United States Department of Agriculture

Soil Conservation Service

In cooperation with Minnesota Agricultural Experiment Station

Soil Survey of Faribault County, Minnesota

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How To Use This Soil Survey

General Soil Map

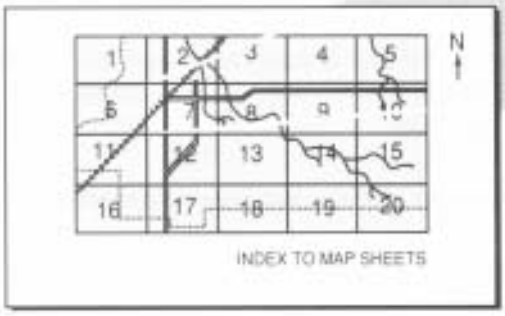
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

Detailed Soil Maps

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

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

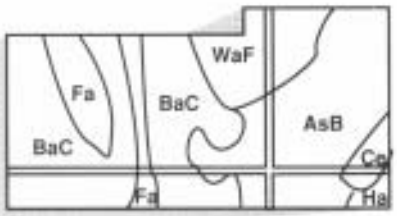


INDEX TO MAP SHEETS

MAP SHEET

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

MAP SHEET



AREA OF INTEREST

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

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

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

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station. It was partially funded by the Legislative Commission for Minnesota Resources and by Faribault County. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Faribault Soil and Water Conservation District.

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

Cover: Stripcropping in an area of the Clarion-Delft-Storden association.

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Issued June 1994

Index to Map Units

Summary of Tables

Foreword

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

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

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

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

Gary R. Nordstrom

Gary R. Nordstrom
State Conservationist
Soil Conservation Service

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Soil Survey of Faribault County, Minnesota

By Kenneth D. Matzdorf, Soil Conservation Service

Fieldwork by Donald O. Clark, John M. Galbraith, Thomas C. Jackson, and Kenneth D. Matzdorf, Soil Conservation Service, and Norman D. Kuhlman, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Minnesota Agricultural Experiment Station

FARIBAULT COUNTY borders Iowa in the south-central part of Minnesota (fig. 1). It has a total area of 461,600 acres, including about 4,500 acres of water. Blue Earth, the county seat, is about 120 miles east of the South Dakota border and about 10 miles north of the Iowa border.

About 80 percent of the county is farmed. The main crops are corn and soybeans, but oats, hay, and specialty crops, such as peas and sweetcorn, also are grown. The main kinds of livestock are hogs, beef and dairy cattle, and poultry.

The soils in Faribault County are very deep and dark colored. Slopes are generally gently sloping but range from nearly level to very steep. The soils formed in silty and clayey glacial lacustrine sediments, loamy glacial till, and loamy and sandy glacial outwash. The native vegetation consists of tall and medium prairie grasses. Some wooded areas are along streams and lakes.

This survey updates the soil survey of Faribault County published in 1957 *(13)*. It provides additional information and larger maps, which show the soils in greater detail.

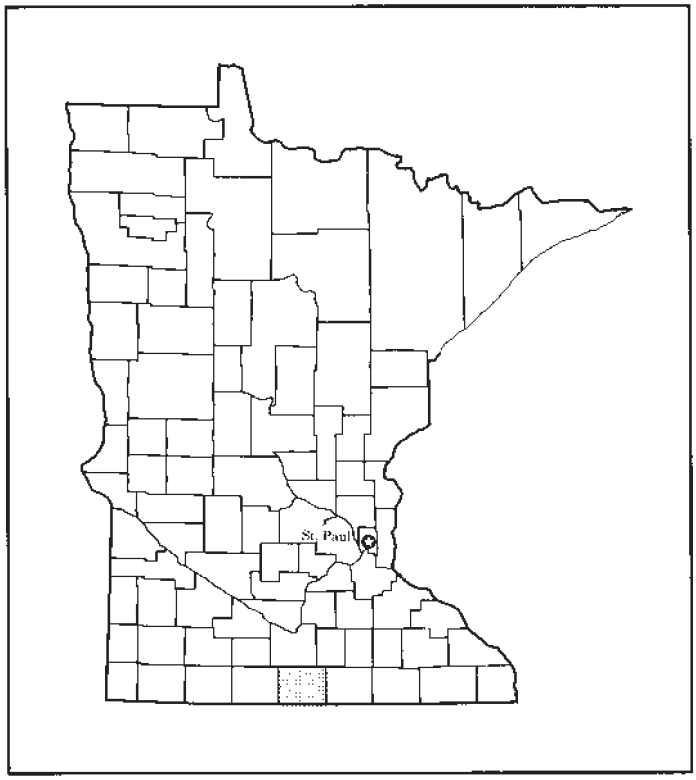

Figure 1.—Location of Faribault County in Minnesota.

General Nature of the County

This section provides general information about the survey area. It describes geology; history; and physiography, relief, and drainage.

Geology

The soils in Faribault County formed during the Quaternary Period. They are quite diverse, ranging from highly organic soils, such as the Histosols, to very young, mineral soils that have an undeveloped profile, such as the Entisols. Most of the soils are

several thousand years old, such as the Mollisols, and have well developed horizons *(10)*.

Glacial drift of Wisconsin age forms the uppermost geologic unit in Faribault County *(16, 17)*. It ranges to several hundred feet in thickness. Glacial till sediments cover about 46 percent of the county, glacial lacustrine deposits cover 45 percent, and glacial outwash deposits of sand and gravel cover 4 percent. About 5 percent of the county is covered by alluvium on flood plains.

History

The Sioux and Winnebago Indians lived along lakes and streams in the area that is now Faribault County before European settlers arrived. Two Indian sites, the Vosburg and the Humphrey, are listed in the roster of prehistoric sites in Minnesota *(3)*.

Faribault County was established in February 1855. It was named after Jean Baptiste Faribault, who was born in Canada and traveled extensively through the survey area on hunting and exploring expeditions. The population of the county increased from about 2,500 in late 1862 to 19,949 in 1910. It reached a peak of 23,941 in 1940 but had declined to 19,218 by 1983 *(6)*.

Physiography, Relief, and Drainage

The surface of Faribault County ranges from a nearly level to gently sloping lake plain in the northern part of the county to an undulating till plain in the southern part. The highest elevation, 1,432 feet, is in the southeast corner of the county, near Kiester. The lowest elevation, 986 feet, is where the Blue Earth River flows out of the county on the northern border *(15)*.

A lake plain, known as Glacial Lake Minnesota, which formed during the most recent glacial period, is in the northern part and much of the central part of the county. The depth to till in this area ranges from 0 to 28 feet, but it generally ranges from 2 to 4 feet in the north and from 4 to 10 feet in the south. In many small areas on the lake plain, glacial till is exposed at the surface. A glacial moraine called the Algona Moraine, also known as the "Kiester Hills," is in the southeast corner of the county *(5)*.

Faribault County is drained by the Blue Earth River system. In the western part of the county, water flows eastward through Elm, Center, and South Creeks. The East Fork of the Blue Earth River drains the southeastern part of the county and joins the main system in the city of Blue Earth. The Cobb and Maple Rivers drain the northeastern part of the county. They flow north and join the Le Sueur River, which empties into the Blue Earth River near Mankato *(15)*.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Winnebago, Minnesota, in the period 1951 to 1987. 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 16 degrees F and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Winnebago on January 22, 1970, is -30 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred on July 29, 1955, is 102 degrees.

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

Of the total annual precipitation, about 23 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.55 inches at Winnebago on July 19, 1963. Thunderstorms occur on about 41 days each year.

The average seasonal snowfall is about 49 inches. The greatest snow depth at any one time during the period of record was 36 inches. On the average, 90 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

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

Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration. They result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

How This Survey Was Made

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

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

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

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

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

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

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

Some of the boundaries on the soil maps of Faribault County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. The differences are a result of improvements in the classification of soils, particularly modifications or refinements in soil series concepts, and of differences in the intensity of mapping or in the extent of the soils in the survey areas.

