is typically neutral to medium acid in the subsoil and ranges widely in the surface layer as a result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Crop production is limited in many years because of lack of available moisture to supply the crops during extended dry periods. Unless rains are timely, crop losses caused by drought are frequent. If this soil is cultivated, the hazards of water erosion and wind erosion are moderate. Blowing sand grains damage young plants on this soil and adjacent soils. Contouring where practical and using conservation tillage, a practice that leaves as much plant residue on the soil surface as possible, greatly reduce crop damage and soil loss.

This Zenor soil is in capability subclass IIIe.

933—Sawmill silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains and in small valleys on uplands. It is subject to flooding. Individual areas generally range from 10 to 40 acres, but a few areas are much larger.

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 24 inches thick. The subsoil is about 16 inches thick. It is dark gray, friable silty clay loam in the upper part and olive gray, mottled, friable silt loam in the lower part. The substratum to a depth of about 60 inches is light olive gray, mottled silt loam or sandy loam. The surface layer is somewhat thicker in swales and in areas adjacent to waterways. In a few small areas the surface layer is thinner and the content of sand is higher.

Available water capacity is high in this Sawmill soil, and permeability is moderate. A seasonal high water

table is on the surface or at a depth of 2 feet. Surface runoff is slow. The surface layer is about 6 percent organic matter. Reaction is typically slightly acid or neutral throughout the profile. The subsoil is medium in available phosphorus and potassium.

This soil is used for cultivated crops, hay, and pasture. It is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed and flooding is adequately controlled. Adequate drainage tile outlets are difficult to obtain in some areas. Areas immediately adjacent to streams are hard to crop because of stream meanders, frequency of flooding, and difficulty of achieving flood control.

This Sawmill soil is in capability subclass IIw.

936—Coland-Spillville-Hanlon complex, 0 to 2 percent slopes. These nearly level, poorly drained, somewhat poorly drained, and moderately well drained soils are on flood plains. They are subject to flooding. Areas are typically irregular in shape and closely border the streams. They range from about 10 acres to 50 acres and are about 50 percent Coland soil, 25 percent Spillville soil, 15 percent Hanlon soil, and 10 percent soils of minor extent. Many areas have shallow bayous and swales that are frequently ponded or remain wet after flooding. These soils are so closely intermingled that it is not practical to separate them in mapping.

Typically, the surface layer of the poorly drained Coland soil is black silty clay loam about 10 inches thick. The subsurface layer is about 16 inches thick. It is black silty clay loam in the upper part and very dark gray clay loam in the lower part. The underlying layer is very dark gray, friable clay loam about 14 inches thick. The substratum to a depth of about 60 inches is very dark gray loam grading to sandy loam as depth increases.

Typically, the surface layer of the moderately well drained or somewhat poorly drained Spillville soil is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 44 inches thick. The substratum to a depth of about 60 inches is dark brown loam.

Typically, the surface layer of the moderately well drained Hanlon soil is black fine sandy loam about 8 inches thick. The subsurface layer is about 40 inches thick. It is black fine sandy loam in the upper part, very dark gray fine sandy loam in the middle part, and very dark gray sandy loam in the lower part. The subsoil extends to a depth of about 60 inches. It is very dark grayish brown, friable sandy loam.

Available water capacity is high in the Coland and Spillville soils, and permeability is moderate. Available water capacity is moderate in the Hanlon soil, and permeability is moderately rapid. A seasonal high water table is at a depth of 1 foot to 3 feet in the Coland soil, and it is at a depth of 3 to 5 feet in the Spillville and Hanlon soils. Surface runoff is slow in all three soils. The surface layer of the Coland soil is about 6 percent organic matter. It is about 6 percent in the Coland soil, 5 percent in the Spillville soil, and 3 percent in the Hanlon soil. Reaction is slightly acid or neutral in all of the soils. The subsoil of the Coland and Spillville soils is low in available phosphorus and very low in available potassium. The subsoil of the Hanlon soil is very low in available phosphorus and potassium.

Most areas of these soils are cultivated. These soils are suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. Most areas are suited to intensive row cropping if they are adequately protected from flooding. Flooding usually occurs before corn is planted. Levees and dikes can provide flood protection. Tile drains function well if adequate outlets are available.

These soils are well suited to trees. A few small areas remain in native hardwoods. Natural and planted seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by careful site preparation or by spraying, cutting, or girdling. There are no hazards or limitations for planting or harvesting trees.

These Coland, Spillville, and Hanlon soils are in capability subclass IIIw.

956—Okoboji-Harps complex, 0 to 2 percent slopes. These level and nearly level, poorly drained and very poorly drained soils are on uplands. The Okoboji soil is subject to ponding by runoff from adjacent areas. Individual areas typically range from 10 to 40 acres, but some areas are much larger. They are about 40 to 50 percent Okoboji soil, 35 to 45 percent Harps soil, and as much as about 25 percent soils of minor extent. The very poorly drained Okoboji soil is in depressional areas, and the poorly drained Harps soil is on rims and low ridges around and between the depressions and is calcareous. The two soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Typically, the surface layer of the Okoboji soil is black silty clay loam about 7 inches thick. The subsurface layer is black, mottled silty clay loam about 21 inches thick. The subsoil is about 15 inches thick. It is black and olive gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the surface layer is mucky silt loam.

Typically, the surface layer of the Harps soil is black loam about 8 inches thick. The subsurface layer is very dark gray and dark gray, mottled loam about 7 inches thick. The subsoil is about 13 inches thick. It is olive gray, mottled, friable loam. The substratum to a depth of about 60 inches is olive gray, mottled loam that has thin lenses of sandy loam. In some small areas the soil is not so high in content of lime as is typical.

Included with these soils in mapping and making up about 15 percent of the map unit are small areas of Canisteo soils. The poorly drained, mildly alkaline

Canisteo soils are in positions on the landscape similar to those of the Harps soil.

Available water capacity is high in these Okoboji and Harps soils. Permeability is moderately slow in the Okoboji soil and moderate in the Harps soil. A seasonal high water table is at a depth of 1 foot to 3 feet in the Harps soil, and it is within 1 foot of the surface in the Okoboji soil. Runoff does not occur until the depressional area of the Okoboji soil is filled with water. The plow layer of the Okoboji soil is about 10 percent organic matter, and the plow layer of the Harps soil is about 5 percent organic matter. Reaction is typically moderately alkaline or mildly alkaline throughout in the Harps soil, and it is neutral in the Okoboji soil. The subsoil of both soils is very low in available phosphorus and potassium.

Most areas of these soils are cultivated. These soils are well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture if excess water is removed. Tile lines commonly are spaced closer together in the Okoboji soil than in the adjacent wet soils because the Okoboji soil is finer textured. Excess lime in the Harps soil reduces the availability of phosphorus and potassium to plants.

These Okoboji and Harps soils are in capability subclass IIw.

1936—Coland-Spillville-Hanlon complex, channeled, 0 to 2 percent slopes. These nearly level, poorly drained, somewhat poorly drained, and moderately well drained soils are on flood plains. They are subject to flooding (fig. 16). Individual areas typically are long and narrow and closely border the streams. They range from about 20 acres to several hundred acres and are made up of about 50 percent Coland soil, 25 percent Spillville soil, 15 percent Hanlon soil, and 10 percent soils of minor extent. In some places as much as 10 percent of the area is calcareous overwash and sandbars. Most areas are dissected by old stream channels that are frequently flooded and are kept wet by recurring floods or by water standing in low places after floods. These soils are so closely intermingled that it is not practical to separate them in mapping.

Typically, the surface layer of the poorly drained Coland soil is black silty clay loam about 13 inches thick. The subsurface layer is about 20 inches thick. It is black silty clay loam in the upper part and very dark gray clay loam in the lower part. The underlying layer is very dark gray, friable clay loam about 7 inches thick. The substratum to a depth of about 60 inches is very dark gray loam grading to sandy loam as depth increases.

Typically, the surface layer of the moderately well drained or somewhat poorly drained Spillville soil is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 44 inches thick. The substratum to a depth of 60 inches is dark brown loam.

Figure 16.—An area of Coland-Spillville-Hanlon complex, channeled, 0 to 2 percent slopes.

Typically, the surface layer of the moderately well drained Hanlon soil is black fine sandy loam about 8 inches thick. The friable subsurface layer is about 40 inches thick. It is black fine sandy loam in the upper part, very dark gray fine sandy loam in the middle part, and very dark gray sandy loam in the lower part. The subsoil extends to a depth of about 60 inches. It is very dark grayish brown, friable sandy loam.

Available water capacity is high in the Coland and Spillville soils, and permeability is moderate. Available water capacity is moderate in the Hanlon soil, and permeability is moderately rapid. A seasonal high water table is at a depth of 1 foot to 3 feet in the Coland soil,

and it is at a depth of 3 to 5 feet in the Spillville and Hanlon soils. Surface runoff is slow in all three soils. The surface layer of the Coland soil is about 6 percent organic matter. It is 5 percent in the Spillville soil and 3 percent in the Hanlon soil. Reaction is slightly acid or neutral in all of the soils. The subsoil of the Coland and Spillville soils is low in available phosphorus and very low in available potassium. The subsoil of the Hanlon soil is very low in available phosphorus and potassium.

Nearly all areas of these soils are in permanent pasture or woods. These soils are generally not suited to cultivated crops; however, some higher lying areas can be successfuly diked for protection against flooding and leveled to fill in old stream channels. These soils can then be used for cultivated crops.

These soils are moderately suited to trees and pasture. Trees need to be protected from grazing livestock and from flooding. In places wetness is a limitation for trees. Providing drainage and flood protection improves pastures. Overgrazing or grazing when the soils are wet causes surface compaction and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

These Coland, Spillville, and Hanlon soils are in capability subclass Vw.

4000—Urban land. This map unit consists of urban areas that are primarily business districts in Ackley, Eldora, and Iowa Falls. These areas are predominantly covered with buildings and streets. Most of the small areas of soil surface not covered with cement have been altered by filling and grading. Very little of the original soil is identifiable.

Urban land is not placed in a capability subclass.

5010—Pits, sand and gravel. This map unit consists of pits that have been mined for sand and gravel. Some pits are active, but some have been mined out and abandoned. These areas vary from a few acres to a hundred acres or more. They are mostly on stream terraces.

Some areas, particularly those that are subject to ponding, are stocked with fish and used for recreational fishing. A few areas have been partially graded and are used as home sites. Other areas have been partially filled and graded and are used as low quality pasture. Many areas have grown up in weeds and native plant species and are used as habitat by wildlife. A few areas in large pits have been partially reclaimed by salvaging the topsoil before mining and redistributing the soil in the mined area. These areas have been classified as Orthents.

Pits, sand and gravel, is not placed in a capability subclass.

5030—Pits, quarries. These quarries are the result of mining limestone for agricultural lime, road material, and animal feed supplements. All of the limestone quarries are on terraces adjacent to the Iowa River. In these areas the glacial, eolian, and alluvial deposits are relatively thin, and less overburden needs to be removed to mine the limestone. As mining progresses toward the uplands, the overlying material thickens and the limestone is at a greater depth from the surface. These quarries range from about an acre to 80 acres or more.

Most of the quarries in Hardin County contain water. Some areas are as much as 20 feet or more in depth. Many abandoned quarries that do not contain water have reverted to weeds and native plant species and are used as habitat for wildlife.

Pits, quarries, is not placed in a capability subclass.

5040—Orthents, loamy. These level to sloping soils have been altered to shape the landscape for a special use. Hills have been leveled to fill in the lower lying areas for such uses as airport runways, intensive livestock facilities, and industrial areas that have not been paved over. A few areas are in large gravel pits. In these areas the original topsoil and subsoil was salvaged in the mining operation and redistributed to a depth of 2 or 3 feet. The internal drainage of these soils is highly variable. It ranges from excessive to poor and is directly related to the kind of material from which the soil was derived and the extent to which it has been altered. Individual areas typically range from 5 to 30 acres.

Typically, the upper 5 feet of these soils is calcareous, dark gray and brown, friable and firm loam. In other areas the soil is sandy loam. Cobbles and pebbles are common on the surface in many areas. In some areas the surface soil is sandy loam. In places 4 to 10 inches of topsoil has been redistributed over the disturbed areas. The surface soil in these areas ranges from very dark gray to dark brown.

Available water capacity ranges from moderate to low in Orthents. Permeability is variable, depending upon texture and density. Soil that was once buried 5 to 10 feet or more below the surface has less pore space and higher density than the original surface layer. This previously buried material has not been appreciably affected by the processes of soil development and freezing and thawing. Surface runoff from Orthents ranges from slow to rapid. The content of organic matter is low unless topsoil has been redistributed over the area. For this reason, a good seedbed is difficult to obtain, and drought stress appears more quickly. Reaction is typically mildly alkaline. In most areas Orthents are very low in available phosphorus and potassium.

A few areas of Orthents are cultivated. Some of these soils are planted to grass and are adjacent to airport runways, some are used for livestock feeding facilities,

and some are in low intensive industrial areas that are not paved over.

Orthents, loamy, is not placed in a capability subclass.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used for crops, pasture, woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

About 260,000 acres, or about 71 percent of Hardin County, is prime farmland. Areas are throughout the county. Most of these prime farmland soils are used for crops. Crops grown on these soils; mainly corn and soybeans, account for much of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the conversion 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, difficult to cultivate, and usually less productive than prime farmland soils.

The soil map units that make up prime farmland in Hardin County are listed in table 5. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Soils that have a high water table, are subject to flooding, or have inadequate rainfall may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. In table 5, the measures used to overcome the limitations, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to see if these limitations have been overcome by corrective measures.

Use and Management of the Soils

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.

About 297,240 acres of crops was harvested in Hardin County in 1980 (*3*). Most of this acreage was used for row crops, mainly corn and soybeans. The acreage in pasture, woods, hay, and other close growing crops has decreased in recent years and land use has shifted to grain production.

Crop production and conservation of our soil resources could be increased by extending known technology to all cropland in the county. This soil survey, which gives the basic characteristics of each kind of soil, can greatly aid in the application of such technology.

Soil erosion by running water is the major soil problem on about 50 percent of the cropland and pasture in Hardin County. In addition, many of the level or nearly level soils are subject to wind erosion if they are not protected. Loss of the topsoil through erosion is damaging for many reasons. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a limited depth of material favorable for root development. Kensett and Rockton soils, for example, have a limited root zone because hard limestone is relatively close to the surface. Lawler, Saude, and Zenor soils have a limited root zone because they are not sufficiently deep over sand and gravel. Topsoil lost through erosion often becomes a damaging pollutant. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Ideal methods of erosion control provide protective surface cover, reduce runoff, and increase infiltration. A cropping system in which vegetation covers the soil for extended periods can keep the amount of soil lost through erosion low enough so that it will not reduce the productive capacity of the soil. On livestock farms, which require pasture and hay, the legume and grass forage in the cropping system reduces erosion on sloping land and also provides nitrogen and improves tilth for the following crop.

Hardin County has a great variety of soils and landscape features. Some slopes are so short, steep, and irregular that contour tillage or terracing is not practical. On these soils a cropping system that provides substantial vegetative cover and minimum tillage are required to control erosion.

Minimizing tillage and leaving crop residue on the surface increase infiltration and reduce runoff and the hazard of erosion. These practices can be adapted to many tillable soils throughout the county. Where the soils are suitable for continuous cropping of corn and soybeans, no-tillage is the most effective method of controlling erosion.

Terraces and diversions control runoff and erosion by reducing the length of slope. They are most adaptable and practical on well drained, gently sloping to moderately sloping soils that have smooth slopes. The gently sloping and moderately sloping Dinsdale, Downs, Fayette, Killduff, and Waubeek soils, and some areas of Clarion, Lester, and Hayden soils are well suited to terracing. Except for Tama, Downs, Fayette, and Killduff soils, however, all or part of the subsoil of these soils formed in glacial till. The topsoil should therefore be stockpiled during terrace construction and used to recover the exposed subsoil when the terrace is completed.

Contouring and a limited amount of contour stripcropping are also used to help control erosion in Hardin County. These methods are best suited to soils that have smooth, uniform slopes. Examples are Dinsdale, Downs, Fayette, Killduff, and Tama soils.

Soil blowing is a hazard on Dickinson, Flagler, Salida, Sparta, and Zenor soils. These soils can be damaged in a relatively short time if winds are strong and the soils are dry and bare of vegetation or surface mulch. Crops grown on these soils and adjacent heavier textured soils, such as Harps, Canisteo, and Webster soils, also can be damaged by wind erosion if conditions are suitable. Soils planted to soybeans and tilled in the fall are especially subject to wind erosion. Maintaining vegetative cover, providing surface mulch, or roughing the surface of the soil by proper tillage methods minimizes soil blowing on all of these soils.

The Technical Guide, available in the office of the Soil Conservation Service, has information on methods of erosion control for each kind of soil.

Soil drainage is a major management problem on about 32 percent of the soils in Hardin County. Garwin, Maxfield, Canisteo, and Webster soils are examples of soils on uplands that are naturally wet and poorly drained. Palms, Okoboji, and Wacousta soils are in depressional areas on uplands where drainage outlets are often difficult to obtain. Colo, Coland, and Sawmill soils are in waterways and on bottom lands, and Marshan soils are on terraces or benches underlain by sand. All of these soils are poorly drained.

Soil fertility varies widely among the soils in Hardin County. Most of the well drained soils on uplands are naturally acid. The excessively drained Salida soil and the well drained Storden soil, however, are alkaline. Naturally poorly drained soils are usually nearly neutral in reaction. The poorly drained Harps soil, however, is alkaline, and the very poorly drained Sperry soil is medium acid. Acid soils require the application of ground limestone for good plant growth. Available potash and phosphorous levels vary widely, but these levels are particularly low on wet, alkaline soils, such as Calco, Harcot, Harps, Harpster, and Tilfer soils. On all of these soils, additions of lime and fertilizer should be based on results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous and are generally high in content of organic matter. Regular additions of crop residue, manure, and other organic material improve the soil structure and reduce crust formation.

Fall plowing is a questionable practice on many of the soils in Hardin County. Sloping soils that have been plowed in the fall and many nearly level soils that have been cropped to soybeans are subject to damaging erosion.

Field crops suited to the soils and climate of Hardin County include many that are not commonly grown. Corn and soybeans are by far the most commonly grown crops. Oats is the most common close growing crop. Wheat, grain sorghum, sunflowers, potatoes, sugar beets, popcorn, pumpkins, sugar cane, canning peas, and navy beans can be grown if economic conditions are favorable. Rye, barley, buckwheat, and flax also could be grown, and grass seed could be produced from bromegrass, redtop, bluegrass, switchgrass, big bluestem, and indiangrass.

The number of special crops grown commercially in Hardin County is limited. At present sweet corn, canning beans, and nursery stock are the only specialty crops grown. Most of the well drained soils in the survey area are suitable for orchards. Soils in low positions where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

The latest information and suggestions for growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

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 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 insures 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 (*11*). 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. These levels are defined in the following paragraphs.

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 limitation 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.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

Table 8 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 important trees. The number 1 indicates very high

productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This 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.

Trees to plant are those that are suited to the soils and to 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, 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 insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 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 nursery.

Recreation

The soils of the survey area are rated in table 10 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock 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

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 11, 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, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, 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 to 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 12 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, a cemented pan, 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 or to a cemented pan, large stones, 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 or to a cemented pan, 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 or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials 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 13 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 13 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 or to a cemented pan, and flooding affect absorption of the

effluent. Large stones and bedrock or a cemented pan 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 13 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 or to a cemented pan, 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, bedrock, and cemented pans 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 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, 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, a cemented pan, 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 14 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 14, 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 toxic material and 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, bedrock, and toxic material.

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, stones, or soluble salts, 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 15 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 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, irrigation, 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 ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as high content of calcium carbonate. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

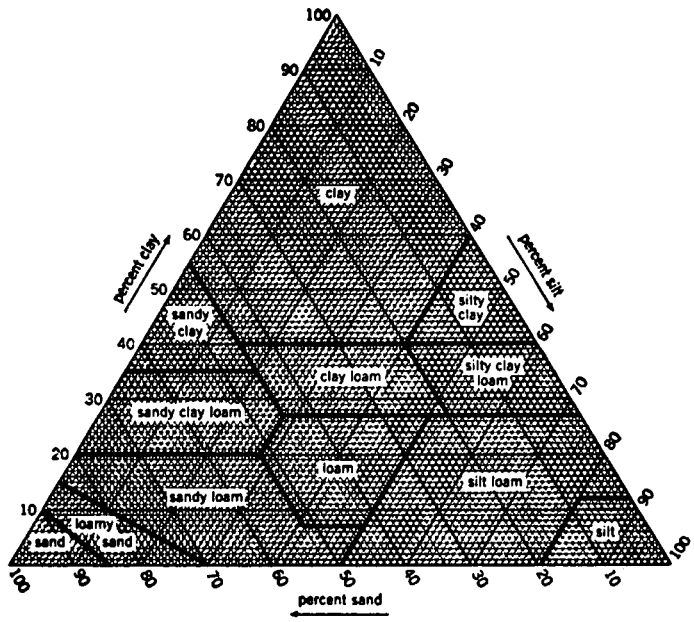


Figure 17.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 17). "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, SP-SM.

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 ovendry 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.

Physical and Chemical Properties

Table 17 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 earth moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture

content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. 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 wind erosion 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 wind erosion 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 wind erosion 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 wind erosion are used.
5. Loamy soils that are less than 18 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 wind erosion are used.
6. Loamy soils that are 18 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 wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, 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 18 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.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 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, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal 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 18 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 18.

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 specified as 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

The system of soil classification used by the National Cooperative Soil Survey has six categories (*12*). 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 19 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 Udoll (*Ud*, meaning humid, 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 Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that have an udic 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 Hapludolls.

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-loamy, mixed, mesic Typic Hapludolls.

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 (10)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (12)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Atterberry Series

The Atterberry series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on ridges, at the heads of drainageways, and on side slopes. They formed in loess deposits ranging from 40 to 60 inches in thickness overlying glacial till. Native vegetation was mixed prairie grasses and trees. Slopes range from 1 to 3 percent.

Atterberry soils are commonly adjacent to Downs, Fayette, Garwin, and Waubeek soils. Downs, Fayette, and Waubeek soils have browner B horizons, better internal drainage, and are at a higher elevation than

Atterberry soils. Garwin soils have thicker A horizons and do not have E horizons. They are at a slightly lower elevation than Atterberry soils.

Typical pedon from an area of Atterberry silt loam, 1 to 3 percent slopes; 600 feet north and 760 feet west of the center of sec. 15, T. 88 N., R. 19 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; neutral; clear smooth boundary.

E—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure parting to weak fine granular; friable; few fine very dark gray (10YR 3/1) root channel fills; medium acid; clear smooth boundary.

Bt1—14 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; few thin very dark gray (10YR 3/1) discontinuous clay films; thin light gray (10YR 7/2) dry silt coats on faces of peds; strongly acid; gradual smooth boundary.

Bt2—21 to 26 inches; mottled grayish brown (10YR 5/2) and light olive brown (2.5Y 5/4) silty clay loam; weak fine prismatic structure parting to strong fine subangular blocky; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; thin discontinuous light gray (10YR 7/2) dry silt coats on faces of peds; few dark concretions of iron and manganese oxides; strongly acid; clear smooth boundary.

Bt3—26 to 35 inches; mottled grayish brown (10YR 5/2) and olive brown (2.5Y 4/4) silty clay loam; grayish brown (10YR 5/2) coatings on faces of peds; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; thin light gray (10YR 7/2) dry silt coats; few fine dark grayish brown (10YR 4/2) clay flows on prisms and peds; few dark concretions of iron and manganese oxides; strongly acid; clear smooth boundary.

BC—35 to 46 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) silty clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thick very dark gray (10YR 3/1) clay flows in root channels and along prisms; few dark concretions of iron and manganese oxides; neutral; abrupt wavy boundary.

C1—46 to 52 inches; mottled olive gray (5Y 5/2) and strong brown (7.5YR 5/6) silt loam; massive; friable; very dark gray (10YR 3/1) clay flows in root channels; few dark concretions of iron and manganese oxides; neutral; abrupt wavy boundary.

2C2—52 to 60 inches; mottled olive gray (5Y 5/2) and strong brown (7.5YR 5/6) loam; massive; firm; thin lenses of sandy loam in upper part of horizon; very dark gray (10YR 3/1) clay flows in root channels; slightly acid.

The solum typically is about 48 inches thick but ranges from 40 to 60 inches in thickness. The loess typically is 45 to 55 inches thick but ranges from 40 to 70 inches in thickness.

The A1 or Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The E horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2).

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 through 4. The upper 20 inches of the argillic horizon averages 28 to 33 percent clay. Reaction is medium acid or strongly acid in the most acid part. The BC horizon is silt loam or silty clay loam and ranges from strongly acid to neutral.

The C horizon is either silt loam or loam, depending on the depth to glacial till. In most pedons a stone line or a thin lense of sandy material separates the loess from the glacial till. The C horizon ranges from medium acid to neutral in the upper part and has free carbonates below a depth of 5 feet.

Calco Series

The Calco series consists of poorly drained, moderately permeable, calcareous soils on bottom lands and in drainageways on uplands. These soils formed in silty alluvium. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Calco soils are similar to Colo, Harpster, and Sawmill soils and are adjacent to Colo and Sawmill soils. Colo and Sawmill soils are in positions on the landscape similar to those of Calco soils, and they are not calcareous. Harpster soils have a mollic epipedon less than 24 inches thick.

Typical pedon from an area of Calco silty clay loam, 0 to 2 percent slopes, 990 feet south and 80 feet east of the northwest corner of sec. 13, T. 89 N., R. 19 W.

A1—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; slight effervescence; moderately alkaline; gradual smooth boundary.

A2—10 to 25 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; few fine dark reddish brown (5YR 3/3) mottles; moderate very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

A3—25 to 36 inches; black (5Y 2/1) silty clay loam, very dark gray (5Y 3/1) dry; weak fine and very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Bg—36 to 41 inches; very dark gray (5Y 3/1) silty clay loam; weak very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg—41 to 60 inches; mottled olive gray (5Y 5/2) and yellowish brown (10YR 5/6) loam; few dark concretions of iron and manganese oxides; massive; friable; few pebbles in lower part; slight effervescence; mildly alkaline.

The solum typically is 36 to 48 inches thick. The A horizon is 24 to 36 inches thick. It ranges from 27 to 35 percent clay and from 5 to 15 percent sand.

The 2Cg horizon ranges from silty clay loam to sandy loam below a depth of about 40 inches.

Canisteo Series

The Canisteo series consists of poorly drained, moderately permeable, calcareous soils on uplands. These soils are on flats and irregularly shaped swales surrounding depressions and in low gradient drainageways. They formed in loamy and silty glacial drift. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Canisteo soils are similar to Harps and Webster soils and are commonly adjacent to Harps, Okoboji, and Webster soils. Harps soils have larger amounts of free carbonates in the A horizon than Canisteo soils. Okoboji soils have a mollic epipedon more than 24 inches thick. They are in small depressions. Webster soils are not calcareous in the A horizons. They are adjacent to and slightly higher on the landscape than Canisteo soils.

Typical pedon from an area of Canisteo silty clay loam, 0 to 2 percent slopes, 2,140 feet south and 85 feet east of the northwest corner of sec. 9, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; firm; 15 to 20 percent very fine sand; slight effervescence; mildly alkaline; clear smooth boundary.

A—8 to 13 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak very fine granular structure; friable; 15 to 20 percent very fine sand; slight effervescence; mildly alkaline; gradual smooth boundary.

AB—13 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct brown (7.5YR 4/4) mottles; weak very fine granular structure; friable; 15 to 20 percent very fine sand; few dark gray (10YR 4/1) krotovina mixings; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg1—20 to 28 inches; dark gray (5Y 4/1) silty clay loam; weak fine subangular blocky structure; friable; 15 to 20 percent very fine sand; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg2—28 to 36 inches; light olive gray (5Y 6/2) clay loam; olive gray (5Y 5/2) coatings on faces of peds; weak fine prismatic structure parting to weak fine subangular blocky; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg1—36 to 44 inches; light olive gray (5Y 6/2) loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg2—44 to 49 inches; light olive gray (5Y 6/2) sandy loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct brown (7.5YR 4/4) mottles; massive; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg3—49 to 60 inches; light olive gray (5Y 6/2) loam; many fine and medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; mildly alkaline.

The solum typically is 24 to 36 inches thick.

The A1 horizon is black (N 2/0 or 10YR 2/1). The AB horizon is very dark gray (10YR 3/1 or N 3/0). The A horizon ranges from 16 to 24 inches in thickness and is silty clay loam or clay loam.

The Bg1 and Bg2 horizons have hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4. It has common faint to distinct mottles. The C horizon ranges from loam to sandy loam.

Clarion Series

The Clarion series consists of well drained, moderately permeable soils on uplands. These soils are on knobs, ridges, and side slopes. They formed in glacial till. Native vegetation was prairie grasses. Slopes range from 2 to 14 percent.

Clarion soils are similar to Lester and Nicollet soils and are commonly adjacent to Nicollet, Storden, and Terril soils. Lester soils have a thinner A1 horizon than Clarion soils and have an E horizon. Nicollet soils have grayer B horizons, are not so well drained, and are downslope from Clarion soils. Storden soils do not have a mollic epipedon and have an alkaline surface layer. They are on knobs and shoulders of slopes. Terril soils have a mollic epipedon more than 24 inches thick. They are downslope on foot slopes and alluvial fans.

Typical pedon from an area of Clarion loam, 2 to 5 percent slopes, 2,300 feet east and 20 feet south of the center of sec. 5, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; neutral; clear smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; medium acid; gradual smooth boundary.

A2—13 to 18 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak

very fine granular structure; friable; slightly acid; gradual smooth boundary.

Bw1—18 to 24 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on faces of peds; weak very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw2—24 to 33 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

BC—33 to 43 inches; yellowish brown (10YR 5/4) loam; brown (10YR 5/3) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; friable; neutral; abrupt smooth boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium distinct light olive gray (5Y 6/2) lime accumulations; massive; friable; strong effervescence; moderately alkaline.

The solum typically is 30 to 45 inches thick but ranges from 20 to 50 inches in thickness.

The A horizons usually are more acid than other parts of the profile. They are medium acid or slightly acid unless limed. The A horizon typically is loam, but silt loam that has high sand content and clay loam are within the range of the series.

The Bw horizons typically are slightly acid or neutral but range to medium acid in some pedons. They are loam or clay loam. Clay content ranges from 16 to 28 percent.

The C horizon ranges from loam to sandy loam. The C horizon typically has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6.

Coland Series

The Coland series consists of poorly drained, moderately permeable soils on flood plains of streams. These soils formed in loamy alluvium. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Coland soils are similar to Colo, Spillville, and Turlin soils and are commonly adjacent to Marshan, Spillville, and Turlin soils. Colo soils have less sand throughout the solum than Coland soils and do not have stratified sandy material in the substratum. Marshan soils have a mollic epipedon that is less than 20 inches thick and have stratified, coarse layers at a depth of less than 40 inches. They are on terraces along streams at a higher level than the Coland soils on flood plains. Spillville and Turlin soils have browner B horizons than Coland soils. They have better internal drainage and are in similar positions on the landscape.

Typical pedon from an area of Coland clay loam, 0 to 2 percent slopes, 1,650 feet north and 160 feet west of the southeast corner of sec. 7, T. 87 N., R. 21 W.

A1—0 to 13 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.

A2—13 to 21 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate very fine granular structure; friable; neutral; gradual smooth boundary.