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 two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a

taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

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

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

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

Soil Descriptions

1. Clarion-Delft-Storden Association

Nearly level to steep, well drained and poorly drained, loamy soils; on till plains (fig. 2)

Setting

Landform and position on the landform: Summits, shoulder slopes, back slopes, and toe slopes on till plains

Slope range: 1 to 24 percent, typically 1 to 15 percent

Composition

Percent of survey area: 5

Extent of components in the association:

Clarion and similar soils—27 percent
Delft and similar soils—24 percent
Storden and similar soils—17 percent
Minor soils—32 percent

Soil Properties and Qualities

Clarion

Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Delft

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Storden

Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Minor Soils

- The very poorly drained Glencoe soils in depressions
- The poorly drained Canisteo soils on rims of depressions
- The moderately well drained Nicollet soils on side slopes and back slopes
- The well drained Swanlake soils on shoulder slopes, summits, and ridges

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 90 percent of the acreage)

Secondary use: Pasture

Major management factors: Clarion and Storden—water erosion, slope; Delft—drainage

2. Beauford-Guckeen Association

Nearly level and gently sloping, poorly drained to moderately well drained, clayey and silty soils; on lake plains and on till plains that have a mantle of lacustrine material

Setting

Landform and position on the landform: Low summits, back slopes, swales, and side slopes on lake plains and on till plains that have a mantle of lacustrine material

Slope range: 0 to 6 percent

Composition

Percent of survey area: 2

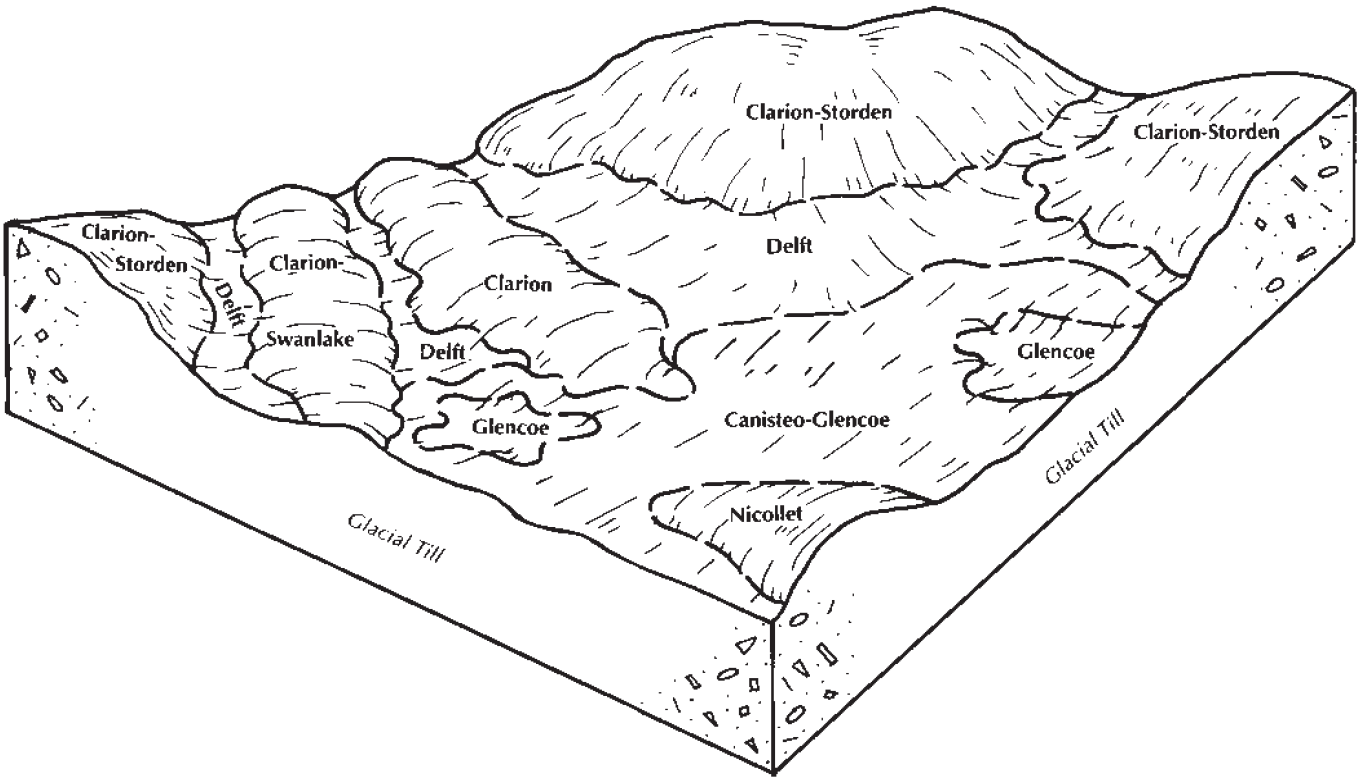

Figure 2.—Typical pattern of soils and parent material in the Clarion-Delft-Storden association.

Extent of components in the association:
Beauford and similar soils—54 percent
Guckeen and similar soils—18 percent
Minor soils—28 percent

Soil Properties and Qualities

Beauford

Drainage class: Poorly drained
Parent material: Clayey, calcareous glacial lacustrine sediments
Surface texture: Silty clay

Guckeen

Drainage class: Somewhat poorly drained or moderately well drained
Parent material: Silty, calcareous glacial till that has a mantle of lacustrine material
Surface texture: Silty clay loam

Minor Soils

- The poorly drained Marna and Waldorf soils in low areas
- The very poorly drained Barbert and Lura soils in depressions

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 98 percent of the acreage)
Major management factors: Beauford and Guckeen—compaction, drainage; Guckeen—water erosion

3. Spicer-Truman-Kingston Association

Nearly level to moderately steep, poorly drained, moderately well drained, and well drained, silty soils; on lake plains (fig. 3)

Setting

Landform and position on the landform: Summits, rims of depressions, side slopes, and back slopes on lake plains
Slope range: 0 to 16 percent

Composition

Percent of survey area: 11
Extent of components in the association:
Spicer and similar soils—25 percent
Truman and similar soils—23 percent