A3—21 to 26 inches; very dark gray (5Y 3/1) clay loam, dark gray (5Y 4/1) dry; black (5Y 2.5/1) coatings on faces of peds; few fine distinct reddish brown (5YR 4/4) mottles; moderate fine granular structure; friable; neutral; gradual smooth boundary.

AC1—26 to 33 inches; very dark gray (5Y 3/1) clay loam, gray (5Y 5/1) dry; discontinuous black (5Y 2.5/1) coatings on faces of peds; many fine distinct dark reddish brown (5YR 3/3) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; friable; neutral; gradual smooth boundary.

AC2—33 to 40 inches; very dark gray (5Y 3/1) clay loam, gray (5Y 5/1) dry; discontinuous black (5Y 2.5/1) coatings on vertical faces of peds; weak fine prismatic structure; friable; neutral; gradual smooth boundary.

C—40 to 60 inches; very dark gray (5Y 3/1) loam, gray (5Y 5/1) dry; few olive gray (5Y 5/2) krotovinas; massive; friable; neutral.

The solum typically is 36 to 48 inches thick. The mollic epipedon is 36 inches or more thick.

The A horizon is 24 to 40 inches thick. It is neutral or has hue of 10YR or 5Y, value of 2 or 3, and chroma of 0 or 1. The A horizon is clay loam or silty clay loam. Clay content ranges from 27 to 35 percent.

A Bw horizon is in some pedons.

The C horizon is neutral or has hue of 2.5Y or 5Y, value of 2 through 5, and chroma of 1 or less. Below a depth of about 48 inches, the C horizon typically is stratified loam, sandy loam, or loamy sand that has some gravel. Reaction is slightly acid or neutral, and depth to carbonates is generally more than 60 inches.

Colo Series

The Colo series consists of poorly drained, moderately permeable soils on flood plains of rivers and narrow intermittent streams. These soils formed in silty alluvium. Native vegetation was water-tolerant grasses. Slopes range from 0 to 5 percent.

Colo soils are similar to Calco, Coland, and Sawmill soils and are commonly adjacent to Ely and Kennebec soils. Calco soils are calcareous and have free carbonates throughout. Coland soils have more sand throughout the solum and have sandy stratified material in the substratum. Sawmill soils have a thinner mollic epipedon than Colo soils. Ely and Kennebec soils have browner B horizons and better internal drainage. They

are just upslope and at a higher elevation than Colo soils.

Typical pedon from an area of Colo silty clay loam, 0 to 2 percent slopes, 228 feet south and 2,230 feet west of the northeast corner of sec. 10, T. 88 N., R. 19 W.

A1—0 to 11 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.
A2—11 to 18 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A3—18 to 30 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine prismatic structure parting to weak very fine subangular blocky; friable; neutral; gradual smooth boundary.
A4—30 to 40 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral; gradual smooth boundary.
AC—40 to 46 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure; firm; neutral; gradual smooth boundary.
Cg—46 to 60 inches; olive gray (5Y 5/2) silt loam; massive; firm; neutral.

The solum ranges from 36 to 54 inches in thickness. The A horizon is neutral or has hue of 10YR or 5Y, value of 2 or 3, and chroma of 0 or 1. It extends to a depth of 36 inches or more. Clay content ranges from 27 to 35 percent.

The horizons below the dark A horizons may have value of 2 to 4 and chroma of 0 or 1. Reaction is slightly acid or neutral, and depth to carbonates typically is more than 60 inches.

Dickinson Series

The Dickinson series consists of well drained soils on uplands. These soils formed in loamy and sandy eolian material overlying a loamy substratum. Native vegetation was prairie grasses. Permeability is moderately rapid in the solum and moderate in the substratum. Slopes range from 2 to 9 percent.

Dickinson soils are similar to Flagler and Sparta soils and are commonly adjacent to Sparta soils. Flagler soils have gravel and coarser sand in the A and Bw horizons and have coarser substrata than Dickinson soils. Sparta soils have less clay and higher sand content in the A horizon and upper part of the Bw horizons. They typically are on adjacent ridges and dunes in positions on the landscape similar to those of Dickinson soils.

Typical pedon from an area of Dickinson fine sandy loam, loamy substratum, 2 to 5 percent slopes, 1,620 feet north and 4,000 feet west of the southeast corner of sec. 6, T. 89 N., R. 21 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.
A—10 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; medium acid; gradual smooth boundary.
Bw1—16 to 23 inches; dark yellowish brown (10YR 4/4) fine sandy loam; dark brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; very friable; medium acid; gradual smooth boundary.
Bw2—23 to 32 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium and coarse subangular blocky structure; very friable; medium acid; gradual smooth boundary.
BC—32 to 50 inches; dark yellowish brown (10YR 4/4) loamy sand grading to yellowish brown (10YR 5/4) with depth; weak coarse subangular blocky structure; very friable; neutral; gradual smooth boundary.
2C1—50 to 56 inches; brown (10YR 5/3) and yellowish brown (10YR 5/6) sandy loam; massive; very friable; mildly alkaline; abrupt smooth boundary.
2C2—56 to 60 inches; olive gray (5Y 5/2) silt loam; many medium distinct strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) mottles; massive; friable; mildly alkaline.

The solum ranges from 36 to 56 inches in thickness. Depth to the loamy substratum is 40 to 60 inches.

The Ap or A1 horizon typically is very dark brown (10YR 2/2) but ranges to very dark grayish brown (10YR 3/2). The A horizon is 10 to 20 inches thick.

The Bw horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/6). The BC horizon is loamy sand or sand.

The 2C horizon typically is stratified sandy loam, silt loam, and loam and is variegated in color.

Dinsdale Series

The Dinsdale series consists of well drained or moderately well drained, moderately permeable soils on convex ridge crests and side slopes on uplands. These soils formed in 20 to 40 inches of loess and the underlying glacial till. Native vegetation was prairie grasses. Slopes range from 2 to 14 percent.

Dinsdale soils are similar to Klinger, Tama, and Waubeek soils and commonly are adjacent to Klinger and Maxfield soils. Tama soils formed in loess deposits of greater depth than Dinsdale soils, but they are in positions on the landscape similar to those of Dinsdale

soils. Klinger and Maxfield soils have grayer B horizons and poorer internal drainage and are downslope. Waubeek soils have a thinner A1 horizon and have E horizons.

Typical pedon from an area of Dinsdale silty clay loam, 2 to 5 percent slopes, 380 feet east and 55 feet south of the northwest corner of sec. 13, T. 89 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A—8 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine granular structure; friable; slightly acid; gradual smooth boundary.

BA—17 to 26 inches; brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

Bt—26 to 34 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; weak fine prismatic structure parting to weak very fine and fine subangular blocky; friable; thin clay films in root channels; medium acid; clear smooth boundary.

2BC—34 to 45 inches; yellowish brown (10YR 5/6) loam; brown (10YR 5/3) coatings on faces of peds; weak medium prismatic structure parting to weak fine and medium subangular blocky; firm; weakly expressed pebble band in upper part; few pebbles throughout; medium acid; gradual smooth boundary.

2C—45 to 60 inches; yellowish brown (10YR 5/6) loam; few fine faint strong brown (7.5YR 5/6) mottles and common fine distinct brown (10YR 5/3) mottles; massive; firm; few fine and medium distinct reddish brown (5YR 4/4) dark concretions of iron oxides; few pebbles throughout; slightly acid.

The solum typically is 45 to 60 inches thick but ranges from 42 to 60 inches in thickness. The loess is generally 26 to 36 inches thick but ranges from 20 to 40 inches in thickness.

The A1 or Ap horizon has hue of 10YR, value of 2, and chroma of 1 or 2. It is heavy silt loam or light silty clay loam.

The Bt or Bw horizon, where present, has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The 2B and 2C horizons have hue of 10YR or 2.5Y, chroma of 4 or 6, and value of 4 or 5. The sand content of the A and B horizons ranges from 3 to 10 percent but is higher near the loess till contact and in the till. A transitional horizon is between the loess and the till in many places. In places discontinuous lenses ranging from sandy loam to sand are between the loess and the till. These lenses are 1 inch to 8 inches thick. Typically, a "stone line" between 2 and 4 inches thick separates the glacial till and the overlying sediment. The underlying till or material that derived from the till typically is loam but ranges to sandy clay loam. In places it is clay loam.

Downs Series

The Downs series consists of well drained, moderately permeable soils on ridges and side slopes on uplands. These soils formed in loess deposits. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 2 to 14 percent.

Downs soils are similar to Fayette and Waubeek soils and commonly are adjacent to Atterberry, Muscatine, and Waubeek soils. Atterberry and Muscatine soils are downslope from Downs soils, and they are not so well drained. They have grayer B horizons, and Muscatine soils have darker A horizons. Fayette soils have a lighter colored A horizon. Waubeek soils formed partly in loess and partly in glacial till. They are on side slopes below Downs soils.

Typical pedon from an area of Downs silt loam, 2 to 5 percent slopes, 2,395 feet south and 320 feet west of the center of sec. 14, T. 86 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; moderate fine granular structure; friable; strongly acid; clear smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure; friable; medium acid; clear smooth boundary.

BE—11 to 15 inches; brown (10YR 4/3) silty clay loam; dark grayish brown (10YR 4/2) coatings on faces of peds; moderate very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

Bt1—15 to 24 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; friable; dark grayish brown (10YR 4/2) clay films on faces of peds; light gray (10YR 7/2) dry silt and fine sand coatings; strongly acid; gradual smooth boundary.

Bt2—24 to 32 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; friable; brown (10YR 4/3) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—32 to 41 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 5/3) coatings on faces of peds; weak fine prismatic structure parting to weak medium subangular blocky; friable; thin dark grayish brown (10YR 4/2) clay films on faces of prisms and peds; strongly acid; gradual smooth boundary.

Bt4—41 to 47 inches; yellowish brown (10YR 5/4) silt loam; discontinuous brown (10YR 5/3) coatings on faces of peds; few fine faint grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 5/6)

mottles; weak medium prismatic structure; friable; thin patchy clay films on prisms; medium acid; gradual smooth boundary.
C—47 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine faint grayish brown (10YR 5/2) mottles; massive; friable; thick clay films in root channels; medium acid.

The solum is 45 to 60 inches thick.

The A1 or Ap horizon is 6 to 9 inches thick and has hue of 10YR, value of 2 or 3, and chroma of 2. The E horizon is mixed with the Ap horizon in many pedons. It is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (10YR 5/3).

The Bt horizon is silty clay loam in the finest part and has hue of 10YR, value of 4 or 5, and chroma of 3 to 6.

Downs Variant

The Downs Variant consists of well drained soils on uplands. These soils formed in about 20 to 40 inches of loess and the underlying residuum weathered from sandstone bedrock. Native vegetation was mixed prairie grasses and trees. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 5 to 14 percent.

Downs Variant soils commonly are adjacent to Downs, Fayette, and Montieth soils. Downs and Fayette soils are in positions on the landscape similar to those of Downs Variant soils, but they formed in loess deposits of greater depth. Montieth soils are in a lower position than Downs Variant soils and formed in weathered sandstone bedrock.

Typical pedon from an area of Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded, 145 feet north and 2,320 feet east of the southwest corner of sec. 22, T. 87 N., R. 19 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; mixed with streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; weak very fine granular structure; friable; medium acid; abrupt smooth boundary.
Bt1—8 to 15 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak very fine subangular blocky structure; friable; few thin dark brown (10YR 3/3) clay films on faces of peds; medium acid; gradual smooth boundary.
Bt2—15 to 22 inches; yellowish brown (10YR 5/4) silty clay loam; weak very fine subangular blocky structure; friable; common thin brown (10YR 4/3) clay films on faces of peds; medium acid; clear smooth boundary.
2BC1—22 to 27 inches; yellowish brown (10YR 5/4) loam; weak fine prismatic structure parting to weak fine subangular blocky structure; friable; few thin brown (10YR 4/3) clay films on faces of peds; medium acid; gradual smooth boundary.
2BC2—27 to 37 inches; yellowish brown (10YR 5/4) sandy loam; few medium brownish yellow (10YR 6/6) pockets; weak fine prismatic structure parting to weak fine and medium subangular blocky structure; friable; few thin dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; abrupt irregular boundary.
2C—37 to 60 inches; brown (7.5YR 4/4) channery sand; single grained; loose; 35 percent thin, hard, ferruginous channers and flagstones and a few soft fragments of weakly cemented sandstone; strongly acid.

The solum is 30 to 40 inches thick.

The A or Ap horizon is 6 to 9 inches thick and has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. An E horizon is present in some pedons but typically is mixed into the Ap horizon where the soil is cultivated. It is dark grayish brown (10YR 4/2) or brown (10YR 5/3).

The Bt horizons are silty clay loam in the finest part and have hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The 2BC horizon typically is loam grading to sandy loam as depth increases. In some pedons the 2BC horizon is sandy loam.

The C horizon is channery sand or channery loamy sand that has soft sandstone and hard ferruginous flagstones. When moist, hand digging usually is not difficult except where layers and pockets of hard ferruginous flagstones are concentrated.

Du Page Series

The Du Page series consists of moderately well drained, moderately permeable soils on the flood plains of the Iowa River and its major tributaries. These soils formed in stratified, medium textured alluvium. Native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Du Page soils commonly are adjacent to Coland, Kennebec, and Spillville soils. They are in positions on the landscape similar to those of Du Page soils, but they are not calcareous. In addition, the Coland soils have poorer internal drainage.

Typical pedon from an area of Du Page silt loam, 0 to 2 percent slopes, 3,500 feet west and 220 feet north of the southeast corner of sec. 4, T. 87 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.
A1—8 to 19 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine granular structure; friable; strong effervescence; moderately alkaline; clear smooth boundary.

A2—19 to 30 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; few strata of brown (10YR 5/3); strong effervescence; moderately alkaline; clear smooth boundary.
A3—30 to 37 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; mixings of grayish brown (10YR 5/2) krotovina; strong effervescence; moderately alkaline; gradual smooth boundary.
A4—37 to 48 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.
AC—48 to 60 inches; very dark grayish brown (2.5YR 3/2) silt loam, grayish brown (2.5YR 5/2) dry; weak very fine subangular blocky structure; friable; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick but ranges from 35 to 65 inches in thickness.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). Below a depth of 36 inches the A and AC horizons vary widely in color and may be mollic or nonmollic. They range from silt loam to loam and fine sandy loam. Some profiles have thin strata of loamy sand below a depth of 36 inches.

Ely Series

The Ely series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are in waterways, on alluvial fans, and on foot slopes. They formed in silty alluvium. Native vegetation was prairie grasses. Slopes range from 2 to 5 percent.

Ely soils are similar to Judson and Muscatine soils and commonly are adjacent to Colo, Dinsdale, and Tama soils. Colo soils are downslope from Ely soils. They have grayer B horizons and poorer internal drainage. Dinsdale and Tama soils are at a higher elevation than Ely soils. They have A horizons less than 20 inches thick and better internal drainage. Judson soils have browner B horizons and better internal drainage. Muscatine soils have A horizons less than 20 inches thick.

Typical pedon from an area of Ely silty clay loam, 2 to 5 percent slopes, 2,600 feet south and 105 feet east of the northwest corner of sec. 35, T. 89 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
A—9 to 24 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.
AB—24 to 30 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
Bw1—30 to 42 inches; dark grayish brown (10YR 4/2) silty clay loam; discontinuous very dark gray (10YR 3/1) coating on faces of peds; weak very fine prismatic structure parting to moderate fine subangular blocky; friable; neutral; gradual smooth boundary.
Bw2—42 to 52 inches; grayish brown (2.5Y 5/2) silt loam and light silty clay loam; few medium distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak medium subangular blocky; friable; few dark concretions of iron and manganese oxides; dark gray (10YR 4/1) coatings in root channels; neutral; gradual smooth boundary.
C—52 to 60 inches; light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) silt loam; few fine distinct reddish brown (5YR 5/3) mottles; massive; friable; few dark concretions of iron and manganese oxides; mildly alkaline.

The solum typically is 48 to 60 inches thick. The soil is 5 to 25 percent sand, most of which is very fine and fine. Stratification is evident in the upper horizons where the soil has received recent outwash material.

The A horizon has hue of 10YR, value of 2 and 3, and chroma of 1 and 2. It ranges from 24 to 36 inches in thickness. The A horizon is silty clay loam or silt loam that is 25 to 32 percent clay.

The matrix of the Bw1 horizon is typically dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The Bw1 horizon is silty clay loam that is 27 to 35 percent clay.

Fayette Series

The Fayette series consists of well drained, moderately permeable soils on uplands. These soils are on ridges and side slopes. They formed in loess. Native vegetation was deciduous trees. Slopes range from 2 to 14 percent.

Fayette soils are similar to Downs soils and commonly are adjacent to Atterberry and Downs soils. Downs soils are in positions on the landscape similar to those of Fayette soils, but they have darker A horizons. Atterberry soils are on low ridges and slightly concave swales downslope from Fayette soils. They have darker surface layers, a grayer subsoil, and are somewhat poorly drained.

Typical pedon from an area of Fayette silt loam, 2 to 5 percent slopes, 950 feet north and 1,195 feet west of the southeast corner of sec. 27, T. 88 N., R. 19 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak very fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 12 inches; brown (10YR 5/3) silt loam; dark grayish brown (10YR 4/2) coatings on faces of peds; moderate medium platy structure parting to weak very fine granular; friable; light gray (10YR 7/2) dry clean silt and sand grains; medium acid; clear wavy boundary.

BE—12 to 15 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silt loam; moderate very fine subangular blocky structure; friable; strongly acid; gradual smooth boundary.

Bt1—15 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; strong very fine subangular blocky structure; friable; dark brown (7.5YR 3/2) thick clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2—18 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; strong fine subangular blocky structure; friable; dark brown (7.5YR 3/2) thick clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—28 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; moderate very fine prismatic structure parting to strong fine subangular blocky; friable; nearly continuous dark reddish brown (5YR 3/2) thick clay films on faces of prisms and peds; medium acid; gradual smooth boundary.

Bt4—38 to 46 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) coatings on faces of prisms; weak medium prismatic structure parting to weak medium subangular blocky; friable; dark reddish brown (5YR 3/2) thick clay films in root channels; medium acid; gradual smooth boundary.

BC—46 to 53 inches; light olive brown (2.5Y 5/4) silty clay loam; brown (10YR 4/3) coatings on prisms; few fine faint olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few dark concretions of iron and manganese oxides; discontinuous dark reddish brown (5YR 3/2) clay films on faces of prisms and in root channels; medium acid; gradual smooth boundary.

C—53 to 60 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; medium acid.

The solum typically is 45 to 55 inches thick but ranges from 36 to 60 inches in thickness.

The Ap horizon is 6 to 9 inches thick and has hue of 10YR, value of 4, and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 1 through 4.

The BE and Bt horizons have hue of 10YR, value of 4 or 5, and chroma of 3 or 4. They are silt loam or silty clay loam.

The BC and C horizons have hue of 10YR, value of 4 or 5, and chroma of 4. They are silty clay loam or silt loam.

Flagler Series

The Flagler series consists of somewhat excessively drained soils on stream terraces and uplands. These soils formed in loamy and sandy material over sand. Native vegetation was prairie grasses. Permeability is moderately rapid in the upper part of the solum and very rapid in the lower part of the solum and substratum. Slopes range from 0 to 9 percent.

Flagler soils are similar to Dickinson and Zenor soils, and commonly are adjacent to Lawler, Marshan, and Saude soils. Dickinson soils do not have coarse sand and gravel. Lawler, Marshan, and Saude soils have more clay and less sand in the A and upper B horizons than Flagler soils. Lawler and Marshan soils are at lower elevations, and they have grayer B horizons and poorer internal drainage. Zenor soils are less acid and are leached to a shallower depth. Saude soils are in positions on the landscape similar to those of Flagler soils.

Typical pedon from an area of Flagler sandy loam, 0 to 2 percent slopes, 520 feet south and 305 feet east of the center of sec. 27, T. 86 N., R. 19 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; medium acid; clear smooth boundary.

A—8 to 17 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few fine pebbles; medium acid; gradual smooth boundary.

BA—17 to 23 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fine pebbles; medium acid; gradual smooth boundary.

Bw—23 to 31 inches; brown (10YR 4/3) sandy loam; very dark brown (10YR 3/2) coatings on faces of peds; weak fine and medium subangular blocky structure; friable; few fine pebbles; medium acid; abrupt wavy boundary.

2BC—31 to 37 inches; brown to dark brown (7.5YR 4/4) loamy sand; very weak medium and coarse subangular blocky structure; very friable; 5 to 10 percent fine and medium gravel; medium acid; clear smooth boundary.

2C—37 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; few fine pebbles; slightly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to sandy material ranges from 24 to 36 inches. The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is 10 to 23 inches thick.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 through 5, and chroma of 3 through 6. Clay content

averages 10 to 15 percent. The Bw horizon typically has some gravel. The 2B horizons typically have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. The amount of gravel varies but generally ranges from 5 to 15 percent.

The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. It is gravelly sand or sand. The content of gravel is highly variable.

Garwin Series

The Garwin series consists of poorly drained, moderately permeable soils on uplands. These soils are in drainageways and low concave positions. They formed in loess. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Garwin soils are similar to Harpster and Maxfield soils and commonly are adjacent to Muscatine and Tama soils. Harpster soils are calcareous and have free carbonates throughout. Maxfield soils formed in 24 to 40 inches of loess and the underlying glacial till. Muscatine and Tama soils are upslope from Garwin soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Garwin silty clay loam, 0 to 2 percent slopes, 335 feet west and 70 feet south of the northeast corner of sec. 13, T. 86 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; friable; neutral; gradual smooth boundary.

AB—17 to 23 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

Bg1—23 to 33 inches; dark gray (5Y 4/1) and olive gray (5Y 4/2) silty clay loam; very dark gray (5Y 3/1) coatings on faces of peds; weak fine subangular blocky structure; friable; mixings of olive (5Y 5/3) krotovina; neutral; clear smooth boundary.

Bg2—33 to 42 inches; olive gray (5Y 5/2) and olive (5Y 5/3) silt loam; few fine prominent yellowish brown (10YR 5/6) and faint olive yellow (5Y 6/6) mottles; weak medium prismatic structure; friable; dark gray (10YR 4/1) clay flows in root channels and on faces of prisms; neutral; abrupt smooth boundary.

Cg—42 to 60 inches; light olive gray (5Y 6/2) silt loam; many medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; few soft white accumulations of calcium carbonates; few dark concretions of iron and manganese oxides; slight effervescence; mildly alkaline.

The solum typically is 40 to 50 inches thick.

The A horizon ranges from 16 to 24 inches in thickness. The A1 horizon is neutral or has hue of 10YR, value of 2, and chroma of 1. The BA horizon has hue of 5Y or 10YR, value of 2 or 3, and chroma of 1 or 2.

If present, the Bw horizon has hue of 2.5Y or 5Y, value of 4, and chroma of 2. It is silty clay loam and has high chroma mottles of 10YR or redder. The Bg1 horizon has hue of 5Y or 2.5Y, value of 4 and 5, and chroma of 1 and 2.

Hanlon Series

The Hanlon series consists of moderately well drained soils on natural levees and nearly level bottom lands. These soils formed in moderately coarse textured alluvium. Native vegetation was prairie grasses. Permeability is moderately rapid. Slopes range from 0 to 3 percent.

Hanlon soils are similar to Spillville soils and commonly are adjacent to Coland and Spillville soils. Coland and Spillville soils are in positions on the landscape similar to those of Hanlon soils, but they have more clay and less sand throughout the solum.

Typical pedon from an area of Hanlon fine sandy loam, 0 to 3 percent slopes, 740 feet west and 200 feet north of the southeast corner of sec. 9, T. 86 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A1—8 to 16 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A2—16 to 40 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.

A3—40 to 48 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) sandy loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw—48 to 60 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral.

The solum is typically about 60 inches thick but ranges from 50 inches to more than 60 inches in thickness. It is typically neutral or slightly acid. The 10- to 40-inch control section averages 12 to 18 percent clay and 50 to 75 percent sand.

The A horizon typically is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2), but in some pedons it is very dark grayish brown (10YR 3/2). It typically is fine sandy loam, but in some pedons it is

sandy loam. The Bw horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. In some pedons mottles are below a depth of 3 feet. The Bw horizon commonly is sandy loam but ranges to very fine sandy loam.

The C horizon, where present, has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. It ranges from sandy loam to loamy sand.

Harcot Series

The Harcot series consists of poorly drained, calcareous soils on stream terraces and in outwash areas. These soils formed in 30 to 40 inches of loamy alluvium over sandy material. Native vegetation was water-tolerant grasses. Permeability is moderate in the solum and very rapid in the substratum. Slopes range from 0 to 2 percent.

Harcot soils are similar to Harps soils and commonly are adjacent to Lawler and Marshan soils. Harps soils do not have stratified, coarse textured layers in the substratum. Lawler and Marshan soils are not calcareous and do not have free carbonates in the solum. Lawler and Marshan soils are in positions on the landscape similar to those of Harcot soils.

Typical pedon from an area of Harcot loam, 0 to 2 percent slopes, 113 feet north and 1,470 feet east of the southwest corner of sec. 32, T. 87 N., R. 21 W.

Ap—0 to 8 inches; black (N 2/0) loam, dark gray (N 4/0) dry; weak very fine subangular blocky structure; friable; few fine snail shell fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—8 to 16 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few fine snail shell fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

AB—16 to 22 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine snail shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Bg—22 to 29 inches; grayish brown (2.5Y 5/2) loam; mixings of very dark gray (10YR 3/1) krotovina; weak medium subangular blocky structure; friable; few fine snail shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

BCg—29 to 37 inches; olive gray (5Y 5/2) loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; mixings of very dark gray (10YR 3/1) krotovina; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Cg1—37 to 45 inches; olive gray (5Y 5/2) sand; very few very fine distinct strong brown (7.5YR 5/6) mottles; single grained; loose; about 5 percent gravel; slight effervescence; mildly alkaline; gradual smooth boundary.

2Cg2—45 to 60 inches; light olive gray (5Y 6/2) fine sand; single grained; loose; slight effervescence; mildly alkaline.

The solum is typically 32 to 40 inches thick.

The A horizon is black (N 2/0 or 10YR 2/1). The AB horizon is generally very dark gray (10YR 3/1 to 5Y 3/1) or very dark grayish brown (2.5Y 3/2) and has olive gray (5Y 5/2) mottles. The A horizon is typically loam but includes clay loam.

The upper part of the B horizon ranges from dark gray (10YR 4/1 or 5Y 4/1) to grayish brown (2.5Y 5/2) or olive gray (5Y 5/2) and is loam or clay loam.

The 2C horizon ranges from gravelly loamy sand to sand that has some gravel.

Harps Series

The Harps series consists of poorly drained, moderately permeable, calcareous soils on convex rims around depressions on uplands. These soils formed in loamy glacial drift. Native vegetation was water-tolerant grasses. Slopes range from 1 to 3 percent.

Harps soils are similar to Canisteo, Harpster, and Harcot soils and commonly are adjacent to Canisteo, Okoboji, and Webster soils. Canisteo soils typically are at a slightly higher elevation than Harps soils. They have smaller amounts of free carbonates in the A horizon. Harpster soils formed in a silty mantle overlying loamy sediment or glacial till. Harcot soils have stratified, coarse layers in the substratum. Okoboji soils have a mollic epipedon more than 20 inches thick. Webster soils are not calcareous and do not have free carbonates in the A horizon.

Typical pedon from an area of Harps loam, 1 to 3 percent slopes, 380 feet west and 75 feet north of the southeast corner of sec. 31, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (N 2/0) loam, dark gray (N 4/0) dry; weak fine granular structure; friable; few fine snail shell fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Ak—8 to 19 inches; black (N 2/0) loam, dark gray (N 4/0) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate very fine granular structure; friable; few fine snail shell fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

ABk—19 to 23 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; few fine prominent yellowish red (5YR 5/6) mottles; moderate fine granular structure; friable; few fine snail shell fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

Bg—23 to 36 inches; olive gray (5Y 5/2) loam; weak fine and medium subangular blocky structure; friable; few fine soft white accumulations of calcium carbonates; mixings of very dark gray (10YR 3/1) krotovina; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg1—36 to 45 inches; olive gray (5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; friable; few dark reddish brown (5YR 3/3) concretions of iron oxides; few pebbles; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg2—45 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; mixings of few very dark gray (N 3/0) krotovina; violent effervescence; moderately alkaline.

The solum is typically 30 to 42 inches thick.

The A1 horizon is black (N 2/0 or 10YR 2/1) or very dark gray (10YR 3/1) and is 12 to 20 inches thick. The A horizon is usually loam but includes clay loam.

The Bg horizon ranges from 12 to 25 inches in thickness and is loam or clay loam that is 20 to 30 percent clay. The Bg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It is loam, clay loam, or sandy clay loam. In some pedons the Bg horizon has thin strata of sandy loam.

The Cg horizon usually has hue of 5Y, value of 5 or 6, and chroma of 1 to 4. It typically is loam, but many pedons have strata of sandy loam.

Harpster Series

The Harpster series consists of poorly drained, moderately permeable, calcareous soils on uplands. These soils are in drainageways and on broad flats. They formed in silty sediment overlying loamy sediment or glacial till. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Harpster soils are similar to Calco, Garwin, Harps, and Maxfield soils and are adjacent to Garwin and Maxfield soils. Calco soils have a mollic epipedon more than 24 inches thick. Harps soils have a higher content of sand than Harpster soils. Garwin and Maxfield soils are upslope from Harpster soils. They are not calcareous and do not have free carbonates in the A horizon.

Typical pedon from an area of Harpster silty clay loam, 0 to 2 percent slopes, 975 feet east and 245 feet north of the southwest corner of sec. 12, T. 89 N., R. 19 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and very fine granular structure; friable; few fine snail shell fragments; strong effervescence; moderately alkaline; clear smooth boundary.

Ak1—8 to 15 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; few fine snail shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Ak2—15 to 22 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; black (5Y 2/1) coatings on faces of peds; weak very fine granular structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Bg—22 to 30 inches; olive gray (5Y 4/2) silty clay loam; weak very fine prismatic structure parting to weak fine subangular blocky; friable; slight effervescence; moderately alkaline; clear smooth boundary.

Cg—30 to 52 inches; olive gray (5Y 5/2) silt loam; massive; friable; slight effervescence; moderately alkaline; clear smooth boundary.

2C—52 to 60 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) sandy loam; massive; friable; few fine dark concretions of iron and manganese oxides; slight effervescence; mildly alkaline.

The solum is typically 30 to 40 inches thick.

The Ak horizons are black (N 2/0 or 10YR 2/1) and are 12 to 23 inches thick.

The Bg horizon has hue of 10YR through 5Y, value of 4 or more, and chroma of 2 or less. It is generally silty clay loam but includes silt loam.

The 2C horizon, where present, is generally loam but ranges from sandy loam to clay loam.

Hayden Series

The Hayden series consists of well drained, moderately permeable soils on uplands. These soils are on knobs, ridges, and side slopes. They formed in glacial till. Native vegetation was deciduous trees. Slopes range from 2 to 50 percent.

Hayden soils are similar to Lester and Renova soils and commonly are adjacent to Coland, Lester, Le Sueur, and Storden soils. Lester soils are in positions on the landscape similar to those of Hayden soils, but they have thicker, darker A horizons. Le Sueur soils have thicker, darker A horizons, mottled gray B horizons, and poorer internal drainage. Coland soils have a mollic epipedon more than 24 inches thick. They have grayer B horizons than Hayden soils and poorer internal drainage. Renova soils developed in older, less friable glacial sediment than Hayden soils. Storden soils have an alkaline surface layer.

Typical pedon from an area of Hayden loam, 2 to 5 percent slopes, 2,290 feet west and 95 feet south of the center of sec. 12, T. 87 N., R 21 W.

A—0 to 3 inches; very dark brown (10YR 2/2) loam; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

E—3 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium platy structure parting to moderate very fine granular; friable; light gray (10YR 7/2) dry clean silt and sand grains; strongly acid; clear wavy boundary.
BE—8 to 16 inches; brown (10YR 5/3) loam; weak thick platy structure parting to moderate very fine subangular blocky; friable; light gray (10YR 7/2) dry discontinuous clean silt and sand grains; strongly acid; clear wavy boundary.
Bt1—16 to 26 inches; yellowish brown (10YR 5/4) clay loam; weak very fine prismatic structure parting to moderate fine subangular blocky; friable; discontinuous dark brown (7.5YR 3/2) clay films; friable; medium acid; clear wavy boundary.
Bt2—26 to 32 inches; yellowish brown (10YR 5/4) clay loam; brown (10YR 4/3) coatings on faces of peds; weak fine prismatic structure parting to weak medium subangular blocky; friable; dark brown (7.5YR 4/2) discontinuous clay films on faces of peds and in root channels; medium acid; clear smooth boundary.
Bt3—32 to 38 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; medium acid; clear smooth boundary.
BC—38 to 52 inches; light olive brown (2.5Y 5/4) clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; common thick brown (7.5YR 4/2) clay films on faces of prisms; thick dark gray (10YR 4/1) clay films in root channels; medium acid; abrupt wavy boundary.
C—52 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few fine dark oxides; few soft white accumulations of calcium carbonates; mildly alkaline.

The solum is typically 35 to 54 inches thick but ranges from 25 to 54 inches.

The A1 horizon is typically loam but includes silt loam that is 15 to 30 percent sand. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon, which is not present in all profles, has hue of 10YR, value of 4 or 5, and chroma of 1 or 2.

The B horizons range from slightly acid to strongly acid. They are usually loam or clay loam but are sandy clay loam or sandy loam in parts of some pedons. The B horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 through 6.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 through 6. It is loam or sandy loam. Reaction is mildly alkaline or moderately alkaline.

Judson Series

The Judson series consists of well drained or moderately well drained, moderately permeable soils on uplands. These soils are in waterways and narrow valleys and on foot slopes adjacent to steep areas. They formed in silty alluvium. Native vegetation was prairie grasses. Slopes range from 2 to 5 percent.

Judson soils are similar to Ely and Kennebec soils and commonly are adjacent to Colo, Dinsdale, and Tama soils. Ely soils have grayer B horizons and poorer internal drainage than Judson soils. Colo soils are downslope from Judson soils. They also have grayer B horizons and poorer internal drainage. Dinsdale and Tama soils are upslope from Judson soils. They have thinner mollic epipedons. Kennebec soils have a thicker mollic epipedon.

Typical pedon from an area of Judson silty clay loam, 2 to 5 percent slopes, 2,520 feet south and 120 feet east of the northwest corner of sec. 25, T. 86 N., R. 19 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.
A1—7 to 16 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine and fine granular; friable; few strata of very dark grayish brown (10YR 3/2); medium acid; clear smooth boundary.
A2—16 to 34 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; medium acid; gradual smooth boundary.
Bw1—34 to 43 inches; very dark grayish brown (10YR 3/2) silty clay loam; black (10YR 2/1) coatings on faces of peds; moderate very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bw2—43 to 48 inches; brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
BC—48 to 60 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) silty clay loam; brown (10YR 4/3) and dark grayish brown (10YR 4/2) coatings on faces of peds; weak medium prismatic structure parting to weak fine subangular blocky; friable; neutral.

The solum is 42 to 60 inches thick.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) and ranges to very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) in the lower part. It is 24 to 36 inches thick. Reaction is medium acid or slightly acid.

The Bw horizon has hue of 10YR, value of 3 or 4, and chroma of 2 through 4. It is typically medium acid or slightly acid but may be neutral in the lower part.

The C horizon, if present, has hue of 10YR, value of 4 or 5, and chroma of 4 through 6.

Kennebec Series

The Kennebec series consists of moderately well drained, moderately permeable soils. These soils are on bottom lands and low terraces along major streams. They formed in silty alluvium. Native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Kennebec soils are similar to Judson soils and commonly are adjacent to Colo and Wiota soils. Colo soils are at a slightly lower elevation than Kennebec soils and have poorer internal drainage. Wiota soils are on low stream terraces and have a thinner mollic epipedon. Judson soils are on foot slopes and in narrow waterways. They have a thinner mollic epipedon than Kennebec soils.

Typical pedon from an area of Kennebec silt loam, 0 to 2 percent slopes, 200 feet south and 820 feet east of the northwest corner of sec. 4, T. 86 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

A1—9 to 20 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure parting to weak very fine granular; friable; slightly acid; neutral; gradual smooth boundary.

A2—20 to 34 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; moderate fine prismatic structure parting to weak very fine subangular blocky; friable; slightly acid; gradual smooth boundary.

AC—34 to 55 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; moderate medium prismatic structure parting to weak fine subangular blocky; friable; noticeable fine sand grains on faces of prisms; neutral; gradual smooth boundary.

C—55 to 60 inches; very dark grayish brown (10YR 3/2) silt loam; very dark gray (10YR 3/1) coatings on faces of peds; weak coarse prismatic structure; friable; noticeable fine sand grains on faces of prisms; neutral.

The solum ranges from 36 to 60 inches in thickness. Depth to coarse material is more than 60 inches.

The A1 horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 24 to 36 inches thick. The A1 horizon is silt loam or silty clay loam. Reaction is slightly acid to neutral.

The C horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3.

Kensett Series

The Kensett series consists of moderately deep, somewhat poorly drained, moderately permeable soils on stream benches. These soils formed in 24 to 40 inches of loamy deposits overlying hard fractured limestone bedrock. Native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Kensett soils are similar to Rockton soils and commonly are adjacent to Tilfer and Rockton soils. Tilfer soils are downslope from Kensett soils. They have grayer B horizons and poorer internal drainage. Rockton soils are upslope from Kensett soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Kensett loam, 0 to 2 percent slopes, 2,130 feet north and 1,040 feet east of the center of sec. 24, T. 89 N., R. 21 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; slightly acid; clear smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate very fine and fine granular structure; friable; slightly acid; gradual smooth boundary.

A2—14 to 19 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on faces of peds; moderate very fine and fine granular structure; friable; neutral; gradual smooth boundary.

BA—19 to 24 inches; dark grayish brown (2.5Y 4/2) loam; very dark gray (2.5Y 3/1) coatings on faces of peds; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw—24 to 29 inches; olive brown (2.5Y 4/4) loam; dark grayish brown (2.5Y 4/2) and very dark grayish brown (2.5Y 3/2) coatings on faces of peds; moderate medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

2R—29 inches; hard shattered limestone.

The solum is typically 28 to 36 inches thick but ranges from 24 to 40 inches in thickness.

The A horizon ranges from silt loam that is 15 to 30 percent sand to loam and clay loam. The A horizon is slightly acid or neutral.

The B horizon is commonly loam or clay loam. It has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 through 4. In the Bw horizon mottles, coatings on faces of peds, or matrix colors have value of 4 or 5 and chroma of 2.

Kenyon Series

The Kenyon series consists of moderately well drained, moderately permeable soils on uplands. These

soils are on ridge crests and side slopes. They formed in 14 to 24 inches of loamy material and the underlying glacial till. Native vegetation was prairie grasses. Slopes range from 5 to 18 percent.

These Kenyon soils are taxadjuncts to the Kenyon series because they do not have a mollic epipedon, which is definitive for the Kenyon series.

Kenyon soils are similar to Dinsdale soils and commonly are adjacent to Dinsdale and Tama soils. Dinsdale soils formed in loess overlying glacial till. Tama soils formed in loess and do not have glacial till within 40 inches of the surface. Both Dinsdale and Tama soils are at slightly higher elevations than Kenyon soils.

Typical pedon from an area of Kenyon loam, 5 to 9 percent slopes, moderately eroded, 900 feet north and 810 feet east of the southwest corner of sec. 23, T. 88 N., R. 19 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (10YR 4/3) subsoil material; weak very fine granular structure; friable; medium acid; abrupt smooth boundary.

BA—8 to 16 inches; brown (10YR 4/3) loam; weak very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

Bw1—16 to 24 inches; yellowish brown (10YR 5/4) loam; weak fine prismatic structure parting to weak fine and medium subangular blocky; friable; thin dark grayish brown (10YR 4/2) clay flows in root channels; pebble band along upper boundary; medium acid; clear smooth boundary.

2Bw2—24 to 33 inches; light olive brown (2.5Y 5/4) loam; few fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few thin dark grayish brown (10YR 4/2) clay flows in root channels; few pebbles; strongly acid; gradual smooth boundary.

2BC—33 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure; firm; few pebbles; few dark concretions of iron and manganese oxides; medium acid.

The solum ranges from 48 to 60 inches or more in thickness. These soils are usually leached of carbonates to a depth of 45 to 80 inches.

Typically, a "stone line" between 2 and 4 inches thick separates the glacial till and the overlying sediment. This "stone line" is absent or weakly developed in some pedons.

The 2Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It has grayish mottles below a depth of about 20 to 34 inches. The 2Bw horizon is generally loam that is 24 to 27 percent clay but includes sandy clay loam or clay loam. It ranges from medium acid to very strongly acid in the upper part and from medium acid to slightly acid in the lower part.

Killduff Series

The Killduff series consists of well drained and moderately well drained, moderately permeable soils on uplands. These soils are on convex ridge crests and side slopes. They formed in loess that has common or many relict gray mottles. Native vegetation was prairie grasses. Slopes range from 5 to 18 percent.

Killduff soils are similar to Tama soils and commonly are adjacent to Ely and Tama soils. Ely soils are downslope from Killduff soils. They have thicker, darker A horizons and grayer B horizons and are somewhat poorly drained. Tama soils are in positions on the landscape similar to those of Killduff soils. They have a darker surface layer, fewer grayish brown mottles in the B horizons, and are well drained.

Typical pedon from an area of Killduff silty clay loam, 5 to 9 percent slopes, moderately eroded, 940 feet south and 125 feet west of the northeast corner of sec. 24, T. 86 N., R. 20 W.

Ap—0 to 7 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; few streaks and pockets of yellowish brown (10YR 5/4) subsoil material; weak fine granular structure; friable; slightly acid; clear smooth boundary.

Bw1—7 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; friable; few patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

Bw2—17 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; common fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; few fine clay flows in root channels; slightly acid; gradual smooth boundary.

Bw3—28 to 35 inches; yellowish brown (10YR 5/4) silt loam; many fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to weak coarse and medium subangular blocky; friable; slightly acid; gradual smooth boundary.

BC—35 to 46 inches; yellowish brown (10YR 5/4) silt loam; many fine faint grayish brown (2.5Y 5/2) mottles; weak fine prismatic structure; friable; common dark concretions of iron and manganese oxides; slightly acid; gradual smooth boundary.

C—46 to 60 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silt loam; massive; friable; common dark concretions of iron and manganese oxides; neutral.

The solum is typically 32 to 50 inches thick. It is slightly acid or medium acid in the most acid part. Sand content is less than 5 percent throughout.

The A1 or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3.

The B horizon is brown (10YR 4/3) or yellowish brown (10YR 5/4). Mottles that have hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 2 increase with depth.

The C horizon has hue of 10YR through 5Y, value of 5 or 6, and chroma of 1 or 2.

Klinger Series

The Klinger series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on ridges, at the heads of drainageways, and on side slopes. They formed in 20 to 40 inches of loess and the underlying till. Native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Klinger soils are similar to Dinsdale and Muscatine soils and commonly are adjacent to Dinsdale, Garwin, and Maxfield soils. Dinsdale soils are at a slightly higher elevation than Klinger soils. They have a browner B horizon and better internal drainage. Garwin and Maxfield soils are at slightly lower elevations than Klinger soils. They have grayer B horizons and poorer internal drainage. Muscatine soils have glacial till at a greater depth.

Typical pedon from an area of Klinger silty clay loam, 0 to 2 percent slopes, 1,180 feet south and 50 feet west of the northeast corner of sec. 1, T. 89 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A—9 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on faces of peds; moderate very fine granular structure; friable; slightly acid; gradual smooth boundary.

BA—16 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine faint grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bt1—22 to 31 inches; brown (10YR 5/3) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few thin dark grayish brown (10YR 4/2) clay films; slightly acid; gradual smooth boundary.

2Bt2—31 to 42 inches; yellowish brown (10YR 5/6) loam; discontinuous brown (10YR 5/3) coatings on faces of peds; common fine and medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky structure; firm; dark grayish brown (10YR 4/2) clay films in root channels; slightly acid; gradual smooth boundary.

2BC—42 to 50 inches; yellowish brown (10YR 5/6) loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium and coarse prismatic structure; firm; few yellowish red (5YR 4/6) concretions of iron oxides; neutral; abrupt wavy boundary.

2C—50 to 60 inches; yellowish brown (10YR 5/6) loam; massive; firm; strong effervescence; mildly alkaline.

The solum typically is 45 to 55 inches thick but ranges from 40 to 60 inches in thickness. The loess typically is 30 to 36 inches thick but ranges from 20 to 40 inches in thickness.

The A horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). The part of the B horizon that formed in loess ranges from 27 to 35 percent clay and from dark grayish brown (10YR or 2.5Y 4/2) to light olive brown (2.5Y 5/4). The content of sand in the A and B horizons ranges from 3 to 10 percent.

The 2B horizon typically is loam, but the range includes sandy clay loam and clay loam. In places thin, discontinuous lenses of sandy loam, loamy sand, or sand are between the loess and the till.

Lawler Series

The Lawler series consists of somewhat poorly drained soils on stream terraces and outwash plains. These soils formed in 24 to 40 inches of loamy deposits overlying sandy material. Native vegetation was prairie grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Lawler soils commonly are adjacent to Marshan, Saude, and Waukee soils. Marshan soils are downslope from Lawler soils. They have grayer B horizons and poorer internal drainage. Saude and Waukee soils are upslope from Lawler soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, 2,010 feet south and 125 feet west of the center of sec. 1, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; firm; slightly acid; abrupt smooth boundary.

A—8 to 17 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine and fine granular structure; friable; slightly acid; gradual smooth boundary.

AB—17 to 21 inches; very dark grayish brown (2.5Y 3/2) loam, grayish brown (2.5Y 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak fine

granular structure; friable; slightly acid; gradual smooth boundary.

Bw—21 to 26 inches; dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) sandy clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; increase in sand size; medium acid; gradual smooth boundary.

2BC—26 to 30 inches; grayish brown (10YR 5/2) sandy loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct strong brown (7.5YR 5/6) mottles; very weak coarse subangular blocky structure; friable; about 5 percent gravel; medium acid; abrupt smooth boundary.

2C1—30 to 49 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) coarse sand; single grained; loose; medium acid; gradual smooth boundary.

2C2—49 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) coarse sand; single grained; loose; few fine gravel; medium acid.

The solum is 24 to 40 inches thick. It extends into the upper part of the underlying sand and gravel in some areas.

The A horizon is typically loam or clay loam but ranges to silty clay loam that is 15 to 20 percent sand.

The Bw1 horizon typically ranges from loam to sandy clay loam and light clay loam. It is commonly underlain by a thin zone of sandy loam below a depth of 24 to 36 inches. The 2BC horizon or the upper part of the 2C horizon typically ranges from loamy coarse sand to gravelly sand and may have thin layers of sandy loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 through 4. If the chroma exceeds 2, the 2C horizons are mottled with chroma of 2.

Lester Series

The Lester series consists of well drained, moderately permeable soils on uplands. These soils are on knobs, ridges, and side slopes. They formed in glacial till. Native vegetation was mixed prairie grasses and trees. Slopes range from 2 to 24 percent.

Lester soils are similar to Clarion and Hayden soils and commonly are adjacent to Clarion, Le Sueur, Nicollet, and Webster soils. Clarion soils have thicker, darker A horizons than Lester soils and do not have E horizons. Hayden soils have lighter colored A horizons than Lester soils. Le Sueur, Nicollet, and Webster soils have grayer B horizons and poorer internal drainage. They are on nearly level flats, swales, and low ridges.

Typical pedon from an area of Lester loam, 2 to 5 percent slopes, 2,080 feet north and 2,100 feet west of the center of sec. 1, T. 89 N., R. 22 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

E—8 to 13 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; dark brown (10YR 3/3) coatings on faces of peds; light gray (10YR 7/2) silt coats; weak medium platy structure parting to weak very fine subangular blocky; friable; very dark grayish brown (10YR 3/2) root channel fills; medium acid; clear wavy boundary.

Bt1—13 to 21 inches; dark yellowish brown (10YR 4/4) clay loam; dark brown (10YR 3/3) coatings on faces of peds; moderate very fine subangular blocky structure; friable; common dark brown (7.5YR 3/2) and brown (7.5YR 4/2) clay films on faces of peds; medium acid; clear wavy boundary.

Bt2—21 to 33 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; few pebbles; dark brown (7.5YR 3/2) and brown (7.5YR 4/2) clay films on faces of peds and prisms; medium acid; clear wavy boundary.

Bt3—33 to 44 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; medium acid; clear wavy boundary.

BC—44 to 50 inches; yellowish brown (10YR 5/4) loam; weak medium prismatic structure; friable; neutral; abrupt smooth boundary.

C—50 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few very dark grayish brown (10YR 3/2) root channel fills; strong effervescence; moderately alkaline.

The solum is typically 36 to 50 inches thick but ranges from 30 to 54 inches in thickness.

The A1 or Ap horizon is typically loam but includes silt loam that is 15 to 30 percent sand. It typically has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. The E horizon, if present, is loam or silt loam that is high in sand content and typically has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The B horizons are usually medium acid but range from strongly acid to neutral. They are loam or clay loam. The B horizons have hue of 10YR, value of 4 or 5, and chroma of 3 or 4.

The C horizon is typically loam but includes sandy loam. The C horizon typically has hue of 2.5Y, value of 4 to 6, and chroma of 2 to 6.

Le Sueur Series

The Le Sueur series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on undulating, low convex ridges and slightly concave or flat lower slopes. They formed in glacial drift. Native vegetation was mixed prairie grasses and trees. Slopes range from 0 to 2 percent.

These Le Sueur soils are taxadjuncts to the Le Sueur series because they do not have a mollic epipedon, which is definitive for the series.

Le Sueur soils are similar to Nicollet soils and commonly are adjacent to Hayden, Lester, and Webster soils. Lester soils are on convex ridges and side slopes. They have browner B horizons and are better drained than Le Sueur soils. Nicollet soils have a thicker, dark surface layer, are less acid, and do not have E horizons. Hayden soils have browner B horizons and are better drained. Webster soils have grayer B horizons and poorer internal drainage than Le Sueur soils.

Typical pedon from an area of Le Sueur silt loam, 0 to 2 percent slopes, 1,045 feet south and 950 feet east of the northwest corner of sec. 1, T. 89 N., 22 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 15 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure parting to weak fine granular; friable; slightly acid; clear wavy boundary.

Bt1—15 to 21 inches; light olive brown (2.5Y 5/4) clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; moderate very fine subangular blocky structure; firm; few dark grayish brown (10YR 4/2) clay films in root channels and on faces of peds; grayish brown (2.5Y 5/2) prism faces; medium acid; gradual wavy boundary.

Bt2—21 to 29 inches; light olive brown (2.5Y 5/4) clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few dark grayish brown (10YR 4/2) clay films in root channels and on faces of peds; grayish brown (2.5Y 5/2) prism faces; medium acid; gradual wavy boundary.

Bt—29 to 40 inches; light olive brown (2.5Y 5/4) clay loam; common medium faint grayish brown (2.5Y 5/2) and distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; common thick dark grayish brown (10YR 2/2) clay films on faces of prisms and peds and in root channels; slightly acid; abrupt irregular boundary.

C1—40 to 44 inches; mottled yellowish brown (10YR 5/6) and gray (5Y 5/1) loam; few fine distinct reddish brown (5YR 4/4) and few fine prominent very dusky red (2.5YR 2/2) mottles; weak coarse prismatic structure; friable; few very dark gray (10YR 3/1) clay films in root channels; strong effervescence; mildly alkaline; abrupt wavy boundary.

C2—44 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5Y 4/6) mottles; massive; friable; few dark concretions of iron oxides; strong effervescence; moderately alkaline.

The solum ranges from 36 to 50 inches in thickness.

The A horizons are typically loam or silt loam that is 15 to 30 percent sand. The Ap or A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2. There are few or no mottles.

The upper 20 inches of the B horizon is clay loam that averages 28 to 35 percent clay. Matrix and mottles have hue of 7.5YR, 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and a wide range of chroma.

Marshan Series

The Marshan series consists of poorly drained soils on stream terraces and outwash plains. These soils formed in 32 to 40 inches of loamy alluvial deposits over sandy material. Native vegetation was water-tolerant grasses. Permeability is moderate in the solum and rapid in the substratum. Slopes range from 0 to 2 percent.

Marshan soils commonly are adjacent to Lawler and Saude soils. Lawler and Saude soils are at slightly higher elevations than Marshan soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, 2,120 feet south and 165 feet east of the northwest corner of sec. 5, T. 86 N., R. 21 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; moderate very fine granular structure; friable; slightly acid; clear smooth boundary.

A1—8 to 16 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.

A2—16 to 21 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; few very fine prominent yellowish red (5YR 5/8) mottles; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw1—21 to 27 inches; olive gray (5Y 4/2) clay loam; very dark gray (5Y 3/1) coatings on faces of peds; few very fine prominent yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw2—27 to 33 inches; mottled dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; neutral; gradual smooth buondary.

BC—33 to 36 inches; mottled dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) sandy loam;

common fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

2C—36 to 48 inches; olive brown (2.5Y 4/4) loamy sand; common medium faint dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) mottles; single grained; loose; about 2 percent gravel; neutral; clear smooth boundary.

2Cg1—48 to 57 inches; light olive gray (5Y 6/2) sand; few coarse prominent yellowish red (5Y 5/8) mottles; single grained; loose; about 10 percent gravel; neutral; abrupt smooth boundary.

2Cg2—57 to 60 inches; light olive gray (5Y 6/2) sand; few coarse prominent yellowish red (5Y 5/8) mottles; single grained; loose; about 5 to 10 percent gravel; mildly alkaline; strong effervescence.

The solum is 24 to 40 inches thick.

The A1 horizon is black (N 2/0 or 10YR 2/1). The A2 horizon, which typically is present, is generally very dark gray (10YR 3/1 to 5Y 3/1) or very dark grayish brown (2.5Y 3/2).

The upper part of the B horizon ranges from dark gray (10YR 4/1 or 5Y 4/1) to dark grayish brown (2.5Y 4/2) or olive gray (5Y 4/2). It is clay loam, sandy clay loam, or silty clay loam that is 15 to 20 percent sand. The 2BC horizon, where present, ranges from sandy loam that is 2 to 5 percent gravel to sand.

The 2C horizon ranges from gravelly loamy sand to sand that has some gravel.

Maxfield Series

The Maxfield series consists of poorly drained, moderately permeable soils on uplands. These soils are on flats and in shallow drainageways. They formed in 24 to 40 inches of loess and the underlying glacial till. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Maxfield soils are similar to Garwin and Harpster soils and commonly are adjacent to Dinsdale and Klinger soils. Harpster soils are calcareous and have free carbonates throughout. Garwin soils formed in deeper deposits of loess overlying glacial till. Dinsdale and Klinger soils are at slightly higher elevations than Maxfield soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Maxfield silty clay loam, 0 to 2 percent slopes, 1,510 feet south and 105 feet west of the northeast corner of sec. 1, T. 89 N., R. 19 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A—8 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.

BA—14 to 20 inches; olive gray (5Y 4/2) silty clay loam; discontinuous very dark gray (5Y 3/1) coatings on faces of peds; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bg—20 to 31 inches; olive gray (5Y 4/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and common fine faint light olive brown (2.5Y 5/4) mottles; weak fine prismatic structure parting to weak fine subangular blocky structure; friable; few thin dark grayish brown (10YR 4/2) clay films in root channels; neutral; clear smooth boundary.

2BC—31 to 52 inches; mottled strong brown (7.5YR 5/6) and light olive gray (5Y 6/2) loam; weak coarse prismatic structure parting to weak medium coarse subangular blocky; friable; mildly alkaline; gradual smooth boundary.

2C—52 to 60 inches; mottled strong brown (7.5YR 5/8) and light olive gray (5Y 6/2) loam; massive; friable; strong effervescence; mildly alkaline.

The solum is typically 42 to 54 inches thick.

The AB horizon, where present, is very dark gray (10YR 3/1 or 5Y 3/1). The A horizon ranges from 14 to 20 inches in thickness. Clay content ranges from about 30 to 35 percent.

The BA horizon, if present, ranges from dark gray (10YR 4/1) to dark grayish brown (2.5Y 4/2) and olive gray (5Y 4/2 or 5/2) and may have mottles of high and low chroma. Clay content of the upper B horizon ranges from about 30 to 35 percent. The Bg horizon ranges from olive gray (5Y 5/2) to dark grayish brown (2.5Y 4/2) and may have mottles of high and low chroma. The 2B horizons are loam but include thin discontinuous strata of sandy loam.

Montieth Series

The Montieth series consists of moderately deep, excessively drained soils on uplands. These soils formed in residuum weathered from Pennsylvanian sandstone. Native vegetation was deciduous trees and native white pine. Permeability is moderately rapid to very rapid. Slopes range from 14 to 40 percent.

Montieth soils commonly are adjacent to Fayette, Downs, and Downs Variant soils. Downs and Fayette soils formed in loess deposits more than 60 inches thick. Downs Variant soils formed in loess 20 to 40 inches thick and in the underlying residuum from sandstone. All of these soils are upslope at higher elevations than Montieth soils.

Typical pedon from an area of Montieth sandy loam, 14 to 40 percent slopes; 350 feet north and 100 feet west of the southeast corner of sec. 5, T. 87 N., R. 19 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam; weak very fine subangular blocky structure; friable; many roots; strongly acid; clear irregular boundary.
E—4 to 10 inches; brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bt—10 to 18 inches; strong brown (7.5YR 4/6) loamy sand; weak fine and medium subangular blocky structure; very friable; few thin discontinuous very dark grayish brown (10YR 3/2) clay films; many roots; very strongly acid; gradual smooth boundary.
BC—18 to 28 inches; strong brown (7.5YR 5/6) sand, very weak medium and coarse subangular blocky structure; very friable; many roots; 5 to 10 percent, by volume, thin hard ferruginous channery fragments; very strongly acid; gradual irregular boundary.
Cr—28 to 60 inches; strong brown (7.5YR 5/6) weakly cemented sandstone; about 10 percent thin hard ferruginous fragments and flagstones.

The solum ranges from 24 to 36 inches in thickness. Depth to bedrock ranges from 24 to 40 inches.

The A horizon is dark brown (10YR 3/3) or dark grayish brown (10YR 4/2). It is sandy loam or loamy sand.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

The Cr horizon is weakly cemented sandstone that has been little affected by pedogenic processes. When moist, hand digging is usually not difficult except where layers and pockets of hard ferruginous flags are concentrated. Exposed bluffs of sandstone appear to be strongly cemented but usually the hard cementation is only a thin rind. Behind this rind the sandstone cementation can be disturbed with slight water pressure or digging equipment.

Muscatine Series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on ridges, at the heads of waterways, and on side slopes. They formed in loess. Native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Muscatine soils are similar to Ely, Klinger, and Tama soils and commonly are adjacent to Dinsdale, Garwin, and Tama soils. Ely soils have a mollic epipedon more than 24 inches thick. Klinger and Dinsdale soils formed in loess deposits less than 40 inches thick and in the underlying glacial till. Garwin soils are downslope at a lower elevation than Muscatine soils. They have grayer B horizons and poorer internal drainage. Tama and Dinsdale soils are upslope from Muscatine soils. They are more sloping, have browner B horizons, and better internal drainage.

Typical pedon from an area of Muscatine silty clay loam, 0 to 2 percent slopes, 220 feet south and 65 feet west of the northeast corner of sec. 13, T. 86 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; slightly acid; clear smooth boundary.
A1—8 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; slightly acid; gradual smooth boundary.
A2—16 to 23 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate very fine granular structure; friable; medium acid; gradual smooth boundary.
Bw1—23 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few very dark grayish brown (2.5Y 3/2) coatings on faces of peds; common medium faint light olive brown (2.5Y 5/4) mottles; weak very fine subangular blocky structure; friable; few thin dark gray (10YR 4/1) clay films on faces of peds; medium acid; gradual smooth boundary.
Bw2—31 to 39 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine and medium faint light olive brown (2.5Y 5/4) and common fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; common dark gray and gray clay films; slightly acid; gradual smooth boundary.
BC—39 to 50 inches; grayish brown (2.5Y 5/2) silt loam; many fine and medium prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to coarse subangular blocky; friable; neutral; gradual smooth boundary.
C—50 to 60 inches; light olive gray (5Y 6/2) silt loam; many medium and coarse prominent yellowish red (5YR 5/6) mottles; massive; friable; mildly alkaline.

The solum typically is about 48 inches thick but ranges from 40 to 60 inches in thickness.

Unless limed, Muscatine soils are medium acid to strongly acid in the A horizon and upper part of the Bt horizon and are medium acid to neutral in the middle and lower parts of the Bt horizon.

The B horizon is 25 to 35 inches thick. It mainly has hue of 10YR or 2.5Y, value of 4, and chroma of 2 in the upper part and value of 5 or 6 and chroma of 2 to 4 in the lower part. The Bt horizon is silty clay loam that ranges from 27 to 35 percent clay.

Nicollet Series

The Nicollet series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on low ridges and on slightly concave to flat

side slopes. Nicollet soils formed in loamy glacial drift. Native vegetation was prairie grasses. Slopes range from 1 to 3 percent.

Nicollet soils are similar to Clarion and Le Sueur soils and commonly are adjacent to Canisteo, Clarion, Harps, and Webster soils. Clarion soils are more sloping than Nicollet soils. They have browner B horizons and better internal drainage. Canisteo, Harps, and Webster soils are at lower elevations than Nicollet soils. They have grayer B horizons and poorer internal drainage. Canisteo and Harps soils have calcareous A horizons that have free carbonates. Le Sueur soils are in positions on the landscape similar to those of Nicollet soils. They have a thinner, dark surface layer and are more acid.

Typical pedon from an area of Nicollet loam, 1 to 3 percent slopes, 1,620 feet west and 205 feet south of the northeast corner of sec. 5, T. 89 N., R. 21 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
A1—9 to 16 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; neutral; gradual smooth boundary.
A2—16 to 22 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
Bw—22 to 30 inches; dark grayish brown (10YR 4/2) loam; few fine faint light olive brown (2.5Y 5/4) mottles; very dark grayish brown (2.5Y 3/2) coatings on faces of peds; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.
BC—30 to 34 inches; olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) loam; weak moderate subangular blocky structure; friable; neutral; abrupt wavy boundary.
C—34 to 60 inches; olive (5Y 5/3) loam; massive; friable; thin lime seams; strong effervescence; mildly alkaline.

The solum typically is 28 to 45 inches thick.

The A horizon is loam or clay loam. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A horizon is 10 to 22 inches thick and is typically medium acid to neutral.

The upper part of the B horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3, and the lower part has hue of 2.5Y, value of 4 or 5, and chroma of 2 through 4. The B horizon has mottles in some parts of the profile. It is loam or clay loam.

The C horizon has hue of 2.5Y or 5Y, value of 5, and chroma of 2 through 4. It is mildly alkaline.