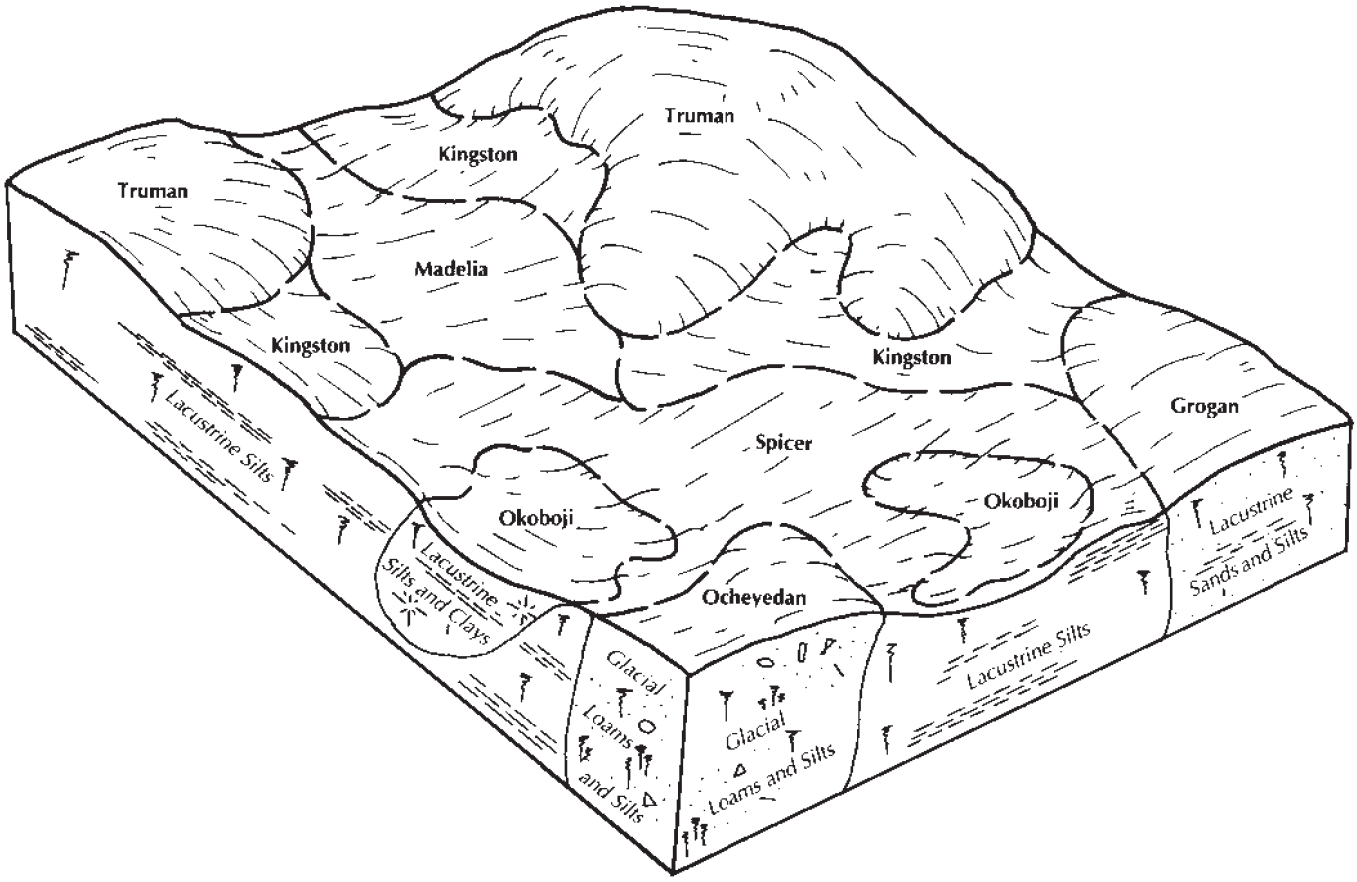

Figure 3.—Typical pattern of soils and parent material in the Spicer-Truman-Kingston association.

Kingston and similar soils—17 percent
Minor soils—35 percent

Soil Properties and Qualities

Spicer

Drainage class: Poorly drained
Parent material: Silty, calcareous glacial lacustrine sediments
Surface texture: Silt loam

Truman

Drainage class: Well drained
Parent material: Silty, calcareous glacial lacustrine sediments
Surface texture: Silt loam

Kingston

Drainage class: Moderately well drained
Parent material: Silty, calcareous lacustrine sediments
Surface texture: Silt loam

Minor Soils

- The very poorly drained Okoboji soils in depressions
- The poorly drained Madelia soils on the lower part of back slopes and in drainageways
- The well drained Grogan and Ocheyedan soils on summits and shoulder slopes

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 95 percent of the acreage)
Major management factors: Spicer—drainage, fertility, pH; Truman—water erosion; Kingston—none

4. Marna-Guckeen Association

Nearly level and gently sloping, poorly drained to moderately well drained, silty soils; on till plains that have a mantle of lacustrine material

Setting

Landform and position on the landform: Swales, low summits, and back slopes on till plains that have a mantle of lacustrine material

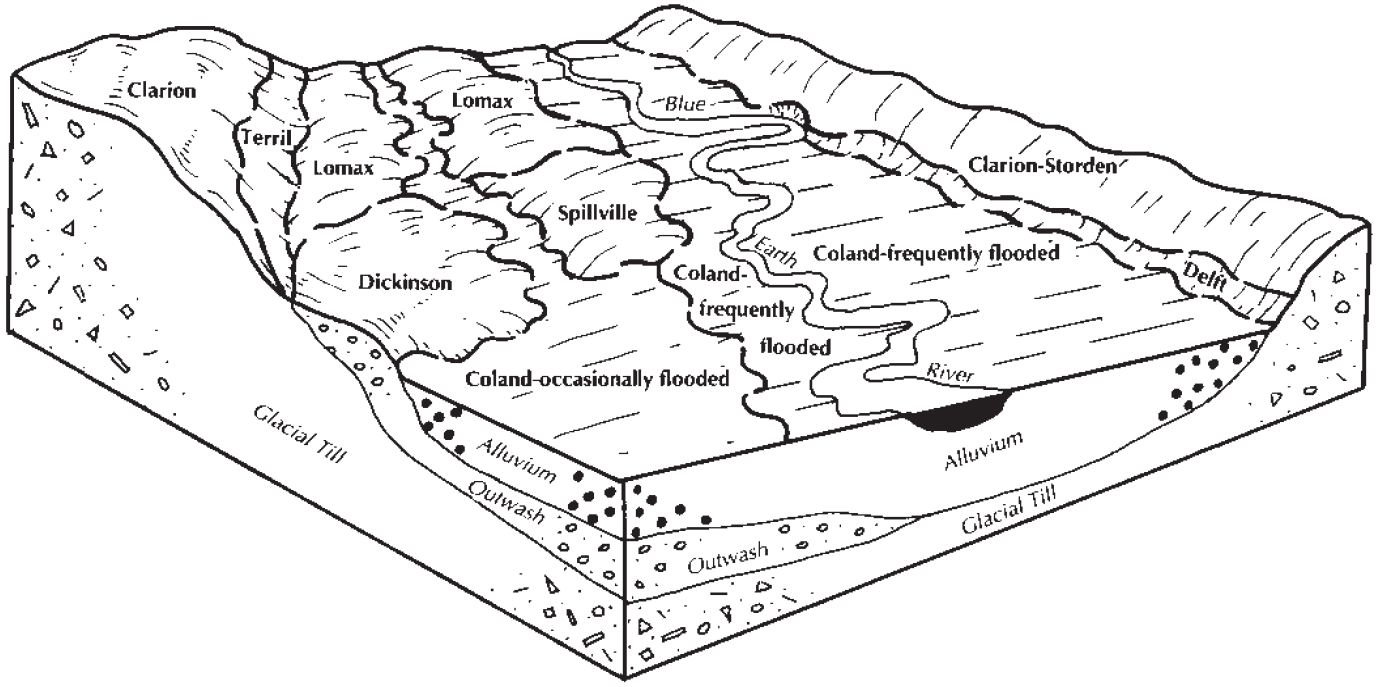

Figure 4.—Typical pattern of soils and parent material in the Coland-Clarion association.

Slope range: 0 to 6 percent

Composition

Percent of survey area: 12
Extent of components in the association:
Marna and similar soils—39 percent
Guckeen and similar soils—35 percent
Minor soils—26 percent

Soil Properties and Qualities

Marna

Drainage class: Poorly drained
Parent material: Silty and clayey, calcareous glacial till that has a mantle of lacustrine material
Surface texture: Silty clay loam

Guckeen

Drainage class: Somewhat poorly drained or moderately well drained
Parent material: Silty, calcareous glacial till that has a mantle of lacustrine material
Surface texture: Silty clay loam

Minor Soils

- The poorly drained Waldorf and Brownton soils in low areas
- The very poorly drained Okoboji and Klossner soils in depressions

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 98 percent of the acreage)
Major management factors: Marna and Guckeen—drainage, compaction; Guckeen—water erosion

5. Coland-Clarion Association

Nearly level to steep, poorly drained and well drained, loamy soils; on flood plains and till plains (fig. 4)

Setting

Landform and position on the landform: Meander belts on flood plains and side slopes, shoulder slopes, and summits on till plains
Slope range: 0 to 24 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Coland and similar soils—50 percent
Clarion and similar soils—15 percent
Minor soils—35 percent

Soil Properties and Qualities

Coland

Drainage class: Poorly drained

Parent material: Loamy alluvial sediments
Surface texture: Silty clay loam or loam

Clarion

Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Minor Soils

- The somewhat poorly drained Spillville soils on flood plains
- The poorly drained Delft soils in drainageways
- The moderately well drained Terril soils on side slopes
- The well drained Lomax soils on terraces
- The well drained or somewhat excessively drained Dickinson soils on outwash plains or till plains

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 80 percent of the acreage)
Secondary uses: Pasture, woodland wildlife habitat
Major management factors: Coland—drainage, flooding; Clarion—water erosion

6. Fieldon-Canisteo-Dickinson Association

Nearly level to sloping, poorly drained, well drained, and somewhat excessively drained, loamy soils; on outwash plains and till plains

Setting

Landform and position on the landform: Rims of depressions, linear back slopes, and low summits on outwash plains and till plains
Slope range: 0 to 12 percent