Okoboji Series

The Okoboji series consists of very poorly drained soils on uplands. These soils are in depressional areas. They formed in local alluvium washed from adjacent uplands. Native vegetation was marsh grasses and sedges. Permeability is moderately slow. Slopes are 0 to 1 percent.

Okoboji soils commonly are adjacent to Canisteo, Harps, and Wacousta soils. Canisteo and Harps soils are on rims above the Okoboji soils. They have thinner mollic epipedons, are calcareous, and have free carbonates in the A horizon. Wacousta soils are in positions on the landscape similar to those of Okoboji soils. They have a thinner mollic epipedon.

Typical pedon from an area of Okoboji silty clay loam, 0 to 1 percent slopes, 930 feet east and 2,175 feet north of the center of sec. 24, T. 89 N., R. 22 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.
A1—7 to 20 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine prismatic structure parting to weak very fine subangular blocky; firm; neutral; gradual smooth boundary.
A2—20 to 28 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; few very fine distinct olive (5Y 4/4) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; firm; neutral; gradual smooth boundary.
Bw—28 to 37 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; few fine distinct olive (5Y 4/4) mottles; weak medium prismatic structure parting to weak very fine subangular blocky; friable; neutral; gradual smooth boundary.
BCg—37 to 43 inches; olive gray (5Y 5/2) silty clay loam; common fine distinct olive (5Y 5/6) and strong brown prominent (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; black (N 3/0) krotovina mixings; neutral; gradual smooth boundary.
Cg1—43 to 49 inches; olive gray (5Y 5/2) silty clay loam; few fine strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; dark gray (N 4/0) krotovina mixings; neutral; gradual smooth boundary.
Cg2—49 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine strong brown prominent (7.5YR 5/6) mottles; massive; friable; mixings of dark gray (N 4/0) krotovina; slight effervescence; mildly alkaline.

The solum is typically 40 to 60 inches thick.

The A horizon ranges from about 24 to 36 inches in thickness. It is neutral or has hue of 10YR, value of 2, and chroma of 0 or 1. The upper 10 to 16 inches ranges

from silty clay loam to mucky silt loam. The lower part ranges from 35 to 40 percent clay.

The BCg horizon is neutral, or it has hue of 5Y or 10YR, value of 2 to 5, and chroma of 0 to 2. The Bg horizons range from 35 to 40 percent clay.

The Cg horizon has a thin layer that is coarser than silty clay loam in some pedons.

Palms Series

The Palms series consists of very poorly drained soils in depressions. These soils formed in 16 to 50 inches of organic material underlain by silty mineral soil material. Native vegetation was marsh grasses and sedges. Permeability is moderately slow to moderately rapid in the solum and moderate or moderately slow in the substratum. Slopes range from 0 to 2 percent.

Palms soils commonly are adjacent to Harps soils and Okoboji mucky silt loam. Harps soils, which formed in glacial drift, are on rims above the Palms soils. They are calcareous and have free carbonates in the A horizon. Okoboji mucky silt loam soils are in positions on the landscape similar to those of Palms soils. They have a thinner surface layer that is lower in organic matter content than that of Palms soils.

Typical pedon from an area of Palms muck, 0 to 2 percent slopes, 500 feet east and 170 feet south of the northwest corner of sec. 22, T. 89 N., R. 22 W.

Oa1—0 to 9 inches; black (N 2/1 rubbed, N 2/0 broken face) sapric material; weak very fine granular structure; slightly sticky; 70 to 75 percent mineral material; neutral; clear smooth boundary.

Oa2—9 to 28 inches; black (10YR 2/1 rubbed, N 2/0 broken face) sapric material; massive parting to weak coarse subangular blocky structure; slightly sticky; 70 to 75 percent mineral material; few fine sand grains on faces of peds; few herbaceous fibers; neutral; clear smooth boundary.

C—28 to 32 inches; black (10YR 2/1) mucky silt loam; few reddish brown (5YR 4/4) fibers and mottles; massive; very friable; mildly alkaline; clear smooth boundary.

Cg1—32 to 44 inches; light olive gray (5Y 6/2) silt loam; massive; friable; yellowish red prominent (5YR 4/8) linings in root channels; violent effervescence; moderately alkaline; clear smooth boundary.

Cg2—44 to 56 inches; gray (5Y 5/1) silt loam; common medium prominent yellowish red (5YR 4/6) mottles; massive; friable; violent effervescence; mildly alkaline; clear smooth boundary.

Cg3—56 to 60 inches; gray (5Y 5/1) silt loam; many medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; weak stratification; light gray (5Y 7/1) lime seam; prominent yellowish red (5YR 4/6) linings in root channels; violent effervescence; moderately alkaline.

The thickness of the organic layer is typically 20 to 40 inches but ranges from 16 to 50 inches. This layer has hue of 10YR or 7.5YR, value of 2, and chroma of 0 or 1. Broken faced, rubbed and pressed colors are similar. The organic material is sapric. Reaction of the organic layer is slightly acid to mildly alkaline. In some pedons a sedimentary peat layer, 1 to 2 inches thick, is present above the 2Cg horizon. The 2Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 through 7, and chroma of 1 or 2. It ranges from loam to silty clay loam and averages less than 35 percent clay. It is mildly alkaline or moderately alkaline.

Renova Series

The Renova series consists of moderately well drained, moderately permeable soils on uplands. These soils are on side slopes and narrow ridge crests. They formed in 10 to 18 inches of loamy material and the underlying glacial till. Native vegetation was deciduous trees. Slopes range from 18 to 35 percent.

These Renova soils are taxadjuncts to the Renova series because they have a slightly higher sand content in the upper part of the solum than is definitive for the series.

Renova soils are similar to Hayden soils and are adjacent to Fayette soils. Hayden soils developed in younger, more friable glacial sediment than Renova soils. Fayette soils are upslope from Renova soils and on more gently sloping ridge crests. They developed in loess deposits more than 40 inches in depth.

Typical pedon from an area of Renova loam, 18 to 35 percent slopes, 820 feet south and 1,600 feet west of the center of sec. 15, T. 88 N., R. 19 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loam; very fine granular structure; friable; neutral; clear smooth boundary.

E—4 to 9 inches; brown (10YR 4/3) sandy loam; dark grayish brown (10YR 4/2) coatings on faces of peds; mixings of very dark grayish brown (10YR 3/2) krotovina; weak thin platy structure parting to moderate very fine granular; friable; slightly acid; clear wavy boundary.

BE—9 to 14 inches; yellowish brown (10YR 5/4) sandy loam, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; friable; few pebbles; medium acid; clear wavy boundary.

2Bt1—14 to 28 inches; yellowish brown (10YR 5/6) loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; pebble band along upper boundary; few thin clay films on prisms; thick clay films in root channels; few pebbles throughout; medium acid; gradual smooth boundary.

2Bt2—28 to 50 inches; yellowish brown (10YR 5/4 and 10YR 5/6) loam; discontinuous brown (10YR 5/3) coatings on faces of peds; weak medium prismatic

structure parting to weak medium subangular blocky; firm; few thin clay films on prisms; few pebbles throughout; strongly acid; clear smooth boundary.
2C1—50 to 58 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; massive; firm; neutral; abrupt wavy boundary.
2C2—58 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; massive; firm; few dark concretions of iron and manganese oxides; few soft white accumulations of calcium carbonates; strong effervescence; mildly alkaline.

The solum is 40 to 60 inches thick. Depth to the pebble band and underlying glacial till typically is 10 to 18 inches.

The A1 horizon and E horizon range from loam to silt loam and sandy loam.

The B horizon typically developed partially in the loamy overburden and partially in the underlying glacial till. The 2B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The 2B2 and 2C horizons are typically loam but range to clay loam and sandy clay loam. Consistence typically is firm but ranges to friable.

Rockton Series

The Rockton series consists of moderately deep, well drained, moderately permeable soils on stream benches. These soils formed in about 20 to 40 inches of loamy material over shattered limestone bedrock. Native vegetation was prairie grasses. Slopes range from 0 to 9 percent.

These Rockton soils are taxadjuncts to the Rockton series because they typically do not have the clay increase needed for the argillic horizon that is definitive for the series.

Rockton soils are similar to Kensett soils and are adjacent to Kensett and Tilfer soils. Kensett and Tilfer soils are at lower elevations than Rockton soils, and they have poorer internal drainage.

Typical pedon from an area of Rockton loam, 2 to 5 percent slopes, 1,270 feet west and 1,600 feet south of the center of sec. 17, T. 89 N., R. 21 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; weak very fine granular structure; friable; neutral; clear smooth boundary.
A1—8 to 14 inches; very dark brown (10YR 2/2) loam; weak very fine granular structure; friable; slightly acid; gradual smooth boundary.
AB—14 to 19 inches; very dark grayish brown (10YR 3/2) loam; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine granular structure; friable; few pebbles; slightly acid; gradual smooth boundary.
Bw1—19 to 24 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; medium very fine subangular blocky structure; friable; few pebbles; slightly acid; abrupt smooth boundary.
2R—24 inches; shattered limestone; bedrock fragments dominantly range from 1 inch to 8 inches.

The thickness of the solum, which corresponds to the depth to limestone, ranges from 20 to 40 inches.

The Ap or A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is 10 to 20 inches thick. The AB horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2).

The B horizon ranges from dark brown or brown (10YR 4/3) to yellowish brown (10YR 5/6). It ranges from loam to clay loam.

The underlying bedrock is highly shattered in the upper 3 to 10 feet.

Salida Series

The Salida series consists of excessively drained, very rapidly permeable soils on stream terraces and on uplands. These soils formed in coarse and moderately coarse textured, calcareous sediment. Native vegetation was prairie grasses. Slopes range from 5 to 18 percent.

Salida soils commonly are adjacent to Clarion, Zenor, and Storden soils. Clarion and Zenor soils are finer textured, more acid, and leached to greater depths than Salida soils. Storden soils are finer textured.

Typical pedon from an area of Salida gravelly coarse sandy loam, 9 to 18 percent slopes, 2,230 feet north and 1,460 feet east of the southwest corner of sec. 31, T. 87 N., R. 19 W.

A1—0 to 6 inches; very dark brown (10YR 2/2) gravelly coarse sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; mixed with streaks and pockets of very dark grayish brown (10YR 3/2) subsurface material; neutral; gradual smooth boundary.
A2—6 to 9 inches; very dark grayish brown (10YR 3/2) gravelly loamy coarse sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline; gradual smooth boundary.
Bw—9 to 14 inches; brown (10YR 4/3) gravelly coarse sand; weak coarse subangular blocky structure; very friable; strong effervescence; mildly alkaline; gradual smooth boundary.
C1—14 to 25 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grained; loose; common fine gravel; strong effervescence; mildly alkaline; gradual smooth boundary.
C2—25 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grained; loose; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 7 to 18 inches. The thickness of the mollic epipedon ranges from 7 to 10 inches. The upper 40 inches typically ranges from 15 to 25 percent gravel.

The A horizon has value of 2 or 3 and chroma of 2 or 3. It ranges from gravelly sandy loam to gravelly loamy sand. Reaction ranges from neutral to moderately alkaline. A B horizon is not present in all profiles.

The C horizon has value of 4 to 6 and chroma of 2 to 6. It is commonly stratified gravelly sand and sand. Reaction is mildly alkaline or moderately alkaline.

Saude Series

The Saude series consists of well drained soils on stream terraces and on uplands. These soils formed in 20 to 36 inches of loamy material over sand and gravel. Native vegetation was prairie grasses. Permeability is moderate in the upper part of the solum and very rapid in the lower part of the solum and substratum. Slopes range from 0 to 9 percent.

Saude soils are similar to Flagler and Zenor soils and commonly are adjacent to Flagler, Lawler, Marshan, and Waukee soils. Flagler and Zenor soils have a lower content of clay in the A horizon and upper part of the B horizon than Saude soils. Lawler and Marshan soils are downslope from Saude soils. They have grayer B horizons and poorer internal drainage. Waukee soils are on ridges and flats adjacent to Saude soils. They have a higher content of clay in the A horizon and upper part of the B horizon and are usually deeper to underlying sand and gravel. Marshan soils are on stream terraces. They are at a slightly lower elevation than Saude soils.

Typical pedon from an area of Saude loam, 0 to 2 percent slopes, 2,575 feet east and 70 feet north of the southwest corner of sec. 1, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A—8 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.

AB—12 to 16 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine granular structure; friable; medium acid; gradual smooth boundary.

Bw—16 to 25 inches; dark brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; strongly acid; abrupt smooth boundary.

2BC—25 to 36 inches; strong brown (7.5YR 5/6) loamy sand; very weak coarse subangular blocky structure; very friable; strongly acid; gradual smooth boundary.

2C—36 to 60 inches; strong brown (7.5YR 5/6) sand; single grained; loose; about 5 percent gravel; medium acid.

The solum is typically 30 to 42 inches thick. Depth of loamy material over the gravelly sand and loamy sand ranges from 20 to 36 inches.

The A horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) and from 10 to 18 inches in thickness.

The B horizon ranges from loam to sandy loam in the upper part and from loamy sand or gravelly sand in the lower part.

The C horizon ranges from dark yellowish brown (10YR 4/4) or strong brown (7.5YR 5/6) to light brownish gray (10YR 6/2) and light gray (10YR 7/2). It is loamy sand ranging to gravelly sand.

Sawmill Series

The Sawmill series consists of poorly drained, moderately permeable soils on flood plains of small streams and on low terraces near larger streams. These soils formed in silty alluvium. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Sawmill soils are similar to Calco and Colo soils and commonly are adjacent to Colo, Ely, and Muscatine soils. Calco soils are calcareous and have free carbonates throughout. Colo soils typically are near larger streams or in small valleys adjacent to soils on steeper slopes. They have a thicker mollic epipedon than Sawmill soils. Ely soils are upslope. They have browner B horizons and better internal drainage than Sawmill soils. Muscatine soils are at a higher elevation than Sawmill soils. They have a mollic epipedon less than 24 inches thick, browner B horizons, and better internal drainage.

Typical pedon from an area of Sawmill silty clay loam, 0 to 2 percent slopes, 2,485 feet east and 930 feet south of the northwest corner of sec. 12, T. 89 N., R. 19 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A1—8 to 15 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A2—15 to 24 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

AB—24 to 32 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; black (5Y 2.5/1) coatings on faces of peds; weak fine granular structure; friable; neutral; gradual smooth boundary.

Bg—32 to 38 inches; dark gray (5Y 4/1) silty clay loam; very dark gray (5Y 3/1) coatings on faces of peds; weak fine and medium granular structure; friable; neutral; gradual smooth boundary.

BCg—38 to 48 inches; olive gray (5Y 5/2) silt loam; many fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; few fine concretions of iron oxides; neutral; gradual smooth boundary.
Cg1—48 to 55 inches; light olive gray (5Y 6/2) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; neutral; clear smooth boundary.
2Cg2—55 to 60 inches; light olive gray (5Y 6/2) sandy loam; many medium and coarse prominent strong brown (7.5YR 5/6) mottles; massive; friable; few pebbles; neutral.

The solum typically is 40 to 60 inches thick.

The A horizon is neutral or has hue of 10YR or 5Y, value of 2 or 3, and chroma of 1. It ranges from 24 to 36 inches in thickness. The A horizon is silty clay loam that averages 27 to 35 percent clay and 5 to 12 percent sand. It typically is very fine sand.

The gleyed B horizon has hue of 10YR, 5Y, and 2.5Y, value of 4 or more, and chroma of 2 or less. The B horizon to a depth of 40 inches averages 27 to 35 percent clay and 5 to 15 percent sand.

The Cg1 horizon has hue of 5Y or 2.5Y, value of 5 or more, and chroma of 2 or less. It is silt loam or silty clay loam. Below a depth of about 50 inches in some areas the C horizon has considerably more sand and is loam or sandy loam. Reaction is slightly acid or neutral throughout, and depth to carbonates is generally more than 60 inches.

Sparta Series

The Sparta series consists of excessively drained soils on uplands. These soils formed in 25 to 40 inches of loamy fine sand over fine sand and is underlain by a loamy substratum. Native vegetation was prairie grasses. Permeability is rapid in the solum and upper part of the substratum and moderate in the lower part. Slopes range from 2 to 14 percent.

Sparta soils are similar to and commonly are adjacent to Dickinson soils. Dickinson soils have higher content of clay and lower content of sand in the A and B horizons than Sparta soils.

Typical pedon from an area of Sparta loamy fine sand, loamy substratum, 2 to 9 percent slopes, 2,640 feet north and 1,125 feet east of the southwest corner of sec. 36, T. 86 N., R. 19 W.

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
A2—8 to 16 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; friable; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
Bw1—16 to 22 inches; brown (10YR 4/3) loamy fine sand; weak medium subangular blocky structure; friable; medium acid; gradual smooth boundary.
Bw2—22 to 38 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak coarse subangular blocky structure; friable; medium acid; gradual smooth boundary.
C1—38 to 54 inches; yellowish brown (10YR 5/4) fine sand; massive; slightly cemented; friable; medium acid; gradual smooth boundary.
2C—54 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; slightly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to medium textured material ranges from 40 to 60 inches.

The Ap and A1 horizons are very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A horizon ranges from 10 to 20 inches in thickness.

The Bw horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). Reaction is medium acid or strongly acid.

The 2C horizon is typically loam, sandy loam, or silt loam.

Sperry Series

The Sperry series consists of very poorly drained, slowly permeable soils on upland divides. These soils are in depressional areas. They formed in loess. Native vegetation was water-tolerant grasses. Slopes range from 0 to 1 percent.

Sperry soils commonly are adjacent to Garwin and Muscatine soils. Garwin and Muscatine soils are at higher elevations than the depressional Sperry soils. They do not have E horizons and have less clay in the Btg horizons.

Typical pedon from an area of Sperry silt loam, 0 to 1 percent slopes, 283 feet north and 1,080 feet west of the southeast corner of sec. 36, T. 87 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; medium acid; clear smooth boundary.
A—8 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak very fine granular structure; friable; medium acid; clear smooth boundary.
E1—12 to 16 inches; gray (5Y 5/1) silt loam; few fine and medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium platy structure parting to weak fine granular; friable; thin light gray (10YR 7/2) dry silt coats; medium acid; clear smooth boundary.
E2—16 to 20 inches; dark gray (5Y 4/1) silty clay loam; weak thick platy structure parting to moderate very

fine subangular blocky; friable; thin light gray (10YR 7/2) dry silt coats; medium acid; clear smooth boundary.

Btg1—20 to 30 inches; dark gray (5Y 4/1) silty clay; continuous very dark gray (5Y 3/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 4/6) mottles; firm; slightly acid; gradual smooth boundary.

Btg2—30 to 37 inches; gray (5Y 5/1) silty clay; nearly continuous very dark gray (5Y 3/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; slightly acid; clear smooth boundary.

Btg3—37 to 44 inches; gray (5Y 5/1) and light olive gray (5Y 6/2) silty clay loam; discontinuous dark gray (5Y 4/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak and moderate medium subangular blocky; firm; common thin very dark gray (10YR 3/1) clay flows in root channels; slightly acid; gradual smooth boundary.

BCg—44 to 56 inches; gray (5Y 5/1) silty clay loam; few fine prominent dark reddish brown (5YR 3/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; common thin dark gray (5Y 4/1) clay flows in root channels; slightly acid; gradual smooth boundary.

Cg—56 to 60 inches; olive gray (5Y 5/2) silt loam; common fine prominent strong brown (7.5YR 5/6) and few medium prominent yellowish red (5YR 5/6) mottles; massive; friable; dark gray (10YR 4/1) clay flows in root channels; neutral.

The solum typically ranges from 45 to 60 inches in thickness.

The Ap or A1 horizon or both horizons range from 10 to 15 inches in thickness. The Ap or A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The E horizon ranges from 6 to 8 inches in thickness. It is neutral or has hue of 10YR or 5Y, value of 4 to 6, and chroma of 0 to 2. It has distinct mottles.

The Btg horizon ranges from hue of 10YR through 5Y, value of 4 or 5, and chroma of 1. The upper part of the Bg horizon averages about 36 to 42 percent clay, but subhorizons less than 6 inches thick may be as much as 48 percent clay.

Spillville Series

The Spillville series consists of moderately well drained or somewhat poorly drained, moderately permeable soils on bottom lands along major streams and some intermittent streams. These soils formed in loamy alluvium. Native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Spillville soils are similar to Hanlon and Turlin soils and commonly are adjacent to Coland soils. Coland soils are in positions on the landscape similar to those of Spillville soils, but they have poorer internal drainage. Hanlon soils have less clay and more sand throughout. Turlin soils have a mollic epipedon that is 24 to 36 inches thick.

Typical pedon from an area of Spillville loam, 0 to 2 percent slopes, 280 feet south and 1,700 feet east of the northwest corner of sec. 22, T. 86 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A1—8 to 19 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A2—19 to 33 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A3—33 to 52 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak fine prismatic structure parting to weak very fine and fine subangular blocky; friable; neutral; gradual smooth boundary.

C—52 to 60 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate medium prismatic structure; friable; neutral.

The solum is typically about 52 inches thick but ranges from 36 to 56 inches in thickness.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2) in the lower part. The A horizon typically is about 48 inches thick but ranges from 36 to 56 inches in thickness. Mottles of high or low chroma may occur below the A horizon. Below a depth of 36 inches the soil is typically loam but ranges to sandy loam or clay loam.

Storden Series

The Storden series consists of well drained, moderately permeable, calcareous soils on uplands. These soils are on knobs, ridges, and side slopes. They formed in glacial till. Native vegetation was prairie grasses. Slopes range from 5 to 40 percent.

Storden soils commonly are adjacent to Clarion, Lester, Nicollet, and Terril soils. These soils have darker surface layers than Storden soils, and they are not calcareous and do not have free carbonates. Clarion and Lester soils are in positions on the landscape similar to those of Storden soils. Nicollet and Terril soils are downslope from Storden soils and have poorer internal drainage.

Typical pedon from an area of Storden loam, 5 to 9 percent slopes, moderately eroded, 150 feet east and 75 feet north of the center of sec. 32, T. 89 N., R. 22 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; mixed with streaks and pockets of yellowish brown (10YR 5/4) substratum material; weak very fine granular structure; friable; violent effervescence; moderately alkaline; clear smooth boundary.
C1—7 to 12 inches; yellowish brown (10YR 5/4) loam; mixings of dark grayish brown (10YR 4/2) krotovina throughout; weak medium subangular blocky structure; friable; few pebbles; violent effervescence; mildly alkaline; gradual smooth boundary.
C2—12 to 20 inches; yellowish brown (10YR 5/4) and light olive brown (2.5Y 5/4) loam; massive; friable; violent effervescence; mildly alkaline; gradual smooth boundary.
C3—20 to 30 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few very pale brown (10YR 7/3) lime streaks, few pebbles; violent effervescence; moderately alkaline; gradual smooth boundary.
C4—30 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine and medium distinct yellowish brown (10YR 5/6) and few fine distinct dark yellowish brown (10YR 4/8) mottles; massive; friable; few pebbles; few dark oxides; very pale brown (10YR 7/3) lime streaks; violent effervescence; moderately alkaline.

The thickness of the solum typically corresponds to the thickness of the A or Ap horizon, which is 6 to 10 inches. The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 6. Hue of 2.5Y usually is below a depth of 20 inches.

Tama Series

The Tama series consists of well drained, moderately permeable soils on uplands. These soils are on ridges and side slopes. They formed in loess deposits. Native vegetation was prairie grasses. Slopes range from 2 to 14 percent.

Tama soils are similar to Dinsdale, Killduff, and Wiota soils and commonly are adjacent to Dinsdale, Ely, Judson, and Muscatine soils. Dinsdale soils are in positions on the landscape similar to those of Tama soils. They formed partly in loess and partly in glacial till. Judson and Ely soils are downslope from Tama soils and have thicker mollic epipedons. Ely and Muscatine soils are downslope from Tama soils and have grayer B horizons and poorer internal drainage. Killduff soils have a lighter colored surface layer and more grayish mottles in the B horizon. Tama soils have a thinner mollic epipedon and somewhat less sand in the lower part of the B horizon and the C horizon.

Typical pedon from an area of Tama silty clay loam, 2 to 5 percent slopes, 395 feet north and 60 feet east of the southwest corner of sec. 13, T. 86 N., R. 19 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; neutral; clear smooth boundary.
AB—8 to 18 inches; very dark brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; mixings of a few very dark grayish brown (10YR 2/2) krotovina; weak very fine granular structure; friable; neutral; gradual smooth boundary.
Bt1—18 to 25 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) coatings on faces of peds; weak very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
Bt2—25 to 32 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
Bt3—32 to 40 inches; yellowish brown (10YR 5/6) silty clay loam; few fine faint brown (10YR 5/3) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; medium acid; clear smooth boundary.
BC—40 to 48 inches; yellowish brown (10YR 5/6) silt loam; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; medium acid; gradual smooth boundary.
C—48 to 60 inches; yellowish brown (10YR 5/6) silt loam; common fine distinct grayish brown (10YR 5/2) and faint strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; medium acid.

The solum typically is 48 inches thick but ranges from 48 to 60 inches in thickness. It is less than 10 percent sand to a depth of 40 inches. Reaction is medium acid in the most acid part.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is silt loam or silty clay loam.

The B horizon averages 27 and 32 percent clay in the finest part. A few fine mottles of high and low chroma are in the lower part of the B horizon in places.

Terril Series

The Terril series consists of moderately well drained, moderately permeable soils on uplands. These soils are in waterways and narrow valleys and on foot slopes adjacent to steep areas. They formed in loamy local alluvium. Native vegetation was prairie grasses. Slopes range from 2 to 5 percent.

Terril soils are similar to Turlin soils and commonly are adjacent to Clarion, Coland, and Storden soils. Turlin soils have grayer B horizons and poorer internal drainage than Terril soils. Clarion soils are at a higher elevation than Terril soils and have a mollic epipedon less than 20 inches in thickness. Coland soils are at a lower elevation and have poorer internal drainage. Storden soils are at a higher elevation than Terril soils. They are light colored and are calcareous.

Typical pedon from an area of Terril loam, 2 to 5 percent slopes, 1,495 feet east and 300 feet south of the northwest corner of sec. 12, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A1—8 to 18 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; neutral; gradual smooth boundary.

A2—18 to 25 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; moderate very fine granular structure; friable; mixings of a few small dark brown (10YR 3/3) krotovina; neutral; gradual smooth boundary.

A3—25 to 32 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; black (10YR 2/1) fills in root channels; neutral; gradual smooth boundary.

Bw—32 to 41 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

BC—41 to 47 inches; yellowish brown (10YR 5/6) sandy loam; few fine brown (10YR 5/3) mottles; weak coarse subangular blocky structure; very friable; few pebbles; neutral; clear smooth boundary.

C—47 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; mildly alkaline.

The solum ranges from 42 to 60 inches in thickness.

The A horizon is black (10YR 2/1) or very dark brown in the upper part and very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3) in the lower part. It ranges from 24 to 36 inches in thickness. The A horizon is loam or silt loam that is 15 to 30 percent sand. It is neutral or slightly acid.

In some pedons the upper part of the B horizon has value of 3 and chroma of 2 or 3, but within a depth of 40 inches or less it has chroma of 3 or 4 and value commonly of 4. The B horizon is loam or clay loam. Horizons that are 6 inches thick or less may be sandy loam. The B horizon is neutral or slightly acid.

The C horizon, which developed in calcareous glacial till, is as shallow as 42 inches on the steeper slopes. In areas where the Terril soils are upslope from stream terraces, sandy loam material is at a depth of 42 inches or more.

Tilfer Series

The Tilfer series consists of moderately deep, poorly drained, moderately permeable soils on stream benches. These soils formed in 20 to 40 inches of loamy deposits overlying fractured limestone bedrock. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Tilfer soils commonly are adjacent to Kensett and Rockton soils. Both soils are upslope from Tilfer soils, and they have browner B horizons and better internal drainage.

Typical pedon from an area of Tilfer loam, 0 to 2 percent slopes, 190 feet north and 460 feet east of the southwest corner of southeast 1/4 sec. 13, T. 89 N., R. 21 W.

Apk—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; common fine snail shell fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Ak1—8 to 17 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; few fine prominent dark reddish brown (2.5YR 3/4) mottles; weak very fine subangular blocky structure; friable; 15 to 20 percent sand; common fine snail shell fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

Bk2—17 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on faces of peds; common fine prominent yellowish red (5YR 4/6) mottles; moderate fine subangular blocky and angular blocky structure; firm; 15 to 20 percent sand; violent effervescence; moderately alkaline; gradual smooth boundary.

BCg—23 to 26 inches; olive gray (5Y 5/2) silty clay loam; few fine dark reddish brown (5YR 3/3) mottles; weak medium prismatic structure; friable; 15 to 20 percent sand; strong effervescence; moderately alkaline.

2R—26 inches; fractured limestone.

The solum is typically 26 to 34 inches thick but ranges from 20 to 40 inches in thickness.

The A horizon ranges from loam to clay loam and silty clay loam that is 15 to 20 percent sand. It is moderately alkaline or mildly alkaline.

The B horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is loam, clay loam, or silty clay loam that is 15 to 20 percent sand. Clay content ranges from 20 to 30 percent.

Turlin Series

The Turlin series consists of somewhat poorly drained, moderately permeable soils on bottom lands and low terraces along streams. These soils formed in loamy alluvium. Native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Turlin soils are similar to Spillville and Terril soils and commonly are adjacent to Coland, Lawler, and Terril soils. Coland soils are at a lower elevation than Turlin soils and have poorer internal drainage. Lawler soils are at a higher elevation. They have a mollic epipedon less than 24 inches thick and are underlain with coarse sediment at shallower depths than Turlin soils. Spillville soils have a thicker mollic epipedon. Terril soils are upslope from Turlin soils. They have browner B horizons and better internal drainage.

Typical pedon from an area of Turlin loam, 0 to 2 percent slopes, 1,700 feet north and 1,400 feet east of the center of sec. 13, T. 89 N., R. 22 W.

A1—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.

A2—10 to 22 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to weak very fine and fine granular; friable; medium acid; gradual smooth boundary.

A3—22 to 29 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; weak fine prismatic structure parting to medium very fine subangular blocky; friable; medium acid; gradual smooth boundary.

BA—29 to 35 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; firm; mixings of many very dark gray (10YR 3/1) krotovina; medium acid; gradual smooth boundary.

Bw—35 to 41 inches; light olive brown (2.5Y 5/4) clay loam; many fine and medium faint grayish brown (2.5Y 5/2) mottles; moderate fine prismatic structure parting to weak medium subangular blocky; firm; strongly acid; abrupt smooth boundary.

C1—41 to 47 inches; yellowish brown (10YR 5/6) coarse sandy loam; common medium prominent light olive gray (5Y 6/2) mottles; massive; friable; 20 percent fine gravel; slightly acid; abrupt smooth boundary.

C2—47 to 60 inches; olive gray (5Y 5/2) silty clay loam; massive; firm; few very dark gray (10YR 3/1) fills in root channels; few dark concretions of iron and manganese oxides; medium acid; abrupt smooth boundary.

The solum is typically 40 to 60 inches thick.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and grades to very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) as depth increases. It is 24 to 36 inches thick.

The B horizon ranges from sandy loam to clay loam above a depth of 40 inches. Textures coarser than coarse sandy loam are at a depth of 48 inches or more. The B horizon is typically medium acid but may have subhorizons that are strongly acid.

Wacousta Series

The Wacousta series consists of very poorly drained, moderately permeable soils on uplands. These soils are in depressional areas. They formed in local alluvium washed from adjacent uplands. Native vegetation was water-tolerant grasses. Slopes range from 0 to 1 percent.

Wacousta soils commonly are adjacent to Canisteo, Harps, and Okoboji soils. Canisteo and Harps soils are on rims above the depressional Wacousta soils. They are calcareous and have free carbonates in the A horizon. Okoboji soils are in positions on the landscape similar to those of Wacousta soils. They have a thicker mollic epipedon.

Typical pedon from an area of Wacousta silt loam, 0 to 1 percent slopes, 125 feet north and 510 feet west of the southeast corner of sec. 5, T. 88 N., R. 20 W.

Ap—0 to 8 inches; black (N 2/0) silt loam, dark gray (N 4/0) dry; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; weak very fine subangular blocky structure; firm; neutral; clear smooth boundary.

Bg—13 to 20 inches; dark gray (5Y 4/1) and olive gray (5Y 4/2) silty clay loam; weak fine prismatic structure; friable; mixings of very dark gray (5Y 3/1) krotovina; mildly alkaline; gradual smooth boundary.

Cg1—20 to 30 inches; olive gray (5Y 5/2) silty clay loam; weak medium prismatic structure; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg2—30 to 44 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg3—44 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine and medium light olive brown (2.5Y 5/4) mottles; massive; friable; 15 to 20 percent sand; mixings of very dark gray (5Y 3/1) krotovina; mildly alkaline; strong effervescence.

The solum typically is 14 to 24 inches thick.

The A horizon is black (N 2/0 to 10YR 2/1) and ranges from about 10 to 16 inches in thickness. It ranges from silty clay loam to mucky silt loam.

The Bg horizon ranges from dark gray (5Y 4/1) to olive gray (5Y 5/2). It is mainly silty clay loam. The 0- to 30-inch zone averages 24 and 36 percent clay. The zone

of maximum clay is typically in the lower part of the A1 or Bg horizon.

The Cg horizon is silt loam or silty clay loam above a depth of 40 inches and ranges from 18 to 30 percent clay. Strata of very fine sandy loam are throughout the C horizon in places.

Waubeek Series

The Waubeek series consists of well drained and moderately well drained, moderately permeable soils on uplands. These soils are on ridge crests and side slopes. They formed in 20 to 40 inches of loess and the underlying glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 2 to 14 percent.

Waubeek soils are similar to Dinsdale and Downs soils and commonly are adjacent to Atterberry, Dinsdale, Downs, and Fayette soils. Atterberry soils are less sloping than Waubeek soils. They have grayer E and B horizons and poorer internal drainage. Dinsdale soils do not have an E horizon and have thicker combined Ap and A horizons. Downs and Fayette soils are in positions on the landscape similar to those of Waubeek soils. Downs soils formed in loess deposits more than 40 inches thick. Fayette soils have a lighter colored surface layer than Waubeek soils and are underlain by glacial till at a greater depth.

Typical pedon from an area of Waubeek silt loam, 2 to 5 percent slopes, 1,870 feet north and 440 feet east of the center of sec. 22, T. 88 N., R. 19 W.

Ap—0 to 8 inches; very dark grayish brown (10Y 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; medium acid; abrupt smooth boundary.

EB—8 to 13 inches; brown (10YR 4/3) silt loam; dark brown (10YR 3/3) coatings on faces of peds; weak thick platy structure parting to moderate fine subangular blocky; friable; medium acid; clear smooth boundary.

Bt1—13 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; discontinuous very dark grayish brown (10YR 3/2) clay films on faces of peds and in root channels; medium acid; gradual smooth boundary.

Bt2—22 to 31 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) coatings on faces of peds; weak fine prismatic structure parting to moderate fine subangular blocky; friable; discontinuous very dark grayish brown (10YR 3/2) clay films on faces of peds and in root channels; medium acid; clear smooth boundary.

2Bt3—31 to 44 inches; yellowish brown (10YR 5/6) sandy clay loam; weak medium prismatic structure parting to weak medium and coarse subangular blocky structure; firm; pebble band at top of horizon; few pebbles throughout; light gray (10YR 7/2) fine sand and silt coatings on prisms and faces of peds, dry; medium acid; clear smooth boundary.

2Bt4—44 to 52 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) loam; weak medium prismatic structure; firm; few very dark grayish brown (10YR 3/2) clay films in root channels and on faces of prisms; few pebbles throughout; medium acid; clear smooth boundary.

2BC—52 to 60 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) loam; weak coarse prismatic structure; firm; thick dark brown (7.5YR 4/2) and dark reddish brown (5YR 2/2) clay fillings in root channels and in small pockets; few pebbles throughout; medium acid.

The solum typically is 48 to 60 inches or more. The loess typically is 26 to 34 inches thick but ranges from 20 to 40 inches in thickness.

The A1 or Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and from 6 to 9 inches in thickness. The content of sand in the A and B horizon that formed in the loess ranges from 3 to 10 percent, but it is higher near the till contact.

The 2B horizon typically is loam or sandy clay loam but in places it is clay loam. Discontinuous lenses of sandy loam and sand ranging from 1 to 8 inches thick are between the loess and the till in other places.

Waukee Series

The Waukee series consists of well drained soils on stream terraces or, less commonly, on uplands. These soils formed in 30 to 40 inches of loamy material over sand and gravel. Permeability is moderate in the upper part of the solum and very rapid in the lower part of the solum and substratum. Slopes range from 0 to 5 percent.

Waukee soils are similar to Lawler and Saude soils and commonly are adjacent to Lawler, Marshan, and Saude soils. Lawler and Marshan soils are downslope from Waukee soils. They have grayer B horizons and poorer internal drainage. Saude soils are lower in clay content and higher in sand content than Waukee soils.

Typical pedon from an area of Waukee loam, 0 to 2 percent slopes, 95 feet south and 3,325 feet east of the northwest corner of sec. 23, T. 89 N., R. 21 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A—8 to 18 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on faces of peds; moderate very fine granular structure; friable; neutral; gradual smooth boundary.

AB—18 to 23 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; moderate fine granular structure; friable; slightly acid; gradual smooth boundary.

Bw1—23 to 31 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw2—31 to 37 inches; yellowish brown (10YR 5/4) loam; brown (10YR 4/3) coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

2BC—37 to 45 inches; brown to dark brown (7.5YR 4/4) gravelly loamy sand; very weak medium and coarse subangular blocky structure; very friable; neutral; gradual smooth boundary.

2C1—45 to 54 inches; dark yellowish brown (10YR 4/4) gravelly sand; single grained; loose; neutral; gradual smooth boundary.

2C2—54 to 60 inches; yellowish brown (10YR 5/6) sand that has a few gravel; single grained; loose; neutral.

The solum is typically 36 to 48 inches thick.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon ranges from loam to silt loam that is 15 to 30 percent sand.

The BA horizon, where present, is loam or silt loam that is 15 to 30 percent sand. The Bw horizon is loam or sandy clay loam that ranges from 18 to 27 percent clay.

The 2B and 2C1 horizons have hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 through 8. The 2C horizon typically is loamy coarse sand, sand, and gravelly sand, or it is gravelly sand.

Webster Series

The Webster series consists of poorly drained, moderately permeable soils on uplands. These soils are on flats, in irregularly shaped swales, and along the upper parts of some drainageways. They formed in loamy and silty glacial till. Native vegetation was water-tolerant grasses. Slopes range from 0 to 2 percent.

Webster soils are similar to Canisteo soils and commonly are adjacent to Canisteo, Clarion, and Nicollet soils. Canisteo soils are calcareous and have free carbonates throughout. Clarion and Nicollet soils are upslope on low convex ridges. They have browner B horizons and better internal drainage than Webster soils.

Typical pedon from an area of Webster silty clay loam, 0 to 2 percent slopes, 1,890 feet south and 200 feet west of the northeast corner of sec. 8,, T. 89 N., R. 22 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; firm; 15 to 20 percent sand; neutral; clear smooth boundary.

A—8 to 15 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; 15 to 20 percent sand; neutral; gradual smooth boundary.

AB—15 to 22 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; few fine distinct yellowish red (5YR 4/6) mottles; medium fine granular structure; friable; 15 to 20 percent sand; neutral; gradual smooth boundary.

Bg1—22 to 27 inches; olive gray (5Y 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on faces of peds; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bg2—27 to 33 inches; olive gray (5Y 5/2) clay loam; discontinuous olive gray (5Y 4/2) coatings on faces of peds; weak very fine subangular blocky structure; friable; few dark gray (10YR 4/1) fills in root channels; neutral; clear smooth boundary.

BCg—33 to 38 inches; olive (5Y 5/3) loam; few fine prominent reddish yellow (7.5YR 7/8) mottles; weak fine prismatic structure; friable; mixing of dark gray (10YR 4/1) krotovina; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg1—38 to 49 inches; olive gray (5Y 5/2) sandy loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; very friable; few dark concretions of iron and manganese oxides; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg2—49 to 60 inches; light olive gray (5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; white lime streaks; violent effervescence; mildly alkaline.

The solum is typically 30 to 45 inches thick.

The A horizon is neutral or has hue of 10YR, value of 2 or 3, and chroma of 0 or 1. It is silty clay loam that is 15 to 20 percent sand or clay loam and ranges from 16 to 23 inches in thickness.

The Bg1 horizon has hue of 5Y and 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam or silty clay loam high in sand content. The Bg2 and BCg horizons have hue of 5Y or 2.5Y, value of 5, and chroma of 2 or 3. They are loam or clay loam.

The C horizon has hue of 5Y, value of 5 or 6, and chroma of 2. It is poorly mixed, loamy glacial till.

Wiota Series

The Wiota series consists of well drained and moderately well drained, moderately permeable soils on stream terraces and alluvial fans. These soils formed in silty alluvium. Native vegetation was prairie grasses. Slopes range from 0 to 5 percent.

Wiota soils are similar to Tama soils and commonly are adjacent to Kennebec, Colo, and Waukee soils. Kennebec soils are at a lower elevation than Wiota soils and have a thicker surface layer. Colo soils are downslope from Wiota soils and have a grayer B horizon and poorer internal drainage. Tama soils have a thinner mollic epipedon and less sand in the lower part of the B horizon and C horizon. Waukee soils are at a higher elevation than Wiota soils and have more sand throughout the solum.

Typical pedon from an area of Wiota silt loam, 0 to 2 percent slopes, 1,475 feet west and 325 feet north of the center of sec. 27, T. 86 N., R. 19 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; neutral; clear smooth boundary.

A—8 to 15 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; medium acid; gradual smooth boundary.

AB—15 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; moderate very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

Bt1—22 to 34 inches; brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; few thin very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—34 to 40 inches; yellowish brown (10YR 5/4) silty clay loam; weak and moderate fine subangular structure; friable; common dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; clear smooth boundary.

BC—40 to 48 inches; yellowish brown (10YR 5/4) silt loam; weak fine prismatic structure parting to weak fine and medium subangular blocky; friable; few dark grayish brown (10YR 4/2) clay films on faces of peds and in root channels; medium acid; gradual smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; slightly acid.

The solum is typically about 48 inches thick but ranges from 36 to 60 inches in thickness. The solum ranges from 5 to 15 percent fine and coarser sand, mainly in the lower part of the B and C horizons.

The A and AB horizons are typically about 24 inches thick but range from 18 to 28 inches in thickness. The upper part of the A horizon is black (10YR 2/1) or very dark gray (10YR 3/1).

The BA horizon is present in some pedons. The Bt horizons typically have hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Content of clay is about 28 to 32 percent.

The BC and C horizons have matrix colors similar to those of the B2 horizon but may have mottles of both high and low chroma.

Zenor Series

The Zenor series consists of somewhat excessively drained soils on uplands and stream terraces. These soils formed in loamy and sandy glacial outwash. Native vegetation was prairie grasses. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 1 to 9 percent.

Zenor soils are similar to Flagler and Saude soils and commonly are adjacent to Saude, Lawler, Salida, Storden, and Clarion soils. Flagler, Saude, and Lawler soils are more acid than Zenor soils and are leached to greater depths. Salida soils have a thinner solum and are shallower to carbonates. Saude and Lawler soils are medium textured in the surface layers and upper part of the subsoils. Clarion and Storden soils are medium textured throughout.

Typical pedon from an area of Zenor sandy loam, 1 to 5 percent slopes, 230 feet north and 900 feet west of the center of sec. 2, T. 87 N., R. 20 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; friable; few gravel; neutral; clear smooth boundary.

AB—9 to 13 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak medium subangular blocky structure parting to weak fine granular; friable; few gravel; neutral; clear wavy boundary.

Bw—13 to 28 inches; brown (10YR 4/3) sandy loam; dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; very friable; few gravel; neutral; clear wavy boundary.

BC—28 to 34 inches; dark yellowish brown (10YR 4/4) coarse loamy sand; weak coarse subangular blocky structure; very friable; few gravel; neutral; abrupt irregular boundary.

C—34 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose; 20 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 24 to 36 inches in thickness.

The A or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A and AB horizons, where present, range from 8 to 16 inches in thickness. Volume of gravel ranges from 1 to 5 percent.

The Bw horizon has hue of 10YR, value of 3 or 4, and chroma of 3 or 4. The BC horizon has hue of 10YR,

value of 4 or 5, and chroma of 4 to 6. Volume of gravel ranges from 4 to 10 percent.

The C horizon typically has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is gravelly sand, gravelly loamy sand, or sand. Volume of gravel ranges from 4 to 20 percent.

Formation of the Soils

This section discusses the factors of soil formation and relates these factors to the soils in Hardin County.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. A long time generally is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

The accumulation of parent material is the first step in the development of a soil. A few soils in Hardin County formed in sandstone weathered in place. Most of the soils, however, formed in material that was transported from other locations and redeposited through the action of glacial ice, water, wind, and gravity.

The principal kinds of parent material in Hardin County are glacial drift, loess, and alluvium. Less extensive are eolian (wind deposited) sand, organic deposits, and sandstone. A few soils formed in thin deposits of loamy sediment overlying limestone bedrock.

Loess, a silty material deposited by wind, covers about 20 percent of the county. It ranges from about 2 feet to 20 feet in thickness and overlies glacial till. Loess consists of about 70 percent silt and about 20 to 25 percent clay. It has no coarse sand or gravel because these materials were too large to be moved by the wind, but it does have small amounts of very fine sand, generally less than 5 percent.

In Hardin County, Dinsdale, Klinger, Maxfield, and Waubeek soils formed in 2 or 3 feet of loess underlain by glacial till. Atterberry, Downs, Fayette, Garwin, Harpster, Killduff, Muscatine, and Tama soils formed in loess ranging from 3 1/2 feet to about 20 feet in thickness. Downs Variant soil formed in 20 to 40 inches of loess and the underlying sandstone bedrock.

Glacial drift is all rock material that has been transported and deposited by glacial ice and includes material sorted by melt water. It also includes glacial till. Glacial till is unsorted sediment in which the particles range from boulders to clay (*6*). Glacial till is the most extensive parent material in Hardin County.

At least two continental glaciers moved over the entire area of Hardin County, and a third glacier covered 80 percent of the county. The oldest ice sheet, known as the Nebraskan, occurred about 750,000 years ago. The Kansan Glaciation probably occurred about 500,000 years ago. The Cary substage of the Wisconsin Glaciation covered much of the county about 13,000 to 14,000 years ago.

The Canisteo, Clarion, Harps, Hayden, Lester, Le Sueur, Nicollet, Okoboji, Salida, Storden, Wacousta, Webster, and Zenor soils formed in the Cary Drift. Canisteo, Harps, and Webster soils are in lower positions on the landscape. They formed in glacial till and in glacial sediment or reworked glacial till. Clarion, Hayden, Lester, and Storden soils are on higher ridges and knobs. Nicollet and Le Sueur soils are on low ridges and lower slopes. Okoboji and Wacousta soils formed in basins of alluvial sediment derived from till that in many places washed from nearby slopes. Salida and Zenor soils formed in coarser sediment of the Cary Drift.

Kenyon soil is an Iowan surface soil that developed mostly in till. It is in small areas throughout the eastern part of the county. The Iowan surface is multilevel and is arranged in a series of steps from the major drainageways toward the boundary divides. It is marked by a stone line. The stone line is on all levels of the

stepped surface, and it passes under the alluvium along the drainageways. Most of the Iowan surface in Hardin County is covered by loess. These areas are in the Dinsdale-Muscatine-Garwin, Downs-Fayette-Montieth, and Tama-Colo associations on the general soil map.

Studies by M. M. Leighton and others indicated that an earlier substage of the Wisconsin glacier, the Iowan surface, covered parts of Hardin County (*4*). Later studies, however, led to the conclusion that the Iowan surface is the result of an erosion cycle rather than of deposition by glacial drift (*7*). The underlying eroded Kansan and Nebraskan glacial till is covered by loess or by a loamy surficial mantle.

Alluvium is material that was deposited by water on the flood plains of streams or in a few glacial outwash areas. Soils derived from alluvium are generally stratified. Much of the alluvium in Hardin County washed from adjoining loamy glacial soils is loam, clay loam, sandy loam, or silty clay loam that is high in content of sand. Coland, Du Page, Hanlon, Spillville, and Turlin soils are loamy soils of the bottom lands. Other areas of the bottom lands received sediment from loess-covered uplands that are low in sand. Colo, Ely, Judson, Kennebec, Calco, and Sawmill soils formed in silty alluvium that washed from these areas. A few areas of Calco soils, however, formed in alluvium in glacial areas. All of these soils except Ely and Judson soils are on first bottoms or very low terraces and are subject to flooding.

Differences in texture are accompanied by differences in the chemical and mineralogical composition of the alluvium. Most of these alluvial derived soils are free of carbonates and are neutral to slightly acid. Calco and Du Page soils, however, are alkaline.

The soils on terraces or second bottoms also consist of alluvium and vary in texture. Most of these soils except Wiota soils are underlain by coarser textured material within a depth of 2 or 3 feet. These soils are at a higher elevation than the present flood plain and generally do not flood. Flagler, Harcot, Lawler, Marshan, Saude, and Waukee soils and those areas of Salida and Zenor soils on terraces or terrace escarpments are examples of alluvial soils. Most areas of Wiota soils developed in more than 5 feet of silty alluvium overlying coarser alluvial sediment. All of these soils except Harcot soils are free of carbonates and range from neutral to medium acid. Harcot soils are alkaline.

Eolian sand is not extensive in Hardin County. Most areas occur as low mounds or dunes on uplands and are underlain by more loamy sediment at a depth of 3-1/2 to 6 feet. Wind-deposited sand consists largely of very fine and fine quartz that is highly resistant to weathering. This sand has not been altered appreciably since it was deposited. The upper 3 feet of this wind-deposited material ranges from sandy loam to sand, depending on the amount of silt and clay mixed in the eolian deposits. The Dickinson and Sparta soils formed mainly in wind-deposited material that has a high content of sand.

Organic material deposits are the parent material of organic soils, such as peat or muck. Muck is a more complete stage of decomposition of the original organic plant remains than peat. In Hardin County muck soils occur in wet areas where poor drainage has delayed the decay of plant remains that have accumulated over a period of time. Most of these organic soils are in the western three-fourths of the county where plant material accumulated in old ponds and lakebeds. A few organic soils occur in hillside seep areas and drainageways. In Hardin County the thickness of the organic material ranges from as little as 8 inches in Okoboji mucky silt loam to more than 48 inches in some of the deeper deposits of Palms muck.

Limestone and sandstone are the oldest parent materials in the county. They are a series of beds deposited during the Mississippian and Pennsylvanian periods. Kensett, Rockton, and Tilfer soils formed in loamy sediment overlying limestone bedrock along the Iowa River. Montieth soils formed in residuum weathered from sandstone. The Downs Variant soils formed in 20 to 40 inches of loess and the underlying weathered sandstone.

Climate

The soils of Hardin County formed under the influence of a midcontental, subhumid climate over a period of at least 5,000 years. Between 5,000 and 16,000 years ago the climate was conducive to the growth of forest vegetation (*5, 13*). The morphology of most of the soils in the county indicates that the climate under which the soils formed was similar to that of the present. The present climate is fairly uniform throughout the county but is marked by wide seasonal extremes in temperature. Precipitation is evenly distributed throughout the year.

Climate is a major factor in determining which soils develop from the various plant materials. The rate and intensity of hydrolysis, carbonation, and other important chemical reactions in the soil are influenced by climate. Temperature, rainfall, relative humidity, and length of the frost-free period all are important factors in determining the kind of vegetation.

The influence of the general climate of the region is somewhat modified by local conditions in or near the forming soil. For example, south-facing, dry, sandy slopes have a local climate or microclimate that is warmer and less humid than the average climate of nearby areas. Low lying, poorly drained areas are wetter and colder than most of the areas around them. These contrasts account for some of the differences in soils within the same general climatic region.

Relief

Relief is an important cause of differences among soils. Indirectly, relief influences soil development

through its effect on drainage. In Hardin County the relief ranges from level to steep.

Many level or nearly level areas are frequently flooded and have a high or periodically high water table. Much of the rainfall runs off the more strongly sloping areas. Marshan, Maxfield, and Webster soils formed in areas where the water table was normally or periodically high. These soils generally have a dominantly olive gray subsoil. Soils that formed in areas where the water table was below the subsoil have a yellowish brown or brown subsoil. Clarion, Dinsdale, Lester, Saude, and Terril soils are examples. Ely, Klinger, Lawler, Le Sueur, Muscatine, and Nicollet soils, which formed in areas where the natural drainage was intermediate, have a grayish brown or mottled grayish brown subsoil. Among the soils that formed under prairie grasses, those that have a high water table generally have more content of organic matter in the surface layer than those that have good natural drainage.

Aspect, as well as gradient, significantly influences soil formation. Because they generally are warmer and drier, south-facing slopes support a different kind and amount of vegetation than north-facing slopes. The influence of porous, rapidly permeable parent material may override the influence of topography, however. For example, although the Dickinson soils are gently sloping, they are somewhat excessively drained because the permeability of these soils is moderately rapid to rapid. In addition, some level Rockton soils are well drained because porous, fractured limestone bedrock is relatively close to the surface.

The Dinsdale, Klinger, and Maxfield soils formed in the same kind of parent material and under similar vegetation, but they differ because of differences in topographic position. Dinsdale soils are on convex ridge crests and side slopes. Maxfield soils are on broad, level flats and in waterways on uplands. Klinger soils are on nearly level ridges and long, gentle side slopes. Topography influences the drainage of these soils.

The Ely, Judson, and Terril soils are on foot slopes and in narrow waterways on uplands. They have properties related to the soils upslope because they receive sediment from those soils.

Many areas of the Storden soil are strongly sloping to steep and have very little soil development. Much of the rainfall runs off the surface of this soil.

Plant and Animal Life

Plant and animal life are important factors in soil formation. Plant life is especially significant. Soil formation actually begins with the coming of vegetation. As plants grow and die, they add organic matter to the upper layers of the soil material. The native grasses have myriads of fibrous roots that penetrate the soil to a depth of 10 to 20 inches and add large amounts of organic matter to the surface layer. Trees commonly feed on plant nutrients deep in the subsoil; consequently, they add little organic matter to the surface layer other than that gained from falling leaves and dead trees. Much of the organic matter from dead leaves and trees remains on the surface where it decomposes.

All living organisms are important to soil formation. These include vegetation, animals, bacteria, and fungi. Vegetation chiefly determines the color of the surface layer and the amount of organic matter and nutrients in the soil. Earthworms and burrowing animals help to keep the soil open and porous. Bacteria and fungi, which decompose the vegetation, release nutrients for plant food.

Most of the soils of Hardin County formed under prairie grasses or a mixture of prairie grasses and water-tolerant plants. Webster, Clarion, Marshan, and Tama soils are typical of those soils that formed under prairie grasses. Webster and Marshan soils are soils that formed under prairie grasses and water-tolerant plants. Lester and Waubeek soils have properties intermediate between those of the soils that formed entirely under prairie and soils that formed entirely under forest. In Hardin County the Fayette, Hayden, and Montieth soils formed entirely under forest. These soils have a thin, dark surface layer that is generally less than 5 inches thick and a lighter colored E horizon below. If these layers are mixed by plowing, the subsequent surface layer is lighter in color than that of the prairie soils. Downs, Lester, Waubeek, and similar soils have properties of a true forest soil, but the surface layer of these soils is somewhat deeper. In contrast to forest soils, soils that formed under prairie vegetation contain a large amount of organic matter derived from roots. Prairie soils have a thick, dark surface layer.

Time

Time is necessary for the various processes of soil formation to take place. The amount of time needed ranges from a few days for the formation of soils in fresh alluvial deposits along the streams to thousands of years for the major soils in Hardin County. If other factors are favorable, the subsoil generally becomes finer and a greater amount of soluble material is leached out as the soils continue to weather. Exceptions are soils that formed in quartz sand, such as Sparta soils, or soils that formed in other material that is resistant to weathering. Such soils do not change much over a long period. Other exceptions are steep soils that have a small amount of water infiltration and a large amount of runoff. Such soils weather more slowly than stable, less sloping soils.

Where organic material, such as trees, has been buried by material deposited by ice, water, or wind, the age of a landscape can be determined by radiocarbon dating (*8*). The loess that covers the eastern part of Hardin County in which Tama, Fayette, and other soils

formed is probably 14,000 to 20,000 years old. The lowan surface beneath the loess could, therefore, be as young as 14,000 years. Where it is covered by loamy sediment, the lowan surface is younger than 14,000 years. The Kenyon soil formed in this loamy sediment. Dates for the base of the Cary glacial drift in the southern part of its extension into Iowa indicate that this drift was deposited about 14,000 years ago (*8*). All of the soils that formed from this drift, therefore, are 14,000 years old or younger. Clarion, Webster, and Nicollet soils are examples.

Time is needed for soil formation, but the age of the parent material does not necessarily reflect the true age of the soil that formed in it.

Man's Influence on the Soil

Important changes take place in the soil when it is drained and cultivated. Some of these changes have little effect on soil productivity. Other changes have drastic effects. Changes caused by erosion generally are most apparent. On some of the cultivated soils in Hardin County, particularly those soils that have steeper slopes, much of the original surface layer has been lost through sheet erosion.

Man has done much to increase the productivity of the soil and to reclaim areas not suitable for crops. The installation of subsurface drainage in many parts of Hardin County has lowered the water table sufficiently so that these areas can be used for crops. Through the use of commercial fertilizers, man has been able to counteract deficiencies in plant nutrients, making many soils more productive. Although many of the soils in Hardin County have not been seriously affected by soil erosion, some of the soils have been seriously damaged.

Man can improve the soil for crop production by good management, or he can reduce soil fertility and production through improper land use. For general information about the soils, refer to the section "General Soil Map Units." This section describes broad patterns of the soils in Hardin County.

Processes of Soil Horizon Differentiation

Horizon differentiation is the result of addition, removal, transfer, and transformation in the soil system. These four kinds of change affect many substances that make up the soils, such as the organic matter, soluble salts, carbonates, sesquioxides, or silicate clay minerals. Generally these four processes promote horizon differentiation, but they can also offset or retard it. Because various processes proceed simultaneously in the soils, the ultimate nature of the profile is governed by the balance of the changes.

The accumulation of organic matter is an important factor in soil horizon differentiation. The addition of organic matter generally is an early step in the process of horizon differentiation. The amount of organic matter that has accumulated in the A1 horizon of soils in Hardin County ranges from very high to very low. In the Hayden and Storden soils, for example, A1 horizons are thin and organic matter content is low. In the Okoboji and Coland soils the A1 horizons are thick and organic matter content is very high and high. In some soils organic matter content is now low because of erosion.

The removal of substances from parts of the soil profile also is an important factor in the differentiation of soil horizons in Hardin County. The downward movement of calcium carbonates and bases in the soils is an example. Many soils in the county have been leached of calcium carbonates in the upper part of the profile, and a few soils have been so strongly leached that they are medium acid or strongly acid in some horizons. Some soils, however, are calcareous throughout. Canisteo, Harps, and Storden soils are examples.

Several kinds of transfers of substances from one horizon to another are evident in the soils of Hardin County. For example, phosphorus is removed from the subsoil by plant roots and is transferred to other parts of the plant. It is later added to the surface layer through the plant residue.

The translocation of clay is important in the differentiation of soil horizons. In Hardin County clay is made up mainly of silicate clay minerals. It is carried downward, suspended in percolating water, from the A horizon to the B horizon. In the B horizon it accumulates in pores and root channels and in clay films on the faces of peds. This translocation has influenced the profile development of many of the soils. Hayden soil is an example. In some soils, however, where the content of clay in the A horizon is not much different from that in the B horizon, only a minimal movement of clay is indicated.

A transformation can be physical or chemical or both physical and chemical. An example of physical transformation is the weathering of soil particles to smaller size. Another kind of transformation is the reduction of iron by a process called gleying. In this process the soil is saturated for long periods in the presence of organic matter. A gleyed soil is characterized by its gray color and the presence of ferrous iron. Reductive and extractable iron is commonly less abundant in poorly drained soils, for example, Webster soils, than in better drained soils, for example, Nicollet and Clarion soils.

Still another kind of transformation is the weathering of the primary apatite mineral in parten material to secondary phosphorous compounds. The pH value of the soil has to decline to about 7 before appreciable amounts of weathering can take place. For example, the Storden soil is calcareous, and its subsoil is very low in available phosphorus. The Hayden soil is leached and its subsoil is medium acid. The amount of available phosphorus is higher in the Hayden soil than in the Storden soil.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Iowa Crop and Livestock Reporting Service. 1981. Iowa agricultural statistics, 1981. Iowa Dep. Agric. and U.S. Dep. Agric.

(4) Leighton, M. M. 1933. The naming of the subdivisions of the Wisconsin glacial age. Sci. (New Ser.) 77:168.

(5) Ruhe, Robert V. 1956. Geomorphic surfaces and the nature of soils. Soil Sci. 82: 441-445, illus.

(6) Ruhe, Robert V. 1969. Quaternary landscapes in Iowa. Iowa State Univ. Press, 255 pp., illus.

(7) Ruhe, R. V., W. P. Dietz, T. E. Fenton, and G. F. Hall. 1968. Iowan drift problem of northeastern Iowa. Iowa Geol. Surv. Rep. Invest. 7, pp. 1-40, illus.

(8) Ruhe, R. V., Meyer Rubin, and W. H. Scholtes. 1957. Late pleistocene radiocarbon chronology in Iowa. Am. J. Sci. 255:671-689.

(9) United States Department of Agriculture. 1923. Soil survey of Hardin County, Iowa. Bur. of Soils in coop. with Iowa Agric. Exp. Stn.

(10) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962.]

(11) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(12) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(13) Walker, P. H. 1966. Post-glacial erosion and environment changes in central Iowa. Soil and Water Conserv. 21:21-23.

Glossary

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.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops

cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 39 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

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 melt water.

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 as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.
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, a plowed surface horizon, most of which was originally part of a B horizon.
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) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B 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, the Arabic numeral 2 precedes the letter C.

Cr horizon. —Soft, consolidated bedrock below the soil.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

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.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
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.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Salty water (in tables.) Water that is too salty for consumption by livestock.

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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

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.

Sinkhole. A depression in the landscape where limestone has been dissolved.

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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 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 of separates recognized in the United States are as follows:

	Millimeters
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 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.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded and 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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, EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 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 layers.