Composition

Percent of survey area: 5
Extent of components in the association:
Fieldon and similar soils—28 percent
Canisteo and similar soils—21 percent
Dickinson and similar soils—16 percent
Minor soils—35 percent

Soil Properties and Qualities

Fieldon

Drainage class: Poorly drained
Parent material: Loamy over sandy, calcareous glacial outwash
Surface texture: Loam

Canisteo

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Dickinson

Drainage class: Well drained or somewhat excessively drained
Parent material: Loamy over sandy, glacial outwash
Surface texture: Fine sandy loam

Minor Soils

- The very poorly drained Glencoe soils in depressions
- The poorly drained Coland soils on flood plains
- The somewhat poorly drained Fostoria soils on uplands
- The well drained Ocheyedan soils on uplands

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 95 percent of the acreage)
Secondary use: Pasture
Major management factors: Fieldon and Canisteo—drainage, fertility, pH; Dickinson—soil blowing, available water capacity, ground-water contamination

7. Canisteo-Clarion-Webster Association

Nearly level to sloping, poorly drained and well drained, loamy soils; on till plains

Setting

Landform and position on the landform: Rims of depressions, summits, and swales on till plains
Slope range: 0 to 12 percent

Composition

Percent of survey area: 31
Extent of components in the association:
Canisteo and similar soils—27 percent
Clarion and similar soils—23 percent
Webster and similar soils—15 percent
Minor soils—35 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Clay loam

Clarion

Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

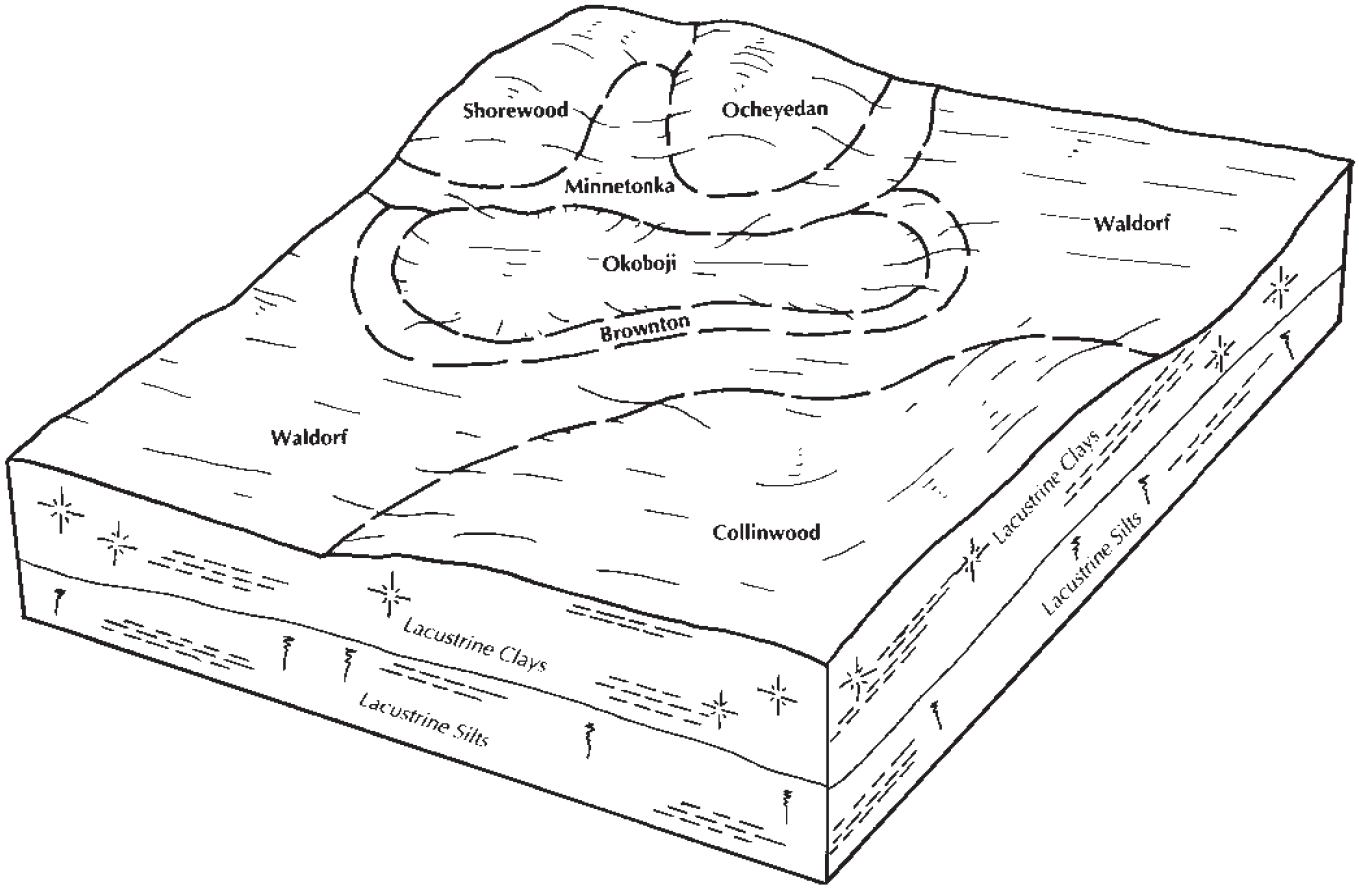

Figure 5.—Typical pattern of soils and parent material in the Waldorf-Collinwood association.

Webster

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Clay loam

Minor Soils

- The very poorly drained Glencoe and Klossner soils in depressions
- The moderately well drained or somewhat poorly drained Nicollet and Fostoria soils on back slopes and summits
- The poorly drained Delft soils on toe slopes

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 98 percent of the acreage)
Major management factors: Canisteo—drainage, fertility, pH; Clarion—water erosion; Webster—drainage

8. Waldorf-Collinwood Association

Nearly level and gently sloping, poorly drained to moderately well drained, silty soils; on lake plains (fig. 5)

Setting

Landform and position on the landform: Swales, back slopes, and low summits on lake plains
Slope range: 0 to 6 percent

Composition

Percent of survey area: 20
Extent of components in the association:
Waldorf and similar soils—39 percent
Collinwood and similar soils—26 percent
Minor soils—35 percent

Soil Properties and Qualities

Waldorf

Drainage class: Poorly drained

Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Surface texture: Silty clay loam

Collinwood

Drainage class: Somewhat poorly drained and moderately well drained
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Surface texture: Silty clay loam

Minor Soils

- The very poorly drained Okoboji soils in depressions
- The well drained Ocheyedan soils on uplands
- The moderately well drained and somewhat poorly drained Shorewood soils on uplands
- The poorly drained Brownton and Minnetonka soils on rims of depressions and in drainageways

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 98 percent of the acreage)
Major management factors: Waldorf and Collinwood—drainage, compaction; Collinwood—water erosion

9. Webster-Nicollet-Canisteo Association

Nearly level, moderately well drained and poorly drained, loamy soils; on till plains

Setting

Landform and position on the landform: Swales, back slopes, low summits, and rims of depressions on till plains
Slope range: 0 to 3 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Webster and similar soils—25 percent
Nicollet and similar soils—24 percent
Canisteo and similar soils—16 percent
Minor soils—35 percent

Soil Properties and Qualities

Webster

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Clay loam

Nicollet

Drainage class: Moderately well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Clay loam

Canisteo

Drainage class: Poorly drained
Parent material: Loamy, calcareous glacial till
Surface texture: Clay loam

Minor Soils

- The very poorly drained Glencoe and Klossner soils in depressions
- The well drained Clarion and Swanlake soils on uplands

Use and Management

Major use: Cultivated crops, mostly corn and soybeans (about 99 percent of the acreage)
Major management factors: Webster—drainage; Nicollet—none; Canisteo—drainage, fertility, pH

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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 the heading "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 characleristics 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, Coland silty clay loam, occasionally flooded, is a phase of the Coland series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Clarion-Storden-Estherville complex, 6 to 12 percent slopes, eroded, 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 and are called "contrasting inclusions." Such differences could significantly affect use and management of the soils in the map unit. Other included soils have properties that are similar to the named soil or soils. The properties of these "similar soils" do not significantly affect use and management. 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. The Pits component of the Pits, gravel-Udorthents complex 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.

Note to user.—This technical publication includes suggested management practices that are intended to maintain crop production, to control soil blowing and water erosion, and to reduce wetness. Over a period of time, some or all of these conservation practices may or may not be in accordance with Federal, State, and local laws and agency rules and guidelines.

Soil Descriptions

8B—Sparta loamy fine sand, 0 to 6 percent slopes

Composition

Sparta soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Summits on outwash plains or till plains

Shape of areas: Elongated
Size of areas: 5 to 20 acres

Typical Profile

0 to 12 inches—black and very dark grayish brown, very friable loamy fine sand
12 to 31 inches—dark brown and dark yellowish brown, loose loamy fine sand
31 to 60 inches—dark yellowish brown, loose fine sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Farrar soils, which are on shoulder slopes and have less sand
• The moderately well drained Litchfield soils in the lower areas
• The poorly drained Darfur soils, which are in the lower areas and have less sand

Similar soils:
• Soils that have a surface layer of fine sandy loam
• Soils that have a higher content of coarse sand and gravel

Use and Management

Cropland

Major crops: Small grain, corn, and soybeans
Major management factors: Droughtiness, soil blowing, fertility, ground-water contamination
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Crops respond well to applications of fertilizer if precipitation is adequate.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IVs
Windbreak suitability group: 7

27B—Dickinson fine sandy loam, 0 to 6 percent slopes

Composition

Dickinson soil and similar soils: 90 to 97 percent
Contrasting inclusions: 3 to 10 percent

Setting

Landform and position on the landform: Summits on outwash plains or till plains
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Typical Profile

0 to 14 inches—very dark brown and very dark grayish brown, friable fine sandy loam
14 to 39 inches—brown and dark yellowish brown, very friable sandy loam and fine sandy loam
39 to 60 inches—dark yellowish brown, loose loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion soils on shoulder slopes and back slopes
• The poorly drained Darfur soils in drainageways

Similar soils:
• Soils that have loamy fine sand or coarser textured material within a depth of 20 inches
• Soils that have layers of very fine sand and have more silt

Use and Management

Cropland

Major crops: Small grain, corn, and soybeans
Major management factors: Droughtiness, soil blowing, ground-water contamination
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.

• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 6G

27C—Dickinson fine sandy loam, 6 to 12 percent slopes

Composition

Dickinson soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex shoulder slopes and side slopes on outwash plains and till plains
Shape of areas: Elongated
Size of areas: 5 to 10 acres

Typical Profile

0 to 10 inches—black, friable fine sandy loam
10 to 31 inches—very dark gray and brown, friable fine sandy loam
31 to 43 inches—brown, very friable loamy sand
43 to 60 inches—dark yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Farrar soils on shoulder slopes and back slopes
• The poorly drained Darfur soils in drainageways
• The excessively drained Sparta soils, which are on summits and have more sand

Similar soils:
• Soils that have loamy fine sand or coarser textured material within a depth of 20 inches
• Soils that have layers of silt and have a higher content of very fine sand
• Soils that have a higher content of coarse sand and gravel

Use and Management

Cropland

Major crops: Small grain, corn, and soybeans
Major management factors: Droughtiness, soil blowing, ground-water contamination
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IVe
Windbreak suitability group: 6G

35—Blue Earth mucky silty clay loam

Composition

Blue Earth soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Depressions in drained lakebeds
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 25 to 200 acres

Typical Profile

0 to 10 inches—black, friable, calcareous mucky silty clay loam (coprogenous earth)
10 to 60 inches—black and very dark grayish brown, friable, mottled, calcareous mucky silty clay loam (coprogenous earth)

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Depth to water table: 2 feet above to 1 foot below the surface
Frequency of flooding: Rare (for brief periods in spring)

Inclusions

Contrasting inclusions:
• The poorly drained Fieldon and Canisteo soils on rims of depressions

Similar soils:
• Soils that have more organic matter in the surface layer
• Soils that have more sand in the surface layer

Use and Management

Cropland

Major management factors: Drainage, wetness, pH, fertility
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

37B—Farrar fine sandy loam, 1 to 6 percent slopes

Composition

Farrar soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Shoulder slopes and summits on till plains
Shape of areas: Elongated
Size of areas: 5 to 20 acres

Typical Profile

0 to 16 inches—very dark gray and very dark grayish brown, friable fine sandy loam
16 to 25 inches—brown, friable fine sandy loam
25 to 60 inches—brown and light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, moderate in the lower part
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Estherville soils, which are on shoulder slopes and back slopes and have more sand and gravel
• The moderately well drained Nicollet and Litchfield soils on the lower side slopes

Similar soils:
• Soils that have more silt in the underlying material

Use and Management

Cropland

Major crops: Corn, soybeans, and small grain
Major management factors: Soil blowing, water erosion
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

41B—Estherville sandy loam, 0 to 6 percent slopes

Composition

Estherville soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Summits on outwash plains and glacial moraines
Shape of areas: Elongated
Size of areas: 5 to 40 acres

Typical Profile

0 to 9 inches—black, friable sandy loam
9 to 19 inches—black and dark brown, friable sandy loam
19 to 60 inches—brown and dark grayish brown, loose, calcareous gravelly coarse sand and gravelly loamy coarse sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which have less sand and gravel

• The well drained Clarion and Storden soils, which are on the higher side slopes and have less sand and gravel

Similar soils:
• Soils that have glacial till within a depth of 40 inches
• Soils that have little or no gravel

Use and Management

Cropland

Major crops: Small grain, corn, and soybeans
Major management factors: Droughtiness, soil blowing, ground-water contamination
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIIs
Windbreak suitability group: 7

84—Brownton silty clay loam

Composition

Brownton soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Rims of depressions and nearly plane areas on lake plains
Slope range: 0 to 1
Shape of areas: Doughnut-like or long and wide with smooth edges
Size of areas: 10 to 75 acres

Typical Profile

0 to 16 inches—black and very dark gray, friable, calcareous silty clay loam
16 to 60 inches—very dark gray, light olive gray, olive gray, and gray, firm, mottled, calcareous silty clay loam and silty clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Okoboji soils in depressions
• The poorly drained Waldorf soils in drainageways

Similar soils:
• Soils that have a thicker dark surface layer
• Soils having a subsoil that has less clay
• Soils that have crystals of gypsum on or near the surface

Use and Management

Cropland

Major management factors: Drainage, fertility, pH
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

86—Canisteo clay loam

Composition

Canisteo soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Rims of depressions and nearly plane areas on till plains
Slope range: 0 to 2 percent
Shape of areas: Doughnut-like or long and wide with smooth edges
Size of areas: 10 to 100 acres

Typical Profile

0 to 18 inches—black, friable, calcareous clay loam
18 to 25 inches—grayish brown, friable, mottled, calcareous loam
25 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The very poorly drained, noncalcareous Glencoe soils in depressions
- The poorly drained, noncalcareous Webster soils in drainageways

Similar soils:
- Soils that have crystals of gypsum on or near the surface
- Soils that have sandy or silty sediments throughout the profile

Use and Management

Cropland

Major management factors: Drainage, fertility, pH
- Most of the climatically adapted crops can be grown if adequate drainage is provided.
- Only plants that tolerate a high pH level should be selected for planting.
- Most crops respond well to applications of nitrogen, phosphorus, and potassium.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

94B—Terril loam, 2 to 6 percent slopes

Composition

Terril soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and foot slopes on alluvial fans
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Typical Profile

0 to 22 inches—black, friable loam
22 to 36 inches—very dark gray, friable, mottled loam
36 to 40 inches—brown, friable, mottled clay loam
40 to 60 inches—light olive brown, friable, mottled loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The well drained Clarion and Swanlake soils in the higher positions on the landscape
- The poorly drained Webster and Delft soils in drainageways

Similar soils:
- Soils that have more sand
- Soils that have more silt
- Soils that have glacial till within a depth of 40 inches

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
- Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

96A—Collinwood silty clay loam, 0 to 3 percent slopes

Composition

Collinwood soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Linear to slightly convex back slopes on lake plains
Shape of areas: Moderately long and wide with lobate edges
Size of areas: 10 to 50 acres