Taxadjuncts. Soils that differ from a recognized series in so few properties and to small a degree that major interpretations are not affected.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1957-78 at Eldora, Iowa]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	24.3	5.7	15.0	48	-22	0	0.75	0.25	1.16	2	6.1
February---	30.4	11.1	20.8	56	-17	0	1.05	.30	1.64	3	8.2
March------	41.9	22.9	32.4	77	-7	32	2.03	1.13	2.83	5	7.7
April------	59.1	36.7	47.9	86	18	66	3.16	1.89	4.29	7	.9
May--------	71.7	48.2	60.0	91	28	328	4.16	2.60	5.56	8	.0
June-------	80.5	57.1	68.8	95	43	564	4.87	2.70	6.78	8	.0
July-------	84.2	61.3	72.8	97	47	707	4.45	2.17	6.42	6	.0
August-----	82.1	58.5	70.3	95	44	629	4.53	2.43	6.36	7	.0
September--	73.3	49.8	61.5	91	32	345	3.12	1.00	4.85	6	.0
October----	63.0	39.4	51.2	88	21	146	2.22	.61	3.51	5	.0
November---	45.4	26.5	36.0	71	1	7	1.43	.34	2.29	3	3.2
December---	30.5	13.7	22.1	59	-18	0	1.03	.47	1.49	3	7.2
Yearly:											
Average--	57.2	35.9	46.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	97	-23	---	---	---	---	---	---
Total----	---	---	---	---	---	2,824	32.80	27.46	37.91	63	33.3

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1957-78 at Eldora, Iowa]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 21	May 5	May 13
2 years in 10 later than--	April 16	April 29	May 8
5 years in 10 later than--	April 8	April 18	April 30
First freezing temperature in fall:			
1 year in 10 earlier than--	October 12	October 2	September 24
2 years in 10 earlier than--	October 18	October 7	September 29
5 years in 10 earlier than--	October 29	October 17	October 8

TABLE 3.--GROWING SEASON

[Recorded in the period 1957-78 at Eldora, Iowa]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	181	158	142
8 years in 10	188	166	149
5 years in 10	203	181	161
2 years in 10	218	196	173
1 year in 10	226	204	180

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
6	Okoboji silty clay loam, 0 to 1 percent slopes	8,485	2.3
7	Wiota silt loam, 0 to 2 percent slopes	575	0.2
7B	Wiota silt loam, 2 to 5 percent slopes	205	0.1
8B	Judson silty clay loam, 2 to 5 percent slopes	680	0.2
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes	6,110	1.7
20C2	Killduff silty clay loam, 5 to 9 percent slopes, moderately eroded	2,050	0.6
20D3	Killduff silty clay loam, 9 to 14 percent slopes, severely eroded	1,850	0.5
20E3	Killduff silty clay loam, 14 to 18 percent slopes, severely eroded	385	0.1
27B	Terril loam, 2 to 5 percent slopes	4,190	1.1
55	Nicollet loam, 1 to 3 percent slopes	24,815	6.8
62C2	Storden loam, 5 to 9 percent slopes, moderately eroded	735	0.2
62D2	Storden loam, 9 to 14 percent slopes, moderately eroded	1,725	0.5
62E2	Storden loam, 14 to 18 percent slopes, moderately eroded	795	0.2
62G2	Storden loam, 18 to 40 percent slopes, moderately eroded	735	0.2
73C	Salida gravelly coarse sandy loam, 5 to 9 percent slopes	265	0.1
73E	Salida gravelly coarse sandy loam, 9 to 18 percent slopes	410	0.1
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded	220	0.1
83E2	Kenyon loam, 9 to 18 percent slopes, moderately eroded	540	0.1
90	Okoboji mucky silt loam, 0 to 1 percent slopes	1,625	0.4
95	Harps loam, 1 to 3 percent slopes	28,135	7.7
96	Turlin loam, 0 to 2 percent slopes	550	0.1
107	Webster silty clay loam, 0 to 2 percent slopes	7,865	2.1
118	Garwin silty clay loam, 0 to 2 percent slopes	2,340	0.6
119	Muscatine silty clay loam, 0 to 2 percent slopes	2,340	0.6
119B	Muscatine silty clay loam, 2 to 5 percent slopes	3,605	1.0
120B	Tama silty clay loam, 2 to 5 percent slopes	12,415	3.4
120C	Tama silty clay loam, 5 to 9 percent slopes	245	0.1
120C2	Tama silty clay loam, 5 to 9 percent slopes, moderately eroded	7,700	2.1
120D2	Tama silty clay loam, 9 to 14 percent slopes, moderately eroded	620	0.2
122	Sperry silt loam, 0 to 1 percent slopes	120	*
133	Colo silty clay loam, 0 to 2 percent slopes	3,675	1.0
135	Coland clay loam, 0 to 2 percent slopes	4,940	1.3
138B	Clarion loam, 2 to 5 percent slopes	69,846	19.0
138C2	Clarion loam, 5 to 9 percent slopes, moderately eroded	17,940	4.9
138D2	Clarion loam, 9 to 14 percent slopes, moderately eroded	930	0.3
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	1,430	0.4
162B	Downs silt loam, 2 to 5 percent slopes	2,080	0.6
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded	1,725	0.5
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded	470	0.1
163B	Fayette silt loam, 2 to 5 percent slopes	855	0.2
163C	Fayette silt loam, 5 to 9 percent slopes	775	0.2
163D	Fayette silt loam, 9 to 14 percent slopes	255	0.1
168B	Hayden loam, 2 to 5 percent slopes	1,320	0.4
168C	Hayden loam, 5 to 9 percent slopes	605	0.2
168G	Hayden loam, 24 to 50 percent slopes	2,395	0.7
177	Saude loam, 0 to 2 percent slopes	1,525	0.4
177B	Saude loam, 2 to 5 percent slopes	2,210	0.6
177C	Saude loam, 5 to 9 percent slopes	345	0.1
178	Waukee loam, 0 to 2 percent slopes	725	0.2
178B	Waukee loam, 2 to 5 percent slopes	410	0.1
184	Klinger silty clay loam, 0 to 2 percent slopes	550	0.1
184B	Klinger silty clay loam, 2 to 5 percent slopes	435	0.1
188	Kensett loam, 0 to 2 percent slopes	205	0.1
201B	Coland-Terril complex, 2 to 5 percent slopes	6,795	1.9
212	Kennebec silt loam, 0 to 2 percent slopes	420	0.1
221	Palms muck, 0 to 2 percent slopes	490	0.1
225	Lawler loam, 24 to 32 inches to sand or gravel, 0 to 2 percent slopes	700	0.2
226	Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes	1,410	0.4
236B	Lester loam, 2 to 5 percent slopes	2,145	0.6
236C	Lester loam, 5 to 9 percent slopes	400	0.1
236C2	Lester loam, 5 to 9 percent slopes, moderately eroded	2,170	0.6
236D2	Lester loam, 9 to 14 percent slopes, moderately eroded	840	0.2
236F	Lester loam, 14 to 24 percent slopes	1,585	0.4
284	Flagler sandy loam, 0 to 2 percent slopes	330	0.1
284B	Flagler sandy loam, 2 to 5 percent slopes	640	0.2
284C2	Flagler sandy loam, 5 to 9 percent slopes, moderately eroded	360	0.1
291	Atterberry silt loam, 1 to 3 percent slopes	525	0.1
325	Le Sueur silt loam, 0 to 2 percent slopes	1,035	0.3
329	Webster-Nicollet complex, 1 to 3 percent slopes	44,882	12.2
335	Harcot loam, 0 to 2 percent slopes	520	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	2,500	0.7
377C2	Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded	1,915	0.5
377D2	Dinsdale silty clay loam, 9 to 14 percent slopes, moderately eroded	585	0.2
382	Maxfield silty clay loam, 0 to 2 percent slopes	280	0.1
393C	Sparta loamy fine sand, loamy substratum, 2 to 9 percent slopes	505	0.1
393D	Sparta loamy fine sand, loamy substratum, 9 to 14 percent slopes	295	0.1
409B	Dickinson fine sandy loam, loamy substratum, 2 to 5 percent slopes	540	0.1
409C	Dickinson fine sandy loam, loamy substratum, 5 to 9 percent slopes	385	0.1
415G	Montieth sandy loam, 14 to 40 percent slopes	990	0.3
428B	Ely silty clay loam, 2 to 5 percent slopes	990	0.3
457	Du Page silt loam, 0 to 2 percent slopes	290	0.1
485	Spillville loam, 0 to 2 percent slopes	1,045	0.3
491G	Renova loam, 18 to 35 percent slopes	600	0.2
506	Wacousta silt loam, 0 to 1 percent slopes	725	0.2
507	Canisteo silty clay loam, 0 to 2 percent slopes	15,200	4.1
536	Hanlon fine sandy loam, 0 to 3 percent slopes	400	0.1
595	Harpster silty clay loam, 0 to 2 percent slopes	380	0.1
638C2	Clarion-Storden loams, 5 to 9 percent slopes, moderately eroded	11,795	3.2
638D2	Clarion-Storden loams, 9 to 14 percent slopes, moderately eroded	3,090	0.8
696	Tilfer loam, 0 to 2 percent slopes	220	0.1
705C2	Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded	430	0.1
705D2	Downs Variant silt loam, 9 to 14 percent slopes, moderately eroded	280	0.1
733	Calco silty clay loam, 0 to 2 percent slopes	1,105	0.3
771B	Waubeek silt loam, 2 to 5 percent slopes	195	*
771C2	Waubeek silt loam, 5 to 9 percent slopes, moderately eroded	480	0.1
771D2	Waubeek silt loam, 9 to 14 percent slopes, moderately eroded	320	0.1
814	Rockton loam, 0 to 2 percent slopes	280	0.1
814B	Rockton loam, 2 to 5 percent slopes	995	0.3
814C2	Rockton loam, 5 to 9 percent slopes, moderately eroded	195	*
828B	Zenor sandy loam, 1 to 5 percent slopes	775	0.2
828C2	Zenor sandy loam, 5 to 9 percent slopes, moderately eroded	405	0.1
933	Sawmill silty clay loam, 0 to 2 percent slopes	1,495	0.4
936	Coland-Spillville-Hanlon complex, 0 to 2 percent slopes	1,265	0.3
956	Okoboji-Harps complex, 0 to 2 percent slopes	7,505	2.0
1936	Coland-Spillville-Hanlon complex, channeled, 0 to 2 percent slopes	2,990	0.8
4000	Urban land	245	0.1
5010	Pits, sand and gravel	835	0.2
5030	Pits, quarries	280	0.1
5040	Orthents, loamy	390	0.1
	Water	750	0.2
	Total	367,168	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
7	Wiota silt loam, 0 to 2 percent slopes
7B	Wiota silt loam, 2 to 5 percent slopes
8B	Judson silty clay loam, 2 to 5 percent slopes
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes (where drained)
27B	Terril loam, 2 to 5 percent slopes
55	Nicollet loam, 1 to 3 percent slopes
95	Harps loam, 1 to 3 percent slopes (where drained)
96	Turlin loam, 0 to 2 percent slopes
107	Webster silty clay loam, 0 to 2 percent slopes (where drained)
118	Garwin silty clay loam, 0 to 2 percent slopes (where drained)
119	Muscatine silty clay loam, 0 to 2 percent slopes
119B	Muscatine silty clay loam, 2 to 5 percent slopes
120B	Tama silty clay loam, 2 to 5 percent slopes
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
135	Coland clay loam, 0 to 2 percent slopes (where drained)
138B	Clarion loam, 2 to 5 percent slopes
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes (where drained)
162B	Downs silt loam, 2 to 5 percent slopes
163B	Fayette silt loam, 2 to 5 percent slopes
168B	Hayden loam, 2 to 5 percent slopes
177	Saude loam, 0 to 2 percent slopes
177B	Saude loam, 2 to 5 percent slopes
178	Waukee loam, 0 to 2 percent slopes
178B	Waukee loam, 2 to 5 percent slopes
184	Klinger silty clay loam, 0 to 2 percent slopes
184B	Klinger silty clay loam, 2 to 5 percent slopes
188	Kensett loam, 0 to 2 percent slopes
201B	Coland-Terril complex, 2 to 5 percent slopes (where drained)
212	Kennebec silt loam, 0 to 2 percent slopes
225	Lawler loam, 24 to 32 inches to sand or gravel, 0 to 2 percent slopes
226	Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes
236B	Lester loam, 2 to 5 percent slopes
291	Atterberry silt loam, 1 to 3 percent slopes (where drained)
325	Le Sueur silt loam, 0 to 2 percent slopes
329	Webster-Nicollet complex, 1 to 3 percent slopes (where drained)
335	Harcot loam, 0 to 2 percent slopes (where drained)
377B	Dinsdale silty clay loam, 2 to 5 percent slopes
382	Maxfield silty clay loam, 0 to 2 percent slopes (where drained)
409B	Dickinson fine sandy loam, loamy substratum, 2 to 5 percent slopes
428B	Ely silty clay loam, 2 to 5 percent slopes
457	Du Page silt loam, 0 to 2 percent slopes
485	Spillville loam, 0 to 2 percent slopes
507	Canisteo silty clay loam, 0 to 2 percent slopes (where drained)
536	Hanlon fine sandy loam, 0 to 3 percent slopes
595	Harpster silty clay loam, 0 to 2 percent slopes (where drained)
696	Tilfer loam, 0 to 2 percent slopes (where drained)
733	Calco silty clay loam, 0 to 2 percent slopes (where drained)
771B	Waubeek silt loam, 2 to 5 percent slopes
814	Rockton loam, 0 to 2 percent slopes
814B	Rockton loam, 2 to 5 percent slopes
933	Sawmill silty clay loam, 0 to 2 percent slopes (where drained and protected from flooding)
936	Coland-Spillville-Hanlon complex, 0 to 2 percent slopes (where drained)

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
6 Okoboji	84	32	67	3.4	3.3	4.3	7.3
7 Wiota	110	42	62	4.6	4.2	6.5	7.6
7B Wiota	108	41	59	4.5	4.0	6.4	7.5
8B Judson	124	47	93	5.2	4.2	7.3	8.6
11B Colo-Ely	111	43	83	4.5	4.1	6.2	7.6
20C2 Killduff	115	43	86	4.9	3.8	7.0	8.1
20D3 Killduff	106	40	79	4.5	3.5	6.3	7.5
20E3 Killduff	---	---	---	3.9	3.3	5.3	6.5
27B Terril	118	45	94	5.0	4.2	7.0	8.3
55 Nicollet	116	40	93	5.0	4.1	6.2	8.3
62C2, 62D2 Storden	83	32	66	3.5	3.3	5.3	5.8
62E2 Storden	68	26	54	2.8	3.3	5.3	5.8
62G2 Storden	---	---	---	2.3	1.5	2.0	2.0
73C Salida	35	15	28	2.4	1.6	2.1	3.5
73E Salida	---	---	---	2.0	1.0	1.5	3.0
83C2 Kenyon	105	40	84	4.4	3.8	6.3	7.3
83E2 Kenyon	96	36	76	4.0	3.4	5.6	6.6
90 Okoboji	84	32	67	3.4	3.3	4.3	7.3
95 Harps	95	36	76	4.0	3.3	5.0	6.6
96 Turlin	120	45	96	5.0	4.1	7.1	8.3
107 Webster	110	42	88	4.4	4.2	6.6	7.3

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
118---------- Garwin	125	47	94	5.0	4.1	7.5	8.3
119---------- Muscatine	131	50	98	5.5	4.2	7.8	9.1
119B---------- Muscatine	129	49	96	5.5	4.2	7.6	9.1
120B---------- Tama	125	48	95	5.2	4.2	7.5	8.6
120C---------- Tama	120	46	90	5.0	4.0	7.1	8.3
120C2---------- Tama	117	44	88	4.9	3.8	7.0	8.1
120D2---------- Tama	108	41	81	4.5	3.3	6.3	7.5
122---------- Sperry	97	37	53	3.5	3.6	5.1	---
133---------- Colo	104	40	78	4.2	4.2	5.5	7.0
135---------- Coland	110	42	83	4.6	4.1	6.0	7.6
138B---------- Clarion	110	42	88	4.6	4.2	6.7	7.6
138C2---------- Clarion	102	39	82	4.3	3.8	6.2	7.1
138D2---------- Clarion	93	35	74	3.9	3.7	5.5	6.5
152---------- Marshan	101	38	81	4.0	4.1	7.1	6.6
162B---------- Downs	119	45	95	5.0	4.1	7.1	8.3
162C2---------- Downs	114	43	91	4.8	4.0	6.8	8.1
162D2---------- Downs	105	40	84	4.4	3.8	6.3	7.3
163B---------- Fayette	113	43	90	4.7	4.0	6.6	7.8
163C---------- Fayette	108	41	86	4.5	3.8	6.5	7.5
163D---------- Fayette	99	38	80	4.2	3.6	6.0	7.0
168B---------- Hayden	100	37	75	4.1	3.5	5.0	6.5
168C---------- Hayden	85	26	70	4.5	3.5	5.0	6.5
168G---------- Hayden	---	---	---	---	1.5	---	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
177---------- Saude	78	30	62	3.3	3.0	4.6	5.5
177B---------- Saude	76	29	61	3.2	3.0	4.5	5.3
177C---------- Saude	71	27	57	3.0	2.8	4.3	5.0
178---------- Waukee	98	37	78	4.1	4.0	5.8	6.8
178B---------- Waukee	96	36	77	4.0	4.0	5.6	6.6
184---------- Klinger	125	47	93	5.2	4.2	7.5	8.6
184B---------- Klinger	123	46	92	5.1	4.2	7.3	8.5
188---------- Kensett	85	32	68	3.6	3.6	5.0	6.0
201B**:							
Coland----------	98	37	78	4.0	3.6	6.2	6.6
Terril----------	118	45	94	5.0	4.2	7.0	8.3
212---------- Kennebec	115	44	90	5.0	4.2	7.0	8.3
221---------- Palms	80	30	65	3.0	3.3	5.3	5.3
225---------- Lawler	85	32	68	3.6	3.7	5.0	6.0
226---------- Lawler	100	38	80	4.2	4.0	6.0	7.0
236B---------- Lester	105	40	80	4.5	3.5	5.5	6.5
236C---------- Lester	95	38	75	4.5	3.5	5.5	6.5
236C2, 236D2---------- Lester	90	35	70	4.3	3.3	5.2	6.3
236F---------- Lester	---	---	---	3.0	3.0	5.0	4.5
284---------- Flagler	72	27	58	3.0	2.3	4.3	5.0
284B---------- Flagler	70	26	56	2.9	2.1	4.1	4.8
284C2---------- Flagler	65	25	52	2.7	1.7	3.8	4.5
291---------- Atterberry	125	47	93	5.5	4.2	7.8	9.1
325---------- Le Sueur	112	43	90	4.5	4.1	6.0	7.8

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
329---------- Webster-Nicollet	115	41	85	4.5	3.9	6.7	7.1
335---------- Harcot	80	30	64	3.2	3.1	4.8	6.0
377B---------- Dinsdale	119	45	89	5.0	4.1	7.1	8.3
377C2---------- Dinsdale	111	42	83	4.6	3.8	6.6	7.6
377D2---------- Dinsdale	102	39	76	4.4	3.6	6.1	7.3
382---------- Maxfield	119	45	89	5.0	4.2	6.6	8.3
393C---------- Sparta	60	23	48	2.2	2.2	3.2	3.2
393D---------- Sparta	---	---	---	1.7	1.8	2.6	2.6
409B---------- Dickinson	86	33	69	3.6	3.1	5.1	6.0
409C---------- Dickinson	81	31	65	3.4	3.0	4.8	5.6
415G---------- Montieth	---	---	---	---	0.5	---	---
428B---------- Ely	124	47	93	5.3	4.0	7.5	8.8
457---------- Du Page	92	28	49	3.5	3.0	---	5.6
485---------- Spillville	122	46	98	5.1	4.2	7.3	8.6
491G---------- Renova	---	---	---	---	1.5	---	---
506---------- Wacousta	100	38	80	4.0	2.0	7.0	8.2
507---------- Canisteo	105	40	84	4.2	3.8	6.3	7.0
536---------- Hanlon	90	34	72	3.8	3.3	5.3	6.3
595---------- Harpster	115	44	92	4.8	4.2	7.5	8.0
638C2---------- Clarion-Storden	93	33	71	4.1	3.5	6.0	6.5
638D2---------- Clarion-Storden	88	31	67	3.8	3.5	6.0	6.0
696---------- Tilfer	85	32	68	3.6	3.4	5.0	5.6
705C2---------- Downs Variant	100	38	80	4.3	3.4	6.0	7.1

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
705D2---------- Downs Variant	90	34	74	3.9	3.2	5.5	6.4
733---------- Calco	99	38	84	4.2	4.2	5.3	7.0
771B---------- Waubeek	113	43	85	4.7	4.0	6.8	7.8
771C2---------- Waubeek	105	40	79	4.4	3.7	6.3	7.3
771D2---------- Waubeek	96	36	72	4.0	3.3	5.6	6.6
814---------- Rockton	95	28	70	4.0	3.0	5.3	5.6
814B---------- Rockton	90	26	65	4.0	3.0	5.3	5.6
814C2---------- Rockton	75	22	57	3.5	2.7	5.0	4.9
828B---------- Zenor	79	30	63	3.3	3.0	4.8	5.5
828C2---------- Zenor	74	28	59	3.1	2.9	4.5	5.1
933---------- Sawmill	104	40	83	4.4	4.1	5.3	7.3
936---------- Coland-Spillville-Hanlon	111	42	86	4.7	4.0	6.2	7.8
956---------- Okoboji-Harps	90	34	72	3.7	3.3	4.7	6.9
1936---------- Coland-Spillville-Hanlon	---	---	---	---	3.1	---	---
4000**. Urban land							
5010**, 5030**. Pits							
5040**. Orthents							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	46,724	---	---	---
II	227,417	114,690	106,823	5,904
III	79,595	64,298	14,967	330
IV	1,740	1,475	---	265
V	2,511	---	2,511	---
VI	1,995	1,585	---	410
VII	4,720	3,730	---	990
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
162B, 162C2, 162D2--Downs	2o	Slight	Slight	Slight	Slight	White oak Northern red oak	65 65	Eastern white pine, red pine, black walnut, sugar maple.
163B, 163C, 163D--Fayette	2o	Slight	Slight	Slight	Slight	White oak Northern red oak	65 65	Eastern white pine, red pine, black walnut, sugar maple.
168B, 168C--Hayden	2o	Slight	Slight	Slight	Slight	Northern red oak American basswood Sugar maple Black walnut Eastern white pine White oak	69 69 --- 62 64 62	Black walnut, northern red oak, American basswood, silver maple, white oak.
168G--Hayden	2r	Moderate	Moderate	Slight	Slight	Northern red oak American basswood Sugar maple Black walnut Eastern white pine White oak	69 69 --- 62 64 62	Black walnut, northern red oak, American basswood, silver maple, white oak.
221--Palms	3w	Slight	Severe	Severe	Severe	Red maple Silver maple White ash Quaking aspen Northern white-cedar Tamarack Black ash	55 --- --- --- --- --- ---	
236B, 236C, 236C2, 236D2--Lester	2o	Slight	Slight	Slight	Slight	Northern red oak American basswood Black walnut Eastern cottonwood Eastern white pine White oak	69 69 62 92 64 62	Black walnut, northern red oak, white oak, silver maple.
236F--Lester	2r	Moderate	Moderate	Slight	Slight	Northern red oak American basswood Black walnut Eastern cottonwood Eastern white pine White oak	69 69 62 92 64 62	Black walnut, northern red oak, white oak, silver maple.
291--Atterberry	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Silver maple White ash Green ash	65 65 90 65 65	Eastern white pine, red pine, silver maple, green ash.
325--Le Sueur	2o	Slight	Slight	Slight	Slight	Sugar maple American basswood Black walnut Eastern cottonwood	60 70 55 85	Black walnut, eastern cottonwood, American basswood.
393C, 393D--Sparta	3s	Slight	Slight	Severe	Slight	Jack pine Northern red oak Red pine	57 47 ---	Red pine, eastern white pine, jack pine.
415G--Montieth	4s	Moderate	Severe	Moderate	Slight	White oak	45	Red pine, eastern white pine, jack pine.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
491G---------- Renova	2r	Moderate	Moderate	Slight	Slight	Black walnut-------- American basswood--- Northern red oak---- Eastern cottonwood-- Eastern white pine-- White oak----------	62 69 69 92 64 62	Black walnut, northern red oak, American basswood, silver maple, white oak.
536---------- Hanlon	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------	55 55	Eastern white pine, red pine, black walnut, sugar maple, European larch.
705C2, 705D2------- Downs Variant	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, northern red oak, green ash, yellow-poplar.
771B, 771C2, 771D2- Waubeek	2o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	65 65	Eastern white pine, red pine, black walnut, sugar maple.
936*, 1936*: Coland.								
Spillville.								
Hanlon----------	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------	55 55	Eastern white pine, red pine, black walnut, sugar maple.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
6---------- Okoboji	---	Northern white-cedar, Siberian peashrub, lilac, Tatarian honeysuckle.	Hackberry, eastern redcedar, bur oak, white spruce.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
7, 7B---------- Wiota	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
8B---------- Judson	---	Amur honeysuckle, Amur maple, autumn-olive, lilac.	Hackberry, bur oak, green ash, Russian-olive, eastern redcedar.	Honeylocust, Austrian pine, eastern white pine.	---
11B*:					
Colo----------	---	Redosier dogwood, American plum, Tatarian honeysuckle.	White fir, white spruce, hackberry, Amur maple, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
Ely----------	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
20C2, 20D3, 20E3-- Killduff	---	Redosier dogwood, gray dogwood, lilac, Siberian peashrub.	Eastern redcedar, Russian-olive, blue spruce, Amur maple, hackberry, northern white-cedar.	Green ash, eastern white pine.	---
27B---------- Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern white-cedar, eastern redcedar.	Eastern white pine, green ash.	---
55---------- Nicollet	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
62C2, 62D2, 62E2, 62G2---------- Storden	American plum-----	Eastern redcedar, hackberry, Tatarian honeysuckle, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
73C, 73E. Salida					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
83C2, 83E2-------- Kenyon	---	Siberian peashrub, gray dogwood, redosier dogwood, lilac.	Northern white-cedar, hackberry, blue spruce, eastern redcedar, Russian-olive, Amur maple.	Eastern white pine, green ash.	---
90---------- Okoboji	---	Northern white-cedar, Siberian peashrub, lilac, Tatarian honeysuckle.	Hackberry, eastern redcedar, bur oak, white spruce.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
95---------- Harps	---	Tatarian honeysuckle, northern white-cedar, Siberian peashrub, lilac.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
96---------- Turlin	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, Amur maple, blue spruce, white spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.
107---------- Webster	---	Redosier dogwood, American plum, Tatarian honeysuckle.	Hackberry, Amur maple, northern white-cedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
118---------- Garwin	---	Redosier dogwood, American plum, Tatarian honeysuckle.	Hackberry, Amur maple, northern white-cedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
119, 119B--------- Muscatine	---	Tatarian honeysuckle, redosier dogwood, lilac.	Blue spruce, northern white-cedar, white spruce, Amur maple.	Austrian pine, eastern white pine, hackberry, green ash.	Silver maple.
120B, 120C, 120C2, 120D2---------- Tama	---	Siberian peashrub, gray dogwood, redosier dogwood, lilac.	Northern white-cedar, eastern redcedar, Amur maple, blue spruce, hackberry, Russian-olive.	Green ash, eastern white pine.	---
122---------- Sperry	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
133---------- Colo	---	Redosier dogwood, American plum, Tatarian honeysuckle.	White fir, white spruce, hackberry, Amur maple, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
135---------- Coland	---	Redosier dogwood, Tatarian honeysuckle, American plum.	White spruce, hackberry, northern white-cedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
138B, 138C2, 138D2---------- Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern white-cedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
152---------- Marshan	---	Redosier dogwood, American plum, Tatarian honeysuckle.	Hackberry, northern white-cedar, Amur maple, white spruce, tall purple willow.	Golden willow, green ash.	Silver maple, eastern cottonwood.
162B, 162C2, 162D2---------- Downs	---	Siberian peashrub, gray dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, hackberry, blue spruce, Russian-olive, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
163B, 163C, 163D-- Fayette	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Northern white-cedar, hackberry, Russian-olive, blue spruce, Amur maple, eastern redcedar.	Eastern white pine, green ash.	---
168B, 168C, 168G-- Hayden	---	Redosier dogwood, gray dogwood, Siberian peashrub, lilac.	Hackberry, eastern redcedar, Russian-olive, Amur maple, northern white-cedar, blue spruce.	Eastern white pine, green ash.	---
177, 177B, 177C--- Saude	Lilac, Tatarian honeysuckle, Siberian peashrub.	Manchurian crabapple, hackberry, eastern redcedar.	Eastern white pine, bur oak, jack pine, green ash, honeylocust, Russian-olive.	---	---
178, 178B--------- Waukee	Lilac, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Manchurian crabapple, hackberry.	Russian-olive, green ash, bur oak, jack pine, eastern white pine, honeylocust.	---	---
184, 184B--------- Klinger	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
188---------- Kensett	---	Redosier dogwood, lilac, Tatarian honeysuckle.	Blue spruce, white spruce, northern white-cedar, Amur maple.	Austrian pine, green ash, eastern white pine, hackberry.	Silver maple.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
201B*: Coland	---	Redosier dogwood, Tatarian honeysuckle, American plum.	White spruce, hackberry, northern white-cedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern white-cedar, eastern redcedar.	Eastern white pine, green ash.	---
212--- Kennebec	Peking cotoneaster	American plum, lilac, Siberian peashrub.	Red pine, eastern redcedar, Manchurian crabapple.	Green ash, golden willow, hackberry, honeylocust.	Eastern cottonwood.
221--- Palms	Vanhoutte spirea	Silky dogwood, Tatarian honeysuckle, American cranberrybush, white spruce.	Northern white-cedar, Manchurian crabapple.	Eastern white pine, Norway spruce, green ash, golden willow.	Carolina poplar.
225, 226--- Lawler	---	Tatarian honeysuckle, redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Eastern white pine, hackberry, Austrian pine, green ash.	Silver maple.
236B, 236C, 236C2, 236D2, 236F--- Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern white-cedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
284, 284B, 284C2-- Flagler	Tatarian honeysuckle, Siberian peashrub, lilac.	Manchurian crabapple, hackberry, eastern redcedar.	Honeylocust, eastern white pine, jack pine, green ash, Russian-olive, bur oak.	---	---
291--- Atterberry	---	Tatarian honeysuckle, redosier dogwood, lilac.	White spruce, blue spruce, northern white-cedar, Amur maple.	Eastern white pine, Austrian pine, hackberry, green ash.	Silver maple.
325--- Le Sueur	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
329*: Webster	---	Redosier dogwood, American plum, Tatarian honeysuckle.	Hackberry, Amur maple, northern white-cedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
329*: Nicollet	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
335--- Harcot	---	Lilac, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	White spruce, eastern redcedar, bur oak, hackberry.	Honeylocust, green ash, golden willow.	Eastern cottonwood.
377B, 377C2, 377D2--- Dinsdale	---	Redosier dogwood, lilac, gray dogwood, Siberian peashrub.	Northern white-cedar, blue spruce, Amur maple, eastern redcedar, hackberry, Russian-olive.	Eastern white pine, green ash.	---
382--- Maxfield	---	Redosier dogwood, American plum, Tatarian honeysuckle.	Hackberry, Amur maple, northern white-cedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
393C, 393D--- Sparta	---	Siberian peashrub, lilac, Siberian crabapple, Russian-olive.	Norway spruce, hackberry.	Red pine, eastern white pine, jack pine.	---
409B, 409C--- Dickinson	Lilac---	Eastern redcedar, Tatarian honeysuckle, Siberian peashrub, Russian-olive.	Red pine, Amur maple, Norway spruce, green ash, hackberry, honeylocust, eastern white pine.	---	---
415G. Montieth					
428B--- Ely	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
457--- Du Page	---	Northern white-cedar, Siberian peashrub, lilac, Tatarian honeysuckle.	Hackberry, bur oak, eastern redcedar, white spruce.	Green ash, golden willow, honeylocust.	Eastern cottonwood.
485--- Spillville	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
491G--- Renova	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Hackberry, northern white-cedar, Amur maple, eastern redcedar, Russian-olive, blue spruce.	Eastern white pine, green ash.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
506---------- Wacousta	---	Northern white-cedar, Tatarian honeysuckle, Siberian peashrub, lilac.	Hackberry, eastern redcedar, bur oak, white spruce.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
507---------- Canisteo	---	Siberian peashrub, Tatarian honeysuckle, lilac, northern white-cedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
536---------- Hanlon	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, blue spruce, white spruce, northern white-cedar.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
595---------- Harpster	---	Lilac, Siberian peashrub, northern white-cedar, Tatarian honeysuckle.	Hackberry, white spruce, bur oak, eastern redcedar.	Hackberry, golden willow, green ash.	Eastern cottonwood.
638C2*, 638D2*: Clarion----------	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern white-cedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden----------	American plum-----	Eastern redcedar, hackberry, Tatarian honeysuckle, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
696---------- Tilfer	---	Northern white-cedar, Tatarian honeysuckle, Siberian peashrub, lilac.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
705C2, 705D2------ Downs Variant	---	Eastern redcedar, autumn-olive, lilac, Washington hawthorn, Tatarian honeysuckle, Amur honeysuckle, radiant crabapple, Siberian peashrub.	Eastern white pine, red pine, jack pine, Austrian pine.	---	---
733---------- Calco	---	Lilac, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	Hackberry, eastern redcedar, bur oak, white spruce.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
771B, 771C2, 771D2---------- Waubeek	---	Redosier dogwood, lilac, gray dogwood, Siberian peashrub.	Eastern redcedar, northern white-cedar, blue spruce, Amur maple, hackberry, Russian-olive.	Eastern white pine, green ash.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
814, 814B, 814C2--Rockton	Tatarian honeysuckle, lilac.	Eastern redcedar, Siberian peashrub.	Eastern white pine, green ash, hackberry, Manchurian crabapple, Russian-olive, jack pine.	Honeylocust, Siberian elm.	---
828B, 828C2--Zenor	Siberian peashrub, Tatarian honeysuckle, lilac.	Hackberry, eastern redcedar, Manchurian crabapple.	Honeylocust, bur oak, jack pine, green ash, Russian-olive, eastern white pine.	---	---
933--Sawmill	---	Tatarian honeysuckle, American plum, redosier dogwood.	Northern white-cedar, white spruce, tall purple willow, hackberry, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
936*:					
Coland	---	Redosier dogwood, Tatarian honeysuckle, American plum.	White spruce, hackberry, northern white-cedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Spillville	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
Hanlon	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, blue spruce, white spruce, northern white-cedar.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
956*:					
Okoboji	---	Northern white-cedar, Siberian peashrub, lilac, Tatarian honeysuckle.	Hackberry, eastern redcedar, bur oak, white oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
Haprs	---	Tatarian honeysuckle, northern white-cedar, Siberian peashrub, lilac.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
1936*:					
Coland	---	Redosier dogwood, Tatarian honeysuckle, American plum.	White spruce, hackberry, northern white-cedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Spillville	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1936*: Hanlon----------	---	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, blue spruce, white spruce, northern white-cedar.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
4000*. Urban land					
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
6 Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
7 Wiota	Slight	Slight	Slight	Slight	Slight.
7B Wiota	Slight	Slight	Moderate: slope.	Slight	Slight.
8B Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
11B*: Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
20C2 Killduff	Slight	Slight	Severe: slope.	Slight	Slight.
20D3 Killduff	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
20E3 Killduff	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
27B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
55 Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
62C2 Storden	Slight	Slight	Severe: slope.	Slight	Slight.
62D2 Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
62E2 Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
62G2 Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
73C Salida	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
73E Salida	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
83C2 Kenyon	Slight	Slight	Severe: slope.	Slight	Slight.
83E2 Kenyon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
90--- Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
95--- Harps	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
96--- Turlin	Severe: flooding, excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
107--- Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
118--- Garwin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
119--- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight---	Slight.
119B--- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight---	Slight.
120B--- Tama	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
120C, 120C2--- Tama	Slight---	Slight---	Severe: slope.	Slight---	Slight.
120D2--- Tama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight---	Moderate: slope.
122--- Sperry	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
133--- Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
135--- Coland	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
138B--- Clarion	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
138C2--- Clarion	Slight---	Slight---	Severe: slope.	Slight---	Slight.
138D2--- Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight---	Moderate: slope.
152--- Marshan	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
162B--- Downs	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
162C2--- Downs	Slight---	Slight---	Severe: slope.	Slight---	Slight.
162D2--- Downs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight---	Moderate: slope.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
163B---------- Fayette	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
163C---------- Fayette	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
163D---------- Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
168B---------- Hayden	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
168C---------- Hayden	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
168G---------- Hayden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
177---------- Saude	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
177B---------- Saude	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
177C---------- Saude	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
178---------- Waukee	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
178B---------- Waukee	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
184---------- Klinger	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
184B---------- Klinger	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
188---------- Kensett	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Moderate: thin layer.
201B*: Coland----------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Terril----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
212---------- Kennebec	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.
221---------- Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
225, 226---------- Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
236B---------- Lester	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.

See footnote at end of table.

TABLE 10.--RECRF^TIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
236C, 236C2---------- Lester	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
236D2---------- Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
236F---------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
284---------- Flagler	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
284B---------- Flagler	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
284C2---------- Flagler	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
291---------- Atterberry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
325---------- Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
329*: Webster----------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Nicollet----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
335---------- Harcot	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
377B---------- Dinsdale	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
377C2---------- Dinsdale	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
377D2---------- Dinsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
382---------- Maxfield	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
393C---------- Sparta	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
393D---------- Sparta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
409B---------- Dickinson	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
409C---------- Dickinson	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
415G---------- Montieth	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
428B---------- Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
457---------- Du Page	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
485---------- Spillville	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
491G---------- Renova	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
506---------- Wacousta	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
507---------- Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
536---------- Hanlon	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
595---------- Harpster	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
638C2*: Clarion----------	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
Storden----------	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
638D2*: Clarion----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Storden----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
696---------- Tilfer	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
705C2---------- Downs Variant	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: droughty.
705D2---------- Downs Variant	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
733---------- Calco	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
771B---------- Waubeek	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
771C2---------- Waubeek	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
771D2---------- Waubeek	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
814---------- Rockton	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: thin layer.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
814B---------- Rockton	Slight----------	Slight----------	Moderate: slope, depth to rock.	Slight----------	Moderate: thin layer.
814C2---------- Rockton	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: thin layer.
828B---------- Zenor	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Slight.
828C2---------- Zenor	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
933---------- Sawmill	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
936*: Coland----------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Spillville----------	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
Hanlon----------	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
956*: Okoboji----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Harps----------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1936*: Coland----------	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
Spillville----------	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Hanlon----------	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
4000*. Urban land					
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
6---------- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
7, 7B---------- Wiota	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8B---------- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
11B*:										
Colo----------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Ely----------	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
20C2---------- Killduff	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
20D3---------- Killduff	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
20E3---------- Killduff	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
27B---------- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
55---------- Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
62C2, 62D2, 62E2--- Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
62G2---------- Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
73C---------- Salida	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
73E---------- Salida	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
83C2, 83E2--------- Kenyon	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
90---------- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
95---------- Harps	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
96---------- Turlin	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
107---------- Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
118---------- Garwin	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
119, 119B---------- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
120B---------- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
120C, 120C2, 120D2- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
122---------- Sperry	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
133---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
135---------- Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
138B---------- Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
138C2, 138D2------- Clarion	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
152---------- Marshan	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
162B---------- Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
162C2, 162D2------- Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163B---------- Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163C, 163D--------- Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
168B---------- Hayden	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
168C---------- Hayden	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
168G---------- Hayden	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
177, 177B---------- Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
177C---------- Saude	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
178, 178B---------- Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
184, 184B---------- Klinger	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
188---------- Kensett	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
201B*: Coland----------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Terril----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
212---------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
221---------- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
225, 226---------- Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
236B---------- Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
236C, 236C2, 236D2- Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
236F---------- Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
284, 284B---------- Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
284C2---------- Flagler	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
291---------- Atterberry	Good	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
325---------- Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
329*:										
Webster----------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Nicollet----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
335---------- Harcot	Good	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
377B---------- Dinsdale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
377C2, 377D2------- Dinsdale	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
382---------- Maxfield	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
393C---------- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
393D---------- Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
409B---------- Dickinson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.
409C---------- Dickinson	Fair	Good	Good	Good	Good	Very poor.	Poor	Fair	Fair	Very poor.
415G---------- Montieth	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
428B---------- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
457---------- Du Page	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
485---------- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
491G---------- Renova	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
506---------- Wacousta	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
507---------- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
536---------- Hanlon	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
595---------- Harpster	Fair	Fair	Good	Fair	Fair	Good	Fair	Fair	Fair	Fair.
638C2*, 638D2*: Clarion----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
696---------- Tilfer	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
705C2, 705D2------- Downs Variant	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
733---------- Calco	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Poor	Fair.
771B---------- Waubeek	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
771C2, 771D2------- Waubeek	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
814, 814B, 814C2--- Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
828B---------- Zenor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
828C2---------- Zenor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
933---------- Sawmill	Good	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
936*: Coland----------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Spillville--------	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Hanlon----------	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
956*: Harps----------	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
Okoboji----------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1936*:										
Coland	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Hanlon	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
4000*. Urban land										
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
6---------- Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
7, 7B---------- Wiota	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
8B---------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
11B*:						
Colo----------	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
Ely----------	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
20C2---------- Killduff	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
20D3---------- Killduff	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
20E3---------- Killduff	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
27B---------- Terril	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
55---------- Nicollet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
62C2---------- Storden	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
62D2---------- Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
62E2, 62G2-------- Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
73C---------- Salida	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
73E---------- Salida	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
83C2---------- Kenyon	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
83E2---------- Kenyon	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Severe: slope.
90---------- Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
95---------- Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
96---------- Turlin	Severe: cutbanks cave, excess humus.	Severe: flooding, low strength.	Severe: flooding.	Severe: flooding, low strength.	Moderate: low strength, flooding, frost action.	Slight.
107---------- Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
118---------- Garwin	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness.
119, 119B--------- Muscatine	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
120B---------- Tama	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
120C, 120C2------- Tama	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
120D2---------- Tama	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
122---------- Sperry	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
133---------- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
135---------- Coland	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
138B---------- Clarion	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
138C2---------- Clarion	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
138D2---------- Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
152--- Marshan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
162B--- Downs	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
162C2--- Downs	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
162D2--- Downs	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
163B--- Fayette	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
163C--- Fayette	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
163D--- Fayette	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
168B--- Hayden	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
168C--- Hayden	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
168G--- Hayden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
177, 177B--- Saude	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Slight---	Slight.
177C--- Saude	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
178, 178B--- Waukee	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Severe: low strength.	Slight.
184, 184B--- Klinger	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
188--- Kensett	Severe: depth to rock, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness, depth to rock.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: thin layer.
201B*: Coland---	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Terril---	Slight---	Slight---	Slight---	Slight---	Severe: low strength.	Slight.
212--- Kennebec	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
221---------- Palms	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
225, 226---------- Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
236B---------- Lester	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
236C, 236C2------- Lester	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
236D2---------- Lester	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
236F---------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
284, 284B--------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
284C2---------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
291---------- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
325---------- Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
329*: Webster----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Nicollet---------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
335---------- Harcot	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
377B---------- Dinsdale	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
377C2---------- Dinsdale	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
377D2---------- Dinsdale	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
382---------- Maxfield	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
393C---------- Sparta	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
393D---------- Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
409B---------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
409C---------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
415G---------- Montieth	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
428B---------- Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
457---------- Du Page	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
485---------- Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
491G---------- Renova	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
506---------- Wacousta	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
507---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
536---------- Hanlon	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
595---------- Harpster	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
638C2*: Clarion----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
Storden----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
638D2*: Clarion----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Storden----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
696---------- Tilfer	Severe: depth to rock, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness.	Severe: flooding, frost action, wetness.	Severe: wetness.
705C2---------- Downs Variant	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
705D2---------- Downs Variant	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
733---------- Calco	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
771B---------- Waubeek	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
771C2---------- Waubeek	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
771D2---------- Waubeek	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
814, 814B---------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.	Moderate: thin layer.
814C2---------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.	Moderate: thin layer.
828B---------- Zenor	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
828C2---------- Zenor	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
933---------- Sawmill	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
936*:						
Coland----------	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Spillville-------	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Hanlon----------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
956*:						
Okoboji----------	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
Harps----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
1936*:						
Coland----------	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Severe: flooding.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1936*: Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
Hanlon	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
4000*. Urban land						
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
6 Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
7 Wiota	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
7B Wiota	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
8B Judson	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
11B*: Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
20C2 Killduff	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
20D3 Killduff	Moderate: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
20E3 Killduff	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
27B Terril	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
55 Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
62C2 Storden	Slight	Severe: slope.	Slight	Slight	Good.
62D2 Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
62E2, 62G2 Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
73C, 73E Salida	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
83C2 Kenyon	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
83E2 Kenyon	Moderate: percs slowly slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
90--- Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
95--- Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
96--- Turlin	Severe: wetness.	Severe: seepage, flooding, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: hard to pack.
107--- Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
118--- Garwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
119, 119B--- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
120B--- Tama	Slight---	Moderate: slope, seepage.	Moderate: too clayey.	Slight---	Fair: too clayey.
120C, 120C2--- Tama	Slight---	Severe: slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
120D2--- Tama	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
122--- Sperry	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
133--- Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
135--- Coland	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
138B--- Clarion	Slight---	Moderate: slope, seepage.	Slight---	Slight---	Good.
138C2--- Clarion	Slight---	Severe: slope.	Slight---	Slight---	Good.
138D2--- Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
152--- Marshan	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
162B--- Downs	Slight---	Moderate: slope, seepage.	Moderate: too clayey.	Slight---	Fair: too clayey.
162C2--- Downs	Slight---	Severe: slope.	Moderate: too clayey.	Slight---	Fair: too clayey.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
162D2--- Downs	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
163B--- Fayette	Slight---	Moderate: slope, seepage.	Moderate: too clayey.	Slight---	Fair: too clayey.
163C--- Fayette	Slight---	Severe: slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
163D--- Fayette	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
168B--- Hayden	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
168C--- Hayden	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
168G--- Hayden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
177, 177B--- Saude	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
177C--- Saude	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
178, 178B--- Waukee	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
184, 184B--- Klinger	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
188--- Kensett	Severe: depth to rock, wetness.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
201B*: Coland---	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Terril---	Slight---	Moderate: seepage, slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
212--- Kennebec	Moderate: flooding, wetness, percs slowly.	Moderate: seepage.	Severe: wetness.	Moderate: flooding, wetness.	Good.
221--- Palms	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
225, 226---------- Lawler	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
236B---------- Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
236C, 236C2--------- Lester	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
236D2---------- Lester	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
236F---------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
284, 284B---------- Flagler	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
284C2---------- Flagler	Severe: poor filter.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
291---------- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
325---------- Le Sueur	Severe: wetness.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
329*: Webster----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Nicollet----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
335---------- Harcot	Severe: wetness, poor filter.	Severe: flooding, seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
377B---------- Dinsdale	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
377C2---------- Dinsdale	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight----------	Good.
377D2---------- Dinsdale	Moderate: slope, percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
382---------- Maxfield	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
393C---------- Sparta	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: seepage, too sandy.
393D---------- Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
409B---------- Dickinson	Severe: poor filter.	Severe: seepage.	Slight----------	Severe: seepage.	Poor: seepage, too sandy.
409C---------- Dickinson	Severe: poor filter.	Severe: slope, seepage.	Slight----------	Severe: seepage.	Poor: seepage, too sandy.
415G---------- Montieth	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, seepage, too sandy.
428B---------- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
457---------- Du Page	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding.	Good.
485---------- Spillville	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.
491G---------- Renova	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
506---------- Wacousta	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
507---------- Canisteo	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
536---------- Hanlon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
595---------- Harpster	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
638C2*:					
Clarion----------	Slight----------	Severe: slope.	Slight ----------	Slight----------	Good.
Storden----------	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
638D2*:					
Clarion----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
696---------- Tilfer	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: area reclaim, wetness.
705C2, 705D2-------- Downs Variant	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
733---------- Calco	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness.
771B---------- Waubeek	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
771C2---------- Waubeek	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
771D2---------- Waubeek	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
814, 814B---------- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
814C2---------- Rockton	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
828B---------- Zenor	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
828C2---------- Zenor	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
933---------- Sawmill	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
936*: Coland----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Spillville---------	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.
Hanlon----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
956*: Okoboji----------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
Harps----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
1936*: Coland----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Spillville---------	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1936*: Hanlon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
4000*. Urban land					
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
6---------- Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
7, 7B---------- Wiota	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
8B---------- Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
11B*: Colo----------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ely----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
20C2---------- Killduff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
20D3---------- Killduff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
20E3---------- Killduff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
27B---------- Terril	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
55---------- Nicollet	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
62C2---------- Storden	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
62D2---------- Storden	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
62E2---------- Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
62G2---------- Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
73C, 73E---------- Salida	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim, too sandy.
83C2---------- Kenyon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
83E2---------- Kenyon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
90---------- Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
95---------- Harps	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
96---------- Turlin	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
107---------- Webster	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
118---------- Garwin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
119, 119B---------- Muscatine	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
120B, 120C, 120C2----- Tama	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
120D2---------- Tama	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
122---------- Sperry	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
133---------- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
135---------- Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
138B, 138C2---------- Clarion	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
138D2---------- Clarion	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
152---------- Marshan	Fair: wetness.	Probable----------	Probable----------	Fair: area reclaim, thin layer.
162B, 162C2---------- Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
162D2---------- Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
163B, 163C---------- Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
163D---------- Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, thin layer.
168, 168C---------- Hayden	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
168G---------- Hayden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
177, 177B, 177C------- Saude	Good----------	Probable----------	Probable----------	Good.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
178, 178B---------- Waukee	Good----------	Probable----------	Probable----------	Good.
184, 184B---------- Klinger	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
188---------- Kensett	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
201B*: Coland----------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Terril----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
212---------- Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
221---------- Palms	Poor: wetness.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
225, 226---------- Lawler	Fair: wetness.	Probable----------	Probable----------	Poor: area reclaim.
236B, 236C, 236C2----- Lester	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
236D2---------- Lester	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
236F---------- Lester	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
284, 284B, 284C2------ Flagler	Good----------	Probable----------	Probable----------	Fair: small stones, area reclaim, thin layer.
291---------- Atterberry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
325---------- Le Sueur	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
329*: Webster----------	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Nicollet----------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
335---------- Harcot	Fair: wetness.	Probable----------	Improbable: too sandy.	Fair: small stones, area reclaim, thin layer.
377B, 377C2---------- Dinsdale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
377D2---------- Dinsdale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
382---------- Maxfield	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
393C, 393D---------- Sparta	Good----------	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
409B, 409C---------- Dickinson	Good----------	Improbable: thin layer.	Improbable: excess fines.	Good.
415G---------- Montieth	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: slope.
428B---------- Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
457---------- Du Page	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
485---------- Spillville	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
491G---------- Renova	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
506---------- Wacousta	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
507---------- Canisteo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
536---------- Hanlon	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
595---------- Harpster	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
638C2*:				
Clarion----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Storden----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
638D2*:				
Clarion----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
696---------- Tilfer	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
705C2, 705D2---------- Downs Variant	Good----------	Probable----------	Improbable: too sandy.	Poor: area reclaim.
733---------- Calco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
771B, 771C2---------- Waubeek	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
771D2---------- Waubeek	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
814, 814B, 814C2------ Rockton	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
828B, 828C2---------- Zenor	Good----------	Probable----------	Improbable: too sandy.	Fair: small stones, thin layer.
933---------- Sawmill	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
936*: Coland----------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Spillville----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Hanlon----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
956*: Okoboji----------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Harps----------	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
1936*: Coland----------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Spillville----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Hanlon----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
4000*. Urban land				
5010*, 5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
6---------- Okoboji	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding---------	Not needed-----	Not needed.
7---------- Wiota	Moderate: seepage.	Slight---------	Severe: no water.	Deep to water	Favorable------	Erodes easily	Erodes easily.
7B---------- Wiota	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
8B---------- Judson	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
11B*: Colo----------	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Flooding, wetness, slope.	Wetness--------	Wetness.
Ely----------	Moderate: slope, seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
20C2---------- Killduff	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
20D3, 20E3-------- Killduff	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
27B---------- Terril	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
55---------- Nicollet	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness--------	Favorable.
62C2---------- Storden	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
62D2, 62E2, 62G2-- Storden	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
73C---------- Salida	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, slope.	Too sandy------	Droughty.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
73E---------- Salida	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, slope.	Slope, too sandy.	Slope, droughty.
83C2---------- Kenyon	Moderate: slope, seepage.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
83E2---------- Kenyon	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
90---------- Okoboji	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Not needed-----	Not needed.
95---------- Harps	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
96---------- Turlin	Moderate: seepage.	Severe: piping, excess humus.	Severe: cutbanks cave.	Deep to water	Favorable------	Favorable------	Favorable.
107---------- Webster	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
118---------- Garwin	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
119---------- Muscatine	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
119B---------- Muscatine	Moderate: seepage, slope.	Moderate: wetness.	Moderate: deep to water, slow refill.	Slope, frost action.	Wetness, slope.	Wetness, erodes easily.	Erodes easily.
120B, 120C, 120C2- Tama	Moderate: slope, seepage.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
120D2---------- Tama	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily, slope.	Slope, erodes easily.
122---------- Sperry	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
133---------- Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness--------	Wetness.
135---------- Coland	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
138B, 138C2--- Clarion	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope---	Erodes easily	Erodes easily.
138D2--- Clarion	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope---	Slope, erodes easily.	Slope, erodes easily.
152--- Marshan	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness---	Wetness, too sandy.	Wetness.
162B, 162C2--- Downs	Moderate: slope, seepage.	Slight---	Severe: no water.	Deep to water	Slope---	Erodes easily	Erodes easily.
162D2--- Downs	Severe: slope.	Slight---	Severe: no water.	Deep to water	Slope---	Slope, erodes easily.	Slope, erodes easily.
163B, 163C--- Fayette	Moderate: slope, seepage.	Slight---	Severe: no water.	Deep to water	Slope, erodes easily.	Favorable---	Erodes easily.
163D--- Fayette	Severe: slope.	Slight---	Severe: no water.	Deep to water	Slope, erodes easily.	Slope---	Slope, erodes easily.
168B, 168C--- Hayden	Moderate: seepage, slope.	Slight---	Severe: no water.	Deep to water	Slope---	Favorable---	Favorable.
168G--- Hayden	Severe: slope.	Slight---	Severe: no water.	Deep to water	Slope---	Slope---	Slope.
177--- Saude	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Favorable---	Too sandy---	Favorable.
177B, 177C--- Saude	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope---	Too sandy---	Favorable.
178--- Waukee	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Favorable---	Too sandy---	Favorable.
178B--- Waukee	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope---	Too sandy---	Favorable.
184--- Klinger	Moderate: seepage.	Moderate: wetness, piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness---	Wetness, erodes easily.	Erodes easily.
184B--- Klinger	Moderate: seepage, slope.	Moderate: wetness, piping.	Moderate: deep to water, slow refill.	Slope, frost action.	Wetness, slope.	Wetness, erodes easily.	Erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
188---------- Kensett	Severe: seepage.	Severe: thin layer.	Severe: depth to rock.	Depth to rock, frost action.	Wetness, depth to rock, rooting depth.	Depth to rock, wetness.	Depth to rock, rooting depth.
201B*:							
Coland----------	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Wetness, slope, flooding.	Wetness--------	Wetness.
Terril----------	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
212---------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Favorable------	Favorable.
221---------- Palms	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
225, 226---------- Lawler	Severe: seepage.	Severe: seepage.	Moderate: cutbanks cave, deep to water, slow refill.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Favorable.
236B, 236C, 236C2- Lester	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
236D2, 236F------- Lester	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
284---------- Flagler	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Soil blowing---	Too sandy, soil blowing.	Favorable.
284B, 284C2------- Flagler	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
291---------- Atterberry	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
325---------- Le Sueur	Moderate: seepage.	Moderate: wetness.	Severe: no water.	Frost action---	Wetness--------	Wetness--------	Favorable.
329*:							
Webster----------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
Nicollet---------	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness--------	Favorable.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
335---------- Harcot	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, rooting depth.	Wetness, too sandy.	Wetness, rooting depth.
377B, 377C2------- Dinsdale	Moderate: slope, seepage.	Slight---------	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
377D2---------- Dinsdale	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
382---------- Maxfield	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness, rooting depth.	Wetness--------	Wetness, rooting depth.
393C---------- Sparta	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
393D---------- Sparta	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
409B, 409C-------- Dickinson	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
415G---------- Montieth	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
428B---------- Ely	Moderate: slope, seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
457---------- Du Page	Moderate: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water	Flooding--------	Favorable------	Favorable.
485---------- Spillville	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Flooding--------	Favorable------	Favorable.
491G---------- Renova	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope----------	Slope, erodes easily.
506---------- Wacousta	Moderate: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Not needed-----	Not needed.
507---------- Canisteo	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
536---------- Hanlon	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
595---------- Harpster	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
638C2*: Clarion----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Storden----------	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
638D2*: Clarion----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Storden----------	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
696---------- Tilfer	Moderate: seepage, depth to rock.	Severe: thin layer, wetness.	Severe: depth to rock.	Depth to rock, flooding, frost action.	Wetness, depth to rock, flooding.	Depth to rock, wetness.	Wetness, depth to rock.
705C2---------- Downs Variant	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily, too sandy.	Erodes easily.
705D2---------- Downs Variant	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
733---------- Calco	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
771B, 771C2------- Waubeek	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
771D2---------- Waubeek	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
814---------- Rockton	Moderate: seepage, depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
814B, 814C2------- Rockton	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
828B, 828C2---------- Zenor	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
933---------- Sawmill	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness----------	Wetness.
936*: Coland----------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness----------	Wetness.
Spillville----------	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Flooding----------	Favorable----------	Favorable.
Hanlon----------	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Soil blowing, flooding.	Soil blowing-----	Favorable.
956*: Okoboji----------	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding: frost action.	Ponding----------	Not needed------	Not needed.
Harps----------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action----	Wetness----------	Wetness----------	Wetness.
1936*: Coland----------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness----------	Wetness.
Spillville----------	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Flooding----------	Favorable----------	Favorable.
Hanlon----------	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Soil blowing, flooding.	Soil blowing-----	Favorable.
4000*. Urban land							
5010*, 5030*. Pits							
5040*. Orthents							

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
6---------- Okoboji	0-7	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	7-28	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	28-43	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	43-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	40-55	20-30
7, 7B---------- Wiota	0-22	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	90-95	30-40	10-20
	22-48	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	48-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
8B---------- Judson	0-34	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	34-43	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
	43-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
11B*:											
Colo----------	0-11	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	11-46	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	46-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Ely----------	0-30	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	30-42	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	42-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
20C2, 20D3, 20E3- Killduff	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	7-28	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	28-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
27B---------- Terril	0-32	Loam----------	CL	A-6	0-5	100	95-100	70-90	60-80	30-40	10-20
	32-60	Clay loam, loam	CL	A-6	0-5	100	100	85-95	65-85	25-40	10-20
55---------- Nicollet	0-22	Loam, clay loam	OL, ML, CL	A-6, A-7	0	95-100	95-100	85-98	55-85	35-50	10-25
	22-34	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	55-80	35-50	15-25
	34-60	Loam----------	CL, ML	A-6, A-4	0-5	95-100	90-100	75-90	50-75	30-40	5-15
62C2, 62D2, 62E2, 62G2---------- Storden	0-7	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	Loam----------	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
73C, 73E---------- Salida	0-6	Gravelly coarse sandy loam.	SM, SP-SM	A-2, A-1	0-5	85-95	60-75	30-60	12-20	---	NP
	6-14	Gravelly loamy sand, gravelly coarse sand, gravelly loamy coarse sand.	SP, SW, GP, GP-GM	A-1	0-5	50-90	40-60	10-30	0-5	---	NP
	14-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, SW, GP, GP-GM	A-1	0-5	20-70	10-60	5-30	0-5	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
83C2, 83E2------- Kenyon	0-8	Loam----------	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
	8-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
90----------	0-10	Mucky silt loam	OH, MH	A-7	0	100	100	95-100	90-95	60-95	10-30
Okoboji	10-30	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	30-45	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	45-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	40-55	20-30
95----------	0-23	Loam----------	CL, CH	A-6, A-7	0-5	100	95-100	80-90	65-80	30-55	15-35
Harps	23-36	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	36-60	Loam, sandy clay loam.	CL	A-6	0-5	95-100	90-100	70-80	50-75	25-40	10-25
96----------	0-29	Loam----------	OL, ML, CL	A-4, A-6	0	100	100	95-100	60-70	30-40	5-15
Turlin	29-41	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	55-70	25-35	5-15
	41-60	Loam, sandy loam, silty clay loam.	SM, SM-SC, SC	A-2, A-4	0	95-100	90-100	85-95	15-40	15-30	2-10
107----------	0-22	Silty clay loam	CL, CH	A-7, A-6	0-5	100	95-100	85-95	70-90	35-60	15-30
Webster	22-38	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	38-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
118----------	0-23	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
Garwin	23-33	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	33-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	15-20
119, 119B--------	0-23	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
Muscatine	23-39	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	39-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
120B, 120C-------	0-18	Silty clay loam	ML	A-6, A-7	0	100	100	100	95-100	35-50	10-20
Tama	18-40	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	40-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
120C2, 120D2-----	0-8	Silty clay loam	ML	A-6, A-7	0	100	100	100	95-100	35-50	10-20
Tama	8-30	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
122----------	0-12	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
Sperry	12-20	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
	20-37	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	37-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	20-30
133----------	0-11	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
Colo	11-46	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	46-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
135----------	0-40	Clay loam--------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
Coland	40-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
138B----------	0-18	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
Clarion	18-43	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	43-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
138C2, 138D2-----	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
Clarion	8-28	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	28-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
152----------	0-21	Clay loam--------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
Marshan	21-27	Silty clay loam, clay loam, silt loam.	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	30-50	15-30
	27-36	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	75-100	70-90	45-75	25-40	5-15
	36-60	Coarse sand, gravelly coarse sand, loamy sand.	SP, SW, GP, GW	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
162B----------	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Downs	11-41	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	41-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
162C2, 162D2-----	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Downs	8-37	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	37-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
163B, 163C, 163D-	0-12	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Fayette	12-53	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	53-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
168B, 168C, 168G-	0-16	Loam----------	CL-ML, CL	A-4	0	100	98-100	85-98	50-80	20-30	4-10
Hayden	16-52	Clay loam, loam	CL	A-7, A-6	0	95-100	90-98	80-95	55-75	30-50	15-26
	52-60	Loam, sandy loam, fine sandy loam.	CL, SC	A-6, A-4	0-5	95-100	90-98	75-90	35-70	20-35	8-15
177, 177B, 177C--	0-16	Loam----------	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
Saude	16-25	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	45-60	20-30	5-15
	25-60	Loamy sand, gravelly coarse sand, sand.	SW, SM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
178, 178B--------	0-23	Loam----------	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
Waukee	23-37	Loam, sandy clay loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	37-60	Gravelly sand, loamy coarse sand, sand, gravelly loamy sand.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
184, 184B--------	0-16	Silty clay loam	CL, ML	A-7	0	100	100	100	95-100	40-50	15-25
Klinger	16-31	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	31-60	Loam, clay loam	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
188----------	0-19	Loam----------	OL, CL, ML	A-6, A-7	0	100	95-100	90-95	70-85	35-50	11-20
Kensett	19-29	Clay loam, loam	CL	A-6	2-5	90-95	85-95	80-90	55-70	30-40	15-25
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
201B*:											
Coland----------	0-40	Clay loam--------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
	40-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
Terril----------	0-32	Loam----------	CL	A-6	0-5	100	95-100	70-90	60-80	30-40	10-20
	32-60	Clay loam, loam	CL	A-6	0-5	100	100	85-95	65-85	25-40	10-20
212----------	0-55	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
Kennebec	55-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
221----------	0-28	Sapric material	PT	---	---	---	---	---	---	---	---
Palms	28-60	Silty clay loam, silt loam, mucky silt loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
225----------	0-21	Loam----------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
Lawler	21-30	Loam, sandy clay loam, sandy loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	30-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
226----------	0-22	Loam----------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
Lawler	22-38	Loam, sandy clay loam, sandy loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	38-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
236B, 236C-------	0-13	Loam----------	ML, CL	A-6, A-4	0	95-100	90-100	80-95	50-70	30-40	5-15
Lester	13-50	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	50-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
236C2, 236D2-----	0-8	Loam----------	ML, CL	A-6, A-4	0	95-100	90-100	80-95	50-70	30-40	5-15
Lester	8-43	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	43-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
236F----------	0-13	Loam----------	ML, CL	A-6, A-4	0	95-100	90-100	80-95	50-70	30-40	5-15
Lester	13-50	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	50-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
284, 284B--------	0-17	Sandy loam--------	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
Flagler	17-31	Sandy loam--------	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	31-60	Loamy sand, gravelly sand, sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
284C2---------- Flagler	0-8	Sandy loam-------	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	8-21	Sandy loam-------	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	21-60	Loamy sand, sand, gravelly sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
291---------- Atterberry	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	14-46	Silty clay loam, silt loam.	CL, CH	A-7, A-6	0	100	100	95-100	95-100	35-55	20-30
	46-60	Silt loam, loam	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
325---------- Le Sueur	0-15	Loam, silt loam	CL, ML, CL-ML	A-6, A-4	0	95-100	95-100	90-100	70-85	20-40	5-15
	15-40	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	40-60	Loam----------	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20
329*: Webster---------	0-22	Silty clay loam	CL, CH	A-7, A-6	0-5	100	95-100	85-95	70-90	35-60	15-30
	22-38	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	38-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
Nicollet--------	0-22	Loam, clay loam	OL, ML, CL	A-6, A-7	0	95-100	95-100	85-98	55-85	35-50	10-25
	22-34	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	55-80	35-50	15-25
	34-60	Loam----------	CL, ML	A-6, A-4	0-5	95-100	90-100	75-90	50-75	30-40	5-15
335---------- Harcot	0-22	Loam----------	CH, CL	A-7	0	95-100	90-95	80-90	55-75	40-55	15-25
	22-37	Loam, clay loam, sandy clay loam.	CL	A-6	0	95-100	90-95	75-85	55-75	30-40	10-20
	37-60	Sand, loamy fine sand, gravelly sand.	SP, SM, SP-SM	A-1	0-5	80-95	55-95	40-50	3-25	---	NP
377B---------- Dinsdale	0-17	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	17-34	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	34-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
377C2, 377D2----- Dinsdale	0-8	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	8-32	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	32-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
382---------- Maxfield	0-14	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	14-31	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	31-60	Loam----------	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
393C, 393D------- Sparta	0-16	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
	16-38	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
	38-54	Sand, fine sand	SP-SM, SM	A-2, A-3	0	85-100	85-100	50-95	5-30	---	NP
	54-60	Loam----------	CL	A-6	2-5	90-95	85-95	80-90	55-65	25-35	11-20
409B, 409C------- Dickinson	0-16	Fine sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	100	80-95	30-50	15-30	NP-10
	16-50	Fine sandy loam, sandy loam, loamy sand.	SM, SP, SM-SC	A-2, A-3	0	100	100	80-95	3-20	10-20	NP-5
	50-60	Loam, sandy loam, silt loam.	CL	A-6	2-5	90-95	85-95	80-90	55-65	25-35	11-20