Typical Profile

0 to 16 inches—black, friable silty clay loam
16 to 32 inches—very dark grayish brown and olive brown, firm, mottled clay and silty clay
32 to 60 inches—yellowish brown, firm, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2.0 to 3.5 feet

Inclusions

Contrasting inclusions:
• The well drained Truman soils in the higher areas
• The poorly drained Waldorf soils in the lower areas and in drainageways

Similar soils:
• Soils that have glacial till within a depth of 40 inches
• Soils that have less clay

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 4L

96B—Collinwood silty clay loam, 3 to 6 percent slopes

Composition

Collinwood soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Summits and convex back slopes on lake plains
Shape of areas: Moderately long and moderately wide with lobate edges
Size of areas: 5 to 25 acres

Typical Profile

0 to 10 inches—black, firm silty clay loam
10 to 39 inches—very dark gray, dark grayish brown, and light olive brown, firm, mottled silty clay loam and silty clay
39 to 60 inches—light olive brown, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Medium
Depth to water table: 3.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Waldorf soils in the lower areas and in drainageways
• The well drained Truman soils in the higher areas and on shoulder slopes

Similar soils:
• Soils that have glacial till within a depth of 40 inches
• Soils that have slopes of less than 3 percent or more than 6 percent
• Soils that are eroded

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 4L

101B—Truman silt loam, 1 to 6 percent slopes

Composition

Truman soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and summits on lake plains
Shape of areas: Elongated
Size of areas: 5 to 40 acres

Typical Profile

0 to 10 inches—black, friable silt loam
10 to 39 inches—dark brown and yellowish brown, friable silt loam
39 to 60 inches—yellowish brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Grogan soils on side slopes

• The moderately well drained Kingston and poorly drained Madelia and Spicer soils in the lower areas

Similar soils:
• Soils having carbonates that are closer to the surface
• Soils that have a loamy mantle
• Soils that have a higher content of fine sand

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

102B—Clarion loam, 1 to 6 percent slopes

Composition

Clarion soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Summits and shoulder slopes on till plains
Shape of areas: Elongated
Size of areas: 5 to 75 acres

Typical Profile

0 to 16 inches—black and very dark gray, friable loam
16 to 28 inches—brown, friable loam
28 to 60 inches—yellowish brown and light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Storden and Swanlake soils on shoulder slopes
• The poorly drained Canisteo and Webster soils in the lower areas and in drainageways
• The moderately well drained Nicollet soils in the lower areas

Similar soils:
• Soils that have sandy or silty sediments in the surface layer or subsoil
• Soils that are eroded

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

110—Marna silty clay loam

Composition

Marna soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Concave swales and linear back slopes on lake plains and lacustrine-mantled till plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with curvilinear edges
Size of areas: 3 to 80 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 34 inches—black and dark grayish brown, firm, mottled silty clay
34 to 60 inches—olive gray and grayish brown, friable, mottled, calcareous loam and clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow in the upper part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Okoboji soils in depressions
• The poorly drained Brownton soils on slight rises
• The somewhat poorly drained Guckeen soils in the higher areas

Similar soils:
• Soils that have a thicker dark surface layer

• Soils that are more than 40 inches deep over till

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

113—Webster clay loam

Composition

Webster soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lower foot slopes, toe slopes, and swales on till plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and moderately wide with curvilinear edges
Size of areas: 10 to 100 acres

Typical Profile

0 to 18 inches—black and very dark gray, friable, mottled clay loam
18 to 29 inches—dark grayish brown, friable, mottled clay loam
29 to 44 inches—grayish brown, friable, mottled loam
44 to 60 inches—gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 2 feet

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Canisteo soils on rims of depressions
• The very poorly drained Glencoe soils in depressions
• The moderately well drained Nicollet soils on slight rises

Similar soils:
• Soils that have a thicker dark surface layer
• Soils that have a calcareous surface layer

Use and Management

Cropland

Major management factors: Drainage
• Most of the climatically adapted crops can be grown if adequate drainage is provided.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

114—Glencoe clay loam

Composition

Glencoe soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions and swales on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 5 to 40 acres

Typical Profile

0 to 24 inches—black, firm clay loam
24 to 52 inches—very dark gray and olive gray, firm, mottled clay loam
52 to 60 inches—olive, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Slow to ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Canisteo soils on rims of depressions
• The poorly drained Webster soils in the slightly higher areas
• The very poorly drained Klossner soils, which are near the center of depressions and formed in muck

Similar soils:
• Soils that have a thinner dark surface layer
• Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Drainage, wetness, ponding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

118—Crippin loam

Composition

Crippin soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex back slopes on till plains
Slope range: 0 to 3 percent
Shape of areas: Short and narrow with lobate edges
Size of areas: 5 to 15 acres

Typical Profile

0 to 15 inches—black, very dark gray, and dark grayish brown, friable, calcareous loam
15 to 25 inches—dark grayish brown, friable, mottled, calcareous loam
25 to 60 inches—grayish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo soils on rims of depressions
• The well drained Clarion and Swanlake soils in the higher areas

Similar soils:
• Soils that have a brighter colored subsurface layer
• Soils that have slopes of more than 3 percent

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: None
• This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1K

128B—Grogan silt loam, 1 to 6 percent slopes

Composition

Grogan soil and similar soils: 90 to 97 percent
Contrasting inclusions: 3 to 10 percent

Setting

Landform and position on the landform: Shoulder slopes and summits on lake plains
Shape of areas: Elongated
Size of areas: 5 to 35 acres

Typical Profile

0 to 18 inches—very dark brown and very dark grayish brown, friable silt loam
18 to 30 inches—dark yellowish brown, friable very fine sandy loam
30 to 60 inches—yellowish brown and light olive brown, very friable, mottled, calcareous, stratified silt loam, very fine sandy loam, and loamy very fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow or medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Ocheyedan and Clarion soils on shoulder slopes
• The very poorly drained Madelia soils in drainageways

Similar soils:
• Soils that have more sand
• Soils that have more silt

Use and Management

Cropland

Major crops: Small grain, corn, and soybeans

Major management factors: Water erosion, soil blowing
• Chisel plowing across the slope reduces the hazard of erosion.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

130—Nicollet clay loam

Composition

Nicollet soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes, back slopes, and concave summits on till plains
Slope range: 1 to 3 percent
Shape of areas: Short and narrow with curvilinear edges
Size of areas: 5 to 40 acres

Typical Profile

0 to 16 inches—black and very dark grayish brown, friable clay loam
16 to 29 inches—dark grayish brown, friable, mottled clay loam
29 to 60 inches—light olive brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion soils in the higher areas
• The poorly drained Webster soils in drainageways

Similar soils:
• Soils that have more silt
• Soils that have more clay in the subsoil
• Soils that have a calcareous surface layer

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: None
• This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1

134—Okoboji silty clay loam

Composition

Okoboji soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions and swales on lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 10 to 60 acres

Typical Profile

0 to 18 inches—black, friable silty clay loam
18 to 26 inches—black, friable, mottled silty clay loam
26 to 60 inches—dark gray, firm, mottled silty clay and friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow in the upper part, moderate in the lower part
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Slow to ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Spicer and Canisteo soils on rims of depressions
• The very poorly drained Klossner soils, which are near the center of depressions and formed in muck

Similar soils:
• Soils that have a calcareous surface layer
• Soils that have glacial till within a depth of 40 inches

Use and Management

Cropland

Major management factors: Drainage, wetness, ponding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

136—Madelia silty clay loam

Composition

Madelia soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: The lower foot slopes and swales on lake plains
Slope range: 0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 10 to 60 acres

Typical Profile

0 to 15 inches—black, friable, mottled silty clay loam
15 to 27 inches—dark grayish brown, firm, mottled silty clay loam
27 to 60 inches—grayish brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Spicer soils on rims of depressions
• The moderately well drained Kingston soils in the slightly higher areas

Similar soils:
• Soils that have a thicker dark surface layer
• Soils that have less silt and more sand

Use and Management

Cropland

Major management factors: Drainage
• Most of the climatically adapted crops can be grown if adequate drainage is provided.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

140—Spicer silt loam

Composition

Spicer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Rims of depressions and nearly plane areas on lake plains
Slope range: 0 to 2 percent
Shape of areas: Doughnut-like or long and wide with smooth edges
Size of areas: 5 to 75 acres