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
415G---------- Montieth	0-10	Sandy loam, loamy sand.	SM	A-2	0-5	95-100	90-100	70-80	15-25	<20	NP
	10-28	Loamy sand, sand, sandy loam.	SP-SM, SM, SM-SC	A-2, A-3	0-10	95-100	90-100	70-80	5-25	<20	NP-5
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
428B---------- Ely	0-30	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	30-42	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	42-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
457---------- Du Page	0-60	Silt loam, loam	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-45	11-21
485---------- Spillville	0-52	Loam----------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
491G---------- Renova	0-4	Loam----------	ML, CL	A-4	0	100	98-100	90-95	75-90	20-40	NP-10
	4-14	Silt loam, loam, sandy loam.	CL	A-6	0	100	98-100	90-95	80-95	30-40	10-20
	14-50	Loam, sandy clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	95-100	85-95	65-85	45-65	20-35	5-15
	50-70	Loam----------	CL	A-6	0-1	95-100	85-95	70-85	50-70	25-40	10-20
506---------- Wacousta	0-13	Silt loam, silty clay loam.	CL, ML	A-6	0	100	100	95-100	95-100	35-40	10-15
	13-20	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	90-100	90-100	40-60	20-35
	20-60	Silt loam, silty clay loam.	CL, ML	A-6, A-4	0-5	95-100	95-100	85-100	80-90	30-40	5-15
507---------- Canisteo	0-20	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	85-100	35-50	15-25
	20-36	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	36-60	Clay loam, loam, sandy loam.	CL	A-6	0-5	95-100	90-98	80-95	60-75	30-40	12-20
536---------- Hanlon	0-48	Fine sandy loam	SM-SC, SC, SM	A-4	0	100	100	75-80	35-50	25-35	5-10
	48-60	Sandy loam, fine sandy loam, loamy fine sand.	SM-SC, SC	A-4, A-2	0	100	100	75-80	25-40	15-25	5-10
595---------- Harpster	0-22	Silty clay loam	CL, CH	A-7	0	100	95-100	95-100	90-100	45-60	20-35
	22-30	Silty clay loam	CL, CH	A-7	0	100	95-100	95-100	85-100	40-60	20-35
	30-52	Silty clay loam, silt loam, loam.	CL, CH	A-6, A-7	0	100	95-100	95-100	70-100	35-55	20-35
	52-60	Stratified sandy loam to clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	100	95-100	95-100	45-95	20-50	5-25
638C2*, 638D2*: Clarion----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-28	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	28-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden----------	0-7	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	Loam----------	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
696---------- Tilfer	0-17	Loam, silty clay loam.	MH, OL, ML, OH	A-7, A-6	0	90-95	85-95	80-90	65-75	35-55	10-25
	17-26	Loam, clay loam, silty clay loam.	SC, CL	A-6, A-7	2-5	90-95	85-90	60-70	45-70	35-45	11-20
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
705C2, 705D2----- Downs Variant	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-22	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	22-37	Loam, sandy loam	SM-SC, SC	A-4	0	100	95-100	80-90	35-50	20-30	5-10
	37-60	Channery sand, channery loamy sand.	SP-SM	A-1	10-25	95-100	45-95	20-40	5-10	<20	NP-5
733---------- Calco	0-41	Silty clay loam	CH, CL	A-7	0	100	100	95-100	85-100	40-60	15-30
	41-60	Silty clay loam, loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
771B---------- Waubeek	0-13	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	100	25-35	5-15
	13-31	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	100	40-50	15-25
	31-60	Loam, sandy clay loam, clay loam.	CL	A-6	0-5	90-95	85-95	75-85	50-65	25-35	10-20
771C2, 771D2----- Waubeek	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	100	25-35	5-15
	8-30	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	100	40-50	15-25
	30-60	Loam, sandy clay loam, clay loam.	CL	A-6	0-5	90-95	85-95	75-85	50-65	25-35	10-20
814, 814B-------- Rockton	0-19	Loam----------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	19-24	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	24	Weathered bedrock	---	---	---	---	---	---	---	---	---
814C2---------- Rockton	0-8	Loam----------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	8-22	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	22	Weathered bedrock	---	---	---	---	---	---	---	---	---
828B---------- Zenor	0-13	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	85-95	80-95	60-70	25-40	15-25	5-10
	13-28	Sandy loam, loam	SM-SC, SC	A-2, A-4	0-5	85-95	80-95	50-70	25-40	15-25	5-10
	28-60	Gravelly loamy sand, gravelly sand, coarse loamy sand.	SW, SP, SP-SM	A-1	0-5	85-95	80-90	20-40	3-12	<20	NP-5
828C2---------- Zenor	0-9	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	85-95	80-95	60-70	25-40	15-25	5-10
	9-23	Sandy loam, loam	SM-SC, SC	A-2, A-4	0-5	85-95	80-95	50-70	25-40	15-25	5-10
	23-60	Gravelly loamy sand, gravelly sand, loamy sand.	SW, SP, SP-SM	A-1	0-5	85-95	80-90	20-40	3-12	<20	NP-5
933---------- Sawmill	0-32	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	15-30
	32-38	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	15-30
	38-60	Silty clay loam, silt loam, sandy loam.	CL	A-6, A-7, A-4	0	100	100	85-100	70-95	25-50	8-25

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
936*:											
Coland----------	0-40	Clay loam--------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
	40-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
Spillville------	0-52	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
Hanlon----------	0-48	Fine sandy loam, sandy loam.	SM-SC, SC, SM	A-4	0	100	100	75-80	35-50	25-35	5-10
	48-60	Sandy loam, fine sandy loam, loamy fine sand.	SM-SC, SC	A-4, A-2	0	100	100	75-80	25-40	15-25	5-10
956*:											
Okoboji---------	0-7	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	7-28	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	28-43	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	43-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	40-55	20-30
Harps-----------	0-23	Loam-------------	CL, CH	A-6, A-7	0-5	100	95-100	80-90	65-80	30-55	15-35
	23-36	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	36-60	Loam, sandy clay loam.	CL	A-6	0-5	95-100	90-100	70-80	50-75	25-40	10-25
1936*:											
Coland----------	0-40	Clay loam--------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
	40-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
Spillville------	0-52	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
Hanlon----------	0-48	Fine sandy loam	SM-SC, SC, SM	A-4	0	100	100	75-80	35-50	25-35	5-10
	48-60	Sandy loam, fine sandy loam, loamy fine sand.	SM-SC, SC	A-4, A-2	0	100	100	75-80	25-40	5-10	
4000*. Urban land											
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
6----------	0-7	35-42	1.25-1.30	0.2-0.6	0.21-0.23	6.1-7.8	High---------	0.37	5	4	9-18
Okoboji	7-28	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.37			
	28-43	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High---------	0.37			
	43-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
7, 7B----------	0-22	24-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	3-4
Wiota	22-48	30-36	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	48-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
8B----------	0-34	24-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	4-5
Judson	34-43	30-35	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.43			
	43-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.43			
11B*:											
Colo----------	0-11	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	11-46	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	46-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
Ely----------	0-30	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7	4-6
	30-42	28-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43			
	42-60	20-30	1.40-1.45	0.6-2.0	0.18-0.20	6.6-8.4	Moderate-----	0.43			
20C2, 20D3, 20E3-	0-7	28-33	1.30-1.35	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.32	5	7	1-3
Kilduff	7-28	30-35	1.35-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	28-60	26-32	1.40-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
27B----------	0-32	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
Terril	32-60	22-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
55----------	0-22	24-35	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.24	5	6	4-8
Nicollet	22-34	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	34-60	22-28	1.35-1.45	0.6-2.0	0.14-0.19	7.4-7.8	Low----------	0.32			
62C2, 62D2, 62E2,											
62G2----------	0-7	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	1-2
Storden	7-60	18-27	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
73C, 73E----------	0-6	5-15	1.35-1.45	2.0-6.0	0.10-0.12	6.1-8.4	Low----------	0.10	3	8	.5-1
Salida	6-14	2-8	1.50-1.65	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
	14-60	0-5	1.50-1.65	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
83C2, 83E2-------	0-8	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-3
Kenyon	8-60	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.28			
90----------	0-10	20-26	1.20-1.25	0.6-2.0	0.24-0.26	6.1-7.8	High---------	0.37	5	6	9-18
Okoboji	10-30	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.37			
	30-45	35-45	1.35-1.40	0.2-0.6	0.18-0.20	7.4-8.4	High---------	0.37			
	45-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
95----------	0-23	25-35	1.35-1.40	0.6-2.0	0.19-0.21	7.9-8.4	Moderate-----	0.24	5	4L	4-5
Harps	23-36	18-32	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
	36-60	20-26	1.50-1.70	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
96----------	0-29	18-26	1.45-1.55	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
Turlin	29-41	20-28	1.55-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.32			
	41-60	8-18	1.65-1.70	6.0-20	0.08-0.17	6.1-7.3	Low----------	0.24			
107----------	0-22	26-36	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate-----	0.24	5	6	6-7
Webster	22-38	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.32			
	38-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
118----------	0-23	30-35	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	6-7
Garwin	23-33	27-35	1.28-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
	33-60	20-26	1.35-1.45	0.6-2.0	0.20-0.22	6.6-7.8	Moderate-----	0.28			
119, 119B----------	0-23	28-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.28	5	7	5-6
Muscatine	23-39	30-35	1.28-1.35	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43			
	39-60	22-30	1.35-1.40	0.6-2.0	0.18-0.20	6.6-7.8	Moderate-----	0.43			
120B, 120C--------	0-18	24-29	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	7	3-4
Tama	18-40	27-35	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	40-60	22-28	1.35-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
120C2, 120D2------	0-8	24-29	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	7	2-3
Tama	8-30	27-35	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	30-60	22-28	1.35-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
122----------	0-12	18-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6	3-4
Sperry	12-20	18-28	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28			
	20-37	38-45	1.40-1.45	0.06-0.2	0.14-0.16	5.1-6.5	High---------	0.43			
	37-60	26-34	1.45-1.50	0.2-0.6	0.19-0.21	5.6-6.5	High---------	0.43			
133----------	0-11	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
Colo	11-46	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	46-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
135----------	0-40	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
Coland	40-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
138B----------	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	3-4
Clarion	18-43	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	43-60	12-22	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
138C2, 138D2------	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-3
Clarion	8-28	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	28-60	12-22	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
152----------	0-21	27-35	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	4	7	4-8
Marshan	21-27	25-35	1.40-1.55	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.28			
	27-36	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low----------	0.28			
	36-60	<5	1.55-1.65	6.0-20	0.02-0.05	6.1-7.8	Low----------	0.15			
162B----------	0-11	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	5	6	2-3
Downs	11-41	26-35	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	41-60	22-26	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
162C2, 162D2------	0-8	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	5	6	1-2
Downs	8-37	26-35	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	37-60	22-26	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
163B, 163C, 163D-	0-12	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.37	5	6	1-2
Fayette	12-53	25-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	53-60	22-26	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.8	Moderate-----	0.37			
168B, 168C, 168G-	0-16	10-25	1.40-1.60	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.32	5	6	.5-2
Hayden	16-52	18-35	1.50-1.65	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.32			
	52-60	15-27	1.65-1.80	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
177, 177B, 177C--	0-16	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	3-4
Saude	16-25	12-18	1.40-1.50	0.6-6.0	0.15-0.19	5.1-6.0	Low----------	0.28			
	25-60	2-8	1.50-1.75	>20	0.02-0.06	5.1-6.5	Low----------	0.10			
178, 178B----------	0-23	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.24	4	6	3-4
Waukee	23-37	18-27	1.40-1.50	0.6-2.0	0.15-0.19	5.1-6.5	Low----------	0.24			
	37-60	2-8	1.50-1.75	>20	0.02-0.06	5.6-6.3	Low----------	0.10			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
184, 184B--------	0-16	26-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	7	5-6
Klinger	16-31	28-35	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	31-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.43			
188--------------	0-19	24-29	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	3	6	5-6
Kensett	19-29	22-29	1.40-1.60	0.6-2.0	0.17-0.19	6.1-7.3	Moderate-----	0.28			
	29	---	---	---	---	---	----------	----			
201B*:											
Coland----------	0-40	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
	40-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
Terril----------	0-32	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
	32-60	22-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
212--------------	0-55	26-30	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6	5-6
Kennebec	55-60	24-48	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
221--------------	0-28	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	2	3	>30
Palms	28-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	----			
225--------------	0-21	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
Lawler	21-30	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low----------	0.28			
	30-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low----------	0.10			
226--------------	0-21	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
Lawler	21-38	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low----------	0.28			
	38-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low----------	0.10			
236B, 236C-------	0-13	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Low----------	0.28	5	6	2-4
Lester	13-50	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	50-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-7.8	Low----------	0.37			
236C2, 236D2-----	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Low----------	0.28	5	6	1-2
Lester	8-43	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	43-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-7.8	Low----------	0.37			
236F--------------	0-13	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Low----------	0.28	5	6	2-4
Lester	13-50	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	50-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-7.8	Low----------	0.37			
284, 284B--------	0-17	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20	4	3	1-2
Flagler	17-31	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low----------	0.20			
	31-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low----------	0.20			
284C2------------	0-8	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20	4	3	1-2
Flagler	8-21	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low----------	0.20			
	21-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low----------	0.20			
291--------------	0-14	20-26	1.20-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6	2-4
Atterberry	14-46	25-35	1.30-1.50	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	46-60	18-27	1.35-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43			
325--------------	0-15	20-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.24	5	6	2-4
Le Sueur	15-40	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.32			
	40-60	20-27	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
329*:											
Webster----------	0-22	26-36	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate-----	0.24	5	6	6-7
	22-38	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.32			
	38-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
Nicollet---------	0-22	24-35	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.24	5	6	4-8
	22-34	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	34-60	22-28	1.35-1.45	0.6-2.0	0.14-0.19	7.4-7.8	Low----------	0.32			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
335----------	0-22	24-29	1.35-1.40	0.6-2.0	0.20-0.22	7.9-8.4	Moderate-----	0.28	4	4L	5-6
Harcot	22-37	18-30	1.40-1.60	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.28			
	37-60	2-8	1.60-1.75	>20	0.05-0.07	6.6-7.8	Low----------	0.15			
377B----------	0-17	25-29	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7	3-5
Dinsdale	17-34	30-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	34-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-8.4	Low----------	0.43			
377C2, 377D2-----	0-8	25-29	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7	2-3
Dinsdale	8-32	30-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	32-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-8.4	Low----------	0.43			
382----------	0-14	30-35	1.35-1.40	0.6-2.0	0.21-0.23	6.6-7.3	High---------	0.24	5	7	6-7
Maxfield	14-31	25-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.32			
	31-60	20-26	1.65-1.85	0.6-2.0	0.17-0.19	6.1-7.8	Low----------	0.32			
393C, 393D-------	0-16	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low----------	0.17	5	2	1-2
Sparta	16-38	2-8	1.40-1.60	6.0-20	0.05-0.11	5.1-6.0	Low----------	0.17			
	38-54	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-6.0	Low----------	0.17			
	54-60	18-24	1.55-1.80	0.6-2.0	0.17-0.19	5.6-6.5	Low----------	0.37			
409B, 409C-------	0-16	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.20	4	3	1-2
Dickinson	16-50	5-15	1.45-1.55	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.20			
	50-60	20-24	1.55-1.80	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
415G----------	0-10	8-15	1.50-1.55	2.0-6.0	0.12-0.15	5.1-7.3	Low----------	0.24	4	3	.5-1
Montieth	10-28	2-15	1.55-1.70	>6.0	0.06-0.10	4.5-5.5	Low----------	0.17			
	28-60	---	---	---	---	---	----------	----			
428B----------	0-30	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7	4-6
Ely	30-42	28-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43			
	42-60	20-30	1.40-1.45	0.6-2.0	0.18-0.20	6.6-8.4	Moderate-----	0.43			
457----------	0-60	18-27	1.40-1.60	0.6-2.0	0.22-0.24	6.6-8.4	Moderate-----	0.28	5	6	3-5
Du Page											
485----------	0-52	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
Spillville	52-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28			
491G----------	0-4	14-24	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	Low----------	0.37	5	6	1-2
Renova	4-14	14-24	1.35-1.45	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.37			
	14-50	20-30	1.55-1.70	0.6-2.0	0.17-0.19	4.5-7.3	Low----------	0.37			
	50-70	20-27	1.55-1.70	0.6-2.0	0.17-0.19	6.6-7.8	Low----------	0.37			
506----------	0-13	24-30	1.20-1.25	0.6-2.0	0.22-0.24	6.1-7.8	Moderate-----	0.28	5	6	8-10
Wacousta	13-20	24-35	1.25-1.30	0.6-2.0	0.18-0.20	6.6-7.8	High---------	0.43			
	20-60	18-30	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	0.43			
507----------	0-20	18-35	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	0.32	5	4L	4-8
Canisteo	20-36	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
	36-60	15-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low----------	0.32			
536----------	0-48	12-18	1.50-1.70	2.0-6.0	0.16-0.18	6.1-7.3	Low----------	0.20	5	3	2-3
Hanlon	48-60	5-10	1.70-1.75	2.0-6.0	0.11-0.13	5.6-7.3	Low----------	0.20			
595----------	0-22	22-35	1.05-1.25	0.6-2.0	0.21-0.24	7.4-8.4	Moderate-----	0.28	5	4L	5-6
Harpster	22-30	27-35	1.20-1.50	0.6-2.0	0.18-0.22	7.4-8.4	Moderate-----	0.28			
	30-52	22-35	1.25-1.55	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28			
	52-60	15-30	1.40-1.60	0.6-2.0	0.11-0.22	7.4-8.4	Low----------	0.28			
638C2*, 638D2*:											
Clarion----------	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	1-3
	8-28	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	28-60	12-22	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Storden----------	0-7	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	1-2
	7-60	18-27	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
696----------	0-17	24-32	1.35-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	0.28	4	4L	5-6
Tilfer	17-26	16-30	1.40-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.28			
	26	---	---	---	---	---	----------	----			
705C2, 705D2-----	0-8	20-26	1.25-1.30	0.6-2.0	0.10-0.15	5.6-6.0	Low----------	0.32	4	6	1-2
Downs Variant	8-22	27-34	1.30-1.35	0.6-2.0	0.10-0.15	5.6-6.0	Moderate-----	0.43			
	22-37	12-20	1.40-1.50	0.6-6.0	0.10-0.15	5.6-6.0	Low----------	0.32			
	37-60	2-10	1.50-1.60	6.0-20	0.06-0.10	5.1-5.5	Low----------	0.17			
733----------	0-41	28-33	1.25-1.30	0.6-2.0	0.21-0.23	7.4-8.4	High---------	0.28	5	7	5-7
Calco	41-60	30-35	1.25-1.30	0.6-2.0	0.21-0.23	7.4-8.4	High---------	0.28			
771B----------	0-13	19-24	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	2-3
Waubeek	13-31	25-34	1.25-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	31-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.43			
771C2, 771D2-----	0-8	19-24	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	1-2
Waubeek	8-30	25-34	1.25-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	30-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.43			
814, 814B--------	0-19	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	2-4
Rockton	19-24	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-7.3	Moderate-----	0.28			
	24	---	---	---	---	---	----------	----			
814C2----------	0-8	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	2-3
Rockton	8-24	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-7.3	Moderate-----	0.28			
	24	---	---	---	---	---	----------	----			
828B----------	0-13	14-18	1.50-1.55	2.0-6.0	0.14-0.16	5.6-7.3	Low----------	0.20	4	3	1-3
Zenor	13-28	14-18	1.55-1.60	2.0-6.0	0.13-0.15	6.1-8.4	Low----------	0.20			
	28-60	2-8	1.60-1.75	6.0-20	0.06-0.09	7.9-8.4	Low----------	0.10			
828C2----------	0-9	14-18	1.50-1.55	2.0-6.0	0.14-0.16	5.6-7.3	Low----------	0.20	4	3	1-2
Zenor	9-23	14-18	1.55-1.60	2.0-6.0	0.13-0.15	6.1-8.4	Low----------	0.20			
	23-60	2-8	1.60-1.75	6.0-20	0.06-0.09	7.9-8.4	Low----------	0.10			
933----------	0-32	27-35	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.28	5	7	5-7
Sawmill	32-38	27-35	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.28			
	38-60	25-35	1.30-1.45	0.6-2.0	0.17-0.20	6.1-7.8	Moderate-----	0.28			
936*:											
Coland----------	0-40	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
	40-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
Spillville------	0-52	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
	52-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28			
Hanlon----------	0-48	12-18	1.50-1.70	2.0-6.0	0.16-0.18	6.1-7.3	Low----------	0.20	5	3	2-3
	48-60	5-10	1.70-1.75	2.0-6.0	0.11-0.13	5.6-7.3	Low----------	0.20			
956*:											
Okoboji---------	0-7	35-42	1.25-1.30	0.2-0.6	0.21-0.23	6.1-7.8	High---------	0.37	5	4	9-18
	7-28	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.37			
	28-43	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High---------	0.37			
	43-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
Harps-----------	0-23	25-35	1.35-1.40	0.6-2.0	0.19-0.21	7.9-8.4	Moderate-----	0.24	5	4	9-18
	23-36	18-32	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
	36-60	20-26	1.50-1.70	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
1936*:											
Coland----------	0-40	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
	40-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
Spillville------	0-52	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
	52-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
1936*:											
Hanlon----------	0-48	12-18	1.50-1.70	2.0-6.0	0.16-0.18	6.1-7.3	Low----------	0.20	5	3	2-3
	48-60	5-10	1.70-1.75	2.0-6.0	0.11-0.13	5.6-7.3	Low----------	0.20			
4000*. Urban land											
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
6---------- Okoboji	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
7, 7B---------- Wiota	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
8B---------- Judson	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
11B*: Colo----------	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
Ely----------	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
20C2, 20D3, 20E3-- Killduff	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
27B---------- Terril	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
55---------- Nicollet	B	None--------	---	---	2.5-5.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
62C2, 62D2, 62E2, 62G2---------- Storden	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
73C, 73E---------- Salida	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
83C2---------- Kenyon	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
83E2---------- Kenyon	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
90---------- Okoboji	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
95---------- Harps	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
96---------- Turlin	B	Rare--------	---	---	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
107---------- Webster	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
118---------- Garwin	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
119, 119B---------- Muscatine	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
120B, 120C, 120C2, 120D2---------- Tama	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
122---------- Sperry	C/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
133---------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
135---------- Coland	B/D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
138B, 138C2, 138D2---------- Clarion	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
152---------- Marshan	B/D	None--------	---	---	1.0-2.5	Apparent	Oct-Jun	>60	---	High-----	High-----	Moderate.
162B, 162C2, 162D2---------- Downs	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
163B, 163C, 163D-- Fayette	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
168B, 168C, 168G-- Hayden	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
177, 177B, 177C--- Saude	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
178, 178B---------- Waukee	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
184, 184B---------- Klinger	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
188---------- Kensett	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	24-40	Hard	High-----	High-----	Low.
201B*: Coland----------	B/D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Terril----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
212---------- Kennebec	B	Rare--------	---	---	4.0-6.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
221---------- Palms	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
225, 226---------- Lawler	B	None--------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
236B, 236C, 236C2, 236D2, 236F------ Lester	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
284, 284B, 284C2-- Flagler	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
291---------- Atterberry	B	None--------	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
325---------- Le Sueur	B	None--------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	Low.
329*: Webster----------	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Nicollet---------	B	None--------	---	---	2.5-5.0	Apparent	Apr-May	>60	---	High-----	High-----	Low.
335---------- Harcot	B/D	Rare--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
377B, 377C2, 377D2---------- Dinsdale	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
382---------- Maxfield	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
393C, 393D-------- Sparta	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
409B, 409C-------- Dickinson	A	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
415G---------- Montieth	B	None--------	---	---	>6.0	---	---	24-40	Soft	Moderate	Low------	Moderate.
428B---------- Ely	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
457---------- Du Page	B	Occasional	Brief-----	Apr-Jun	4.0-6.0	Apparent	Nov-Jul	>60	---	Moderate	Low------	Low.
485---------- Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
491G---------- Renova	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
506---------- Wacousta	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
507---------- Canisteo	B/D	None--------	---	---	1.0-3.0	Apparent	Oct-Jul	>60	---	High-----	High-----	Low.
536---------- Hanlon	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jun	>60	---	Moderate	Moderate	Low.
595---------- Harpster	B/D	None--------	---	---	+.5-2.0	Apparent	Feb-Jun	>60	---	High-----	High-----	Low.
638C2*, 638D2*:												
Clarion----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Storden----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
696---------- Tilfer	B/D	None--------	---	---	0-2.0	Apparent	Nov-Jul	20-40	Hard	High-----	High-----	Low.
705C2, 705D2------ Downs Variant	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
733---------- Calco	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
771B, 771C2, 771D2---------- Waubeek	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
814, 814B, 814C2-- Rockton	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low------	Low.
828B, 828C2------- Zenor	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
933---------- Sawmill	B/D	Frequent----	Brief-----	Mar-Jun	0-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
936*:												
Coland----------	B/D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Spillville-------	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
Hanlon----------	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jun	>60	---	Moderate	Moderate	Low.
956*:												
Okoboji----------	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
Harps----------	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1936*:												
Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
Spillville	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
Hanlon	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jun	>60	---	Moderate	Moderate	Low.
4000*. Urban land												
5010*, 5030*. Pits												
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Atterberry	Fine-silty, mixed, mesic Udollic Ochraqualfs
Calco	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Clarion	Fine-loamy, mixed, mesic Typic Hapludolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Dinsdale	Fine-silty, mixed, mesic Typic Argiudolls
Downs	Fine-silty, mixed, mesic Mollic Hapludalfs
Downs Variant	Fine-silty, mixed, mesic Mollic Hapludalfs
Du Page	Fine-loamy, mixed, mesic Cumulic Hapludolls
Ely	Fine-silty, mixed, mesic Cumulic Hapludolls
Fayette	Fine-silty, mixed, mesic Typic Hapludalfs
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Garwin	Fine-silty, mixed, mesic Typic Haplaquolls
Hanlon	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Harcot	Fine-loamy over sandy or sandy-skeletal, mesic Typic Calciaquolls
Harps	Fine-loamy, mesic Typic Calciaquolls
Harpster	Fine-silty, mesic Typic Calciaquolls
Hayden	Fine-loamy, mixed, mesic Typic Hapludalfs
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Kensett	Fine-loamy, mixed, mesic Aquic Hapludolls
*Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Killduff	Fine-silty, mixed, mesic Dystric Eutrochrepts
Klinger	Fine-silty, mixed, mesic Aquic Hapludolls
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
*Le Sueur	Fine-loamy, mixed, mesic Aquic Argiudolls
Lester	Fine-loamy, mixed, mesic Mollic Hapludalfs
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Maxfield	Fine-silty, mixed, mesic Typic Haplaquolls
Montieth	Sandy, mixed, mesic Psammentic Hapludalfs
Muscatine	Fine-silty, mixed, mesic Aquic Hapludolls
Nicollet	Fine-loamy, mixed, mesic Aquic Hapludolls
Okoboji	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Orthents	Loamy, mixed, mesic Typic Udorthents
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
*Renova	Fine-loamy, mixed, mesic Typic Hapludalfs
*Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
Salida	Sandy-skeletal, mixed, mesic Entic Hapludolls
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Sawmill	Fine-silty, mixed, mesic Cumulic Haplaquolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Sperry	Fine, montmorillonitic, mesic Typic Argialbolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Tama	Fine-silty, mixed, mesic Typic Argiudolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tilfer	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Turlin	Fine-loamy, mixed, mesic Cumulic Hapludolls
Wacousta	Fine-silty, mixed, mesic Typic Haplaquolls
Waubeek	Fine-silty, mixed, mesic Mollic Hapludalfs
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Webster	Fine-loamy, mixed, mesic Typic Haplaquolls
Wiota	Fine-silty, mixed, mesic Typic Argiudolls
Zenor	Coarse-loamy, mixed, mesic Typic Hapludolls

* An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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