Typical Profile

0 to 9 inches—black, friable, calcareous silt loam
9 to 34 inches—mixed very dark gray, dark grayish brown, and olive gray, friable, mottled, calcareous silt loam and silty clay loam
34 to 60 inches—light olive gray, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Okoboji soils in depressions
• The poorly drained Madelia soils in drainageways
• The moderately well drained Kingston soils on slight rises

Similar soils:
• Soils that have a thicker dark surface layer
• Soils that have a noncalcareous surface layer
• Soils that have more clay in the surface and subsurface layers

Use and Management

Cropland

Major management factors: Drainage, fertility, pH
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

160—Fieldon loam

Composition

Fieldon soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Rims of depressions and linear back slopes on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Doughnut-like or long and wide with smooth edges
Size of areas: 5 to 40 acres

Typical Profile

0 to 10 inches—black, friable, calcareous loam
10 to 28 inches—very dark gray and dark grayish brown, friable, mottled, calcareous fine sandy loam
28 to 60 inches—olive brown, friable, mottled, calcareous fine sandy loam that is stratified with very fine sandy loam and loamy very fine sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Litchfield soils on slight rises
• The very poorly drained Glencoe soils in depressions

Similar soils:
• Soils that have a noncalcareous surface layer
• Soils that have a thicker dark surface layer
• Soils that have more sand

Use and Management

Cropland

Major management factors: Drainage, fertility, ground-water contamination, pH
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

181—Litchfield fine sandy loam

Composition

Litchfield soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Low summits and linear back slopes on outwash plains
Slope range: 0 to 3 percent
Shape of areas: Moderately long and moderately wide with lobate edges
Size of areas: 5 to 35 acres

Typical Profile

0 to 17 inches—black, very dark grayish brown, and very dark gray, very friable fine sandy loam
17 to 60 inches—brown, dark grayish brown, and grayish brown, loose, mottled, stratified fine sand, very fine sandy loam, and loamy very fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Depth to water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils in the higher areas
• The poorly drained Darfur soils in drainageways
• The poorly drained, calcareous Fieldon soils in the lower areas

Similar soils:
• Soils that have less sand in the surface layer
• Soils that have gravel

Use and Management

Cropland

Major crops: Small grain, corn, or soybeans
Major management factors: Droughtiness, ground-water contamination, soil blowing
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIs
Windbreak suitability group: 1

197—Kingston silt loam

Composition

Kingston soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Side slopes, back slopes, and concave summits on lake plains
Slope range: 0 to 3 percent
Shape of areas: Moderately long and moderately wide with smooth edges
Size of areas: 10 to 40 acres

Typical Profile

0 to 10 inches—black, friable silt loam
10 to 37 inches—very dark gray, olive brown, and grayish brown, friable, mottled silty clay loam
37 to 60 inches—grayish brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The well drained, calcareous Bold soils in the higher areas
• The poorly drained Madelia soils in drainageways
• The poorly drained, calcareous Spicer soils in the lower areas

Similar soils:
• Soils that have glacial till
• Soils that have mottles below a depth of 30 inches

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: None
• This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1

211—Lura silty clay

Composition

Lura soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on lake plains
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 3 to 100 acres

Typical Profile

0 to 34 inches—black, firm silty clay
34 to 50 inches—black and olive gray, firm, mottled silty clay
50 to 60 inches—olive gray, firm, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Slow in the upper part, slow or moderately slow in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow to ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Klossner soils, which are near the center of depressions and formed in muck
• The poorly drained, calcareous Brownton soils on rims of depressions

Similar soils:
• Soils that have glacial till
• Soils that have less clay

Use and Management

Cropland

Major management factors: Drainage, soil compaction, wetness, ponding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

229—Waldorf silty clay loam

Composition

Waldorf soil and similar soils: 88 to 97 percent
Contrasting inclusions: 3 to 12 percent

Setting

Landform and position on the landform: Swales and linear back slopes on lake plains
Slope range: 0 to 1 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to 250 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 38 inches—very dark gray, dark grayish brown, grayish brown, and olive gray, firm, mottled silty clay and clay
38 to 60 inches—olive gray, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow in the middle part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 0 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Brownton soils on rims of depressions
• The very poorly drained Okoboji soils in depressions
• The somewhat poorly drained Collinwood soils in the higher areas

Similar soils:
• Soils that have glacial till within a depth of 40 inches

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

230A—Guckeen silty clay loam, 0 to 3 percent slopes

Composition

Guckeen soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Low summits and back slopes on lake plains and lacustrine-mantled till plains
Shape of areas: Moderately long and wide with lobate edges
Size of areas: 4 to 30 acres

Typical Profile

0 to 16 inches—black, friable silty clay loam
16 to 24 inches—dark grayish brown, firm silty clay loam
24 to 60 inches—dark grayish brown and olive gray, friable, mottled, calcareous loam and clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 2.0 to 3.5 feet

Inclusions

Contrasting inclusions:
• The poorly drained Waldorf and Marna soils in drainageways
• The very poorly drained Okoboji soils in depressions
• The well drained Ocheyedan soils on convex rises

Similar soils:
• Soils that have less clay and more sand in the surface layer
• Soils that have more clay and less sand in the underlying material
• Soils that are poorly drained

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIw

Windbreak suitability group: 4L

230B—Guckeen silty clay loam, 3 to 6 percent slopes

Composition

Guckeen soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes, summits, and shoulder slopes on lake plains and lacustrine-mantled till plains
Shape of areas: Moderately long and moderately wide with lobate edges
Size of areas: 4 to 80 acres

Typical Profile

0 to 17 inches—black and dark brown, friable silty clay loam
17 to 24 inches—olive brown, friable, mottled silty clay loam
24 to 60 inches—dark grayish brown and grayish brown, friable, mottled, calcareous loam and clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 3.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Okoboji soils in depressions
• The poorly drained Waldorf and Marna soils in drainageways
• The well drained Ocheyedan soils on convex rises

Similar soils:
• Soils that have more clay and less sand in the underlying material
• Soils that have layers of sandy or gravelly material in the subsoil and substratum
• Soils that are somewhat poorly drained

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 4L

247—Linder loam

Composition

Linder soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Low summits on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Elongated
Size of areas: 5 to 40 acres

Typical Profile

0 to 22 inches—black and very dark gray, friable loam
22 to 26 inches—dark grayish brown, friable, mottled sandy loam
26 to 60 inches—grayish brown and light olive brown, loose, mottled, calcareous sand and loamy sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderately rapid in the middle part, very rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Coland and Biscay soils in the lower areas
• The well drained Dickinson and Estherville soils in the higher areas

Similar soils:
• Soils that have a brighter colored subsoil
• Soils that are more than 3 feet deep over sand and gravel

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Droughtiness, ground-water contamination
• The best suited crops are those that can withstand drought.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIs
Windbreak suitability group: 1

248—Lomax loam

Composition

Lomax soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Slight rises on stream terraces
Slope range: 0 to 3 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 10 to 40 acres

Typical Profile

0 to 25 inches—very dark gray and black, friable loam
25 to 60 inches—very dark gray and brown, very friable sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to water table: More than 6 feet
Frequency of flooding: Rare (in spring or after heavy or prolonged rainfall)

Inclusions

Contrasting inclusions:
• The moderately well drained Spillville soils in drainageways
• The poorly drained Coland soils in the lower areas
• Spillville and Coland soils that have more clay and less sand

Similar soils:
• Soils that have a surface layer of fine sandy loam

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: None
• This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 5

255—Mayer loam

Composition

Mayer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Swales and linear back slopes on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 5 to 50 percent

Typical Profile

0 to 23 inches—black and very dark gray, friable, calcareous loam
23 to 39 inches—grayish brown and olive gray, friable, mottled, calcareous sandy clay loam and loam
39 to 60 inches—dark grayish brown, loose, mottled, calcareous coarse sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils in depressions
• The somewhat poorly drained Linder soils on slight rises

Similar soils:
• Soils that have a noncalcareous surface layer
• Soils that are deeper over sand and gravel

Use and Management

Cropland

Major management factors: Drainage, fertility, ground-water contamination, pH
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

269—Millington clay loam

Composition

Millington soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Meander belts on flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 10 to 40 acres

Typical Profile

0 to 24 inches—black, friable, calcareous clay loam
24 to 43 inches—very dark gray and grayish brown, friable, mottled, calcareous clay loam and loam
43 to 60 inches—grayish brown, friable, mottled, calcareous, stratified fine sandy loam, loam, and clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 0.5 feet above to 2.0 feet below the surface
Frequency of flooding: Occasional (for brief periods in spring)

Inclusions

Contrasting inclusions:
• The moderately well drained Spillville soils on slight rises
• The poorly drained, noncalcareous Coland soils in old drainageways or stream channels

Similar soils:
• Soils that have strata of gravel or sand in the underlying material
• Soils that have a noncalcareous surface layer

Use and Management

Cropland

Major management factors: Drainage, fertility, pH
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

275B—Ocheyedan loam, 2 to 6 percent slopes

Composition

Ocheyedan soil and similar soils: 80 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Summits and shoulder slopes on the borders of till plains and lake plains
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Typical Profile

0 to 10 inches—black, friable loam
10 to 30 inches—dark brown, friable loam
30 to 60 inches—yellowish brown, friable, mottled, calcareous silt loam and loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Fostoria and Kingston soils in the lower areas
• The well drained Grogan soils, which have more silt and very fine sand

Similar soils:
• Soils that have glacial till in the underlying material
• Soils that have a surface layer of silt loam

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

275C2—Ocheyedan loam, 6 to 12 percent slopes, eroded

Composition

Ocheyedan soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Summits, shoulder slopes, and side slopes on the borders of till plains and lake plains
Shape of areas: Elongated
Size of areas: 4 to 20 acres

Typical Profile

0 to 9 inches—very dark brown, friable loam
9 to 23 inches—brown, friable loam
23 to 60 inches—yellowish brown and light olive brown, friable, mottled, calcareous, stratified silt loam and loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained, calcareous Storden and Bold soils
• The somewhat poorly drained Fostoria soils in the lower areas

Similar soils:
• Soils that have glacial till in the underlying material
• Soils that have a surface layer of silt loam or sandy loam

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Terraces, diversions, grassed waterways, and chisel plowing across the slope reduce the hazard of erosion.
• Using minimum tillage and including high-residue crops or alfalfa in the rotation reduce the hazard of erosion.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 3

281—Darfur loam

Composition

Darfur soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Swales and linear back slopes on outwash plains
Slope range: 0 to 1 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 4 to 30 acres

Typical Profile

0 to 22 inches—black and very dark gray, friable loam
22 to 36 inches—dark grayish brown, friable, mottled fine sandy loam
36 to 60 inches—grayish brown, very friable, mottled, stratified fine sandy loam, loamy fine sand, loamy sand, and fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately rapid in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Litchfield soils in the higher areas
• The poorly drained, calcareous Fieldon soils in convex areas

Similar soils:
• Soils that have a thicker dark surface layer
• Soils that are very poorly drained

Use and Management

Cropland

Major management factors: Drainage, ground-water contamination
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

286A—Shorewood silty clay loam, 0 to 3 percent slopes

Composition

Shorewood soil and similar soils: 90 to 95 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Low summits and linear back slopes on lake plains
Shape of areas: Moderately long and wide with lobate edges
Size of areas: 5 to 50 acres

Typical Profile

0 to 11 inches—black, friable silty clay loam
11 to 37 inches—dark grayish brown and grayish brown, firm, mottled silty clay
37 to 60 inches—light olive brown, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the middle part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
- The poorly drained Minnetonka soils in drainageways
- The well drained Ocheyedan soils on shoulder slopes

Similar soils:
- Soils that do not have dark clay films in the B horizon
- Soils that have slopes of more than 3 percent

Use and Management

Cropland

Major management factors: Drainage, soil compaction
- Most of the climatically adapted crops can be grown if adequate drainage is provided.
- If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Woodland wildlife habitat

Major trees: Native oak and hickory
Major management factors: Wetness
- Only trees and shrubs that tolerate wetness should be planted.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 4L

286B—Shorewood silty clay loam, 3 to 6 percent slopes

Composition

Shorewood soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Summits and side slopes on lake plains
Shape of areas: Moderately long and moderately wide with lobate edges
Size of areas: 5 to 40 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 35 inches—dark brown and olive brown, firm, mottled silty clay loam
35 to 60 inches—light olive brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the middle part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 3 to 5 feet

Inclusions

Contrasting inclusions:
- The poorly drained Minnetonka soils in drainageways
- The well drained Ocheyedan soils on shoulder slopes

Similar soils:
- Soils that do not have dark clay films in the B horizon
- Soils that have slopes of more than 6 percent

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
- Chisel plowing across the slope reduces the hazard of erosion.

Woodland wildlife habitat

Major trees: Native oak and hickory
Major management factors: Water erosion
• The hazard of erosion can be reduced by limiting surface disturbance.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 4L

286C2—Shorewood silty clay loam, 6 to 12 percent slopes, eroded

Composition

Shorewood soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Summits, shoulder slopes, and side slopes on lake plains
Shape of areas: Elongated
Size of areas: 4 to 25 acres

Typical Profile

0 to 9 inches—very dark gray, friable silty clay loam
9 to 29 inches—dark grayish brown, firm, mottled silty clay and silty clay loam
29 to 60 inches—grayish brown, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the middle part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: 4 to 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Minnetonka soils in drainageways
• The well drained Ocheyedan and Truman soils on shoulder slopes

Similar soils:
• Soils that do not have dark clay films in the B horizon
• Soils that have slopes of more than 12 percent

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Terraces, diversions, grassed waterways, and chisel plowing across the slope reduce the hazard of erosion.
• Using minimum tillage and including high-residue crops or alfalfa in the rotation reduce the hazard of erosion.

Woodland wildlife habitat

Major trees: Native oak and hickory
Major management factors: Water erosion
• Limiting surface disturbance and planting trees on the contour reduce the hazard of erosion.
• Establishing roads and trails on the contour helps to control erosion.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 4L

287—Minnetonka silty clay loam

Composition

Minnetonka soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Swales and linear back slopes on lake plains
Slope range: 0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 10 to 80 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 43 inches—black, dark gray, and olive gray, firm, mottled silty clay loam and silty clay
43 to 60 inches—light brownish gray, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow in the upper part, slow in the middle part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 0 to 3 feet

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Shorewood and Guckeen soils in the higher areas
• The very poorly drained Barbert and Okoboji soils in depressions

Similar soils:
• Soils that have a calcareous surface layer
• Soils that have less clay in the B horizon

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Woodland wildlife habitat

Major trees: Cottonwood, willow, and maple
Major management factors: Wetness
• Only trees and shrubs that tolerate wetness should be planted.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

310—Beauford silty clay

Composition

Beauford soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Swales and linear back slopes on lake plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to more than 300 acres

Typical Profile

0 to 9 inches—black, friable silty clay
9 to 45 inches—black and olive gray, firm, mottled clay
45 to 60 inches—grayish brown, friable, mottled, calcareous, stratified clay loam, silty clay, and silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Lura and Barbert soils in depressions
• The somewhat poorly drained Guckeen soils in the higher areas

Similar soils:
• Soils that have less clay
• Soils that have a calcareous surface layer

Use and Management

Cropland

Major management factors: Drainage, soil compaction
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

313—Spillville loam

Composition

Spillville soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Splays in flood plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and moderately wide with smooth edges
Size of areas: 5 to 50 acres

Typical Profile

0 to 19 inches—black, friable loam
19 to 60 inches—very dark brown and very dark grayish brown, friable, mottled loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 3 to 5 feet
Frequency of flooding: Occasional (for very brief periods in spring or after heavy or prolonged rainfall)

Inclusions

Contrasting inclusions:
• The poorly drained Coland soils in the lower areas

• The somewhat poorly drained Linder soils on the higher terraces

Similar soils:
• Soils that have a surface layer of sandy loam
• Soils that have more sand or gravel in the underlying material

Use and Management

Cropland

Major management factors: Drainage
• Most of the climatically adapted crops can be grown if adequate drainage is provided.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 1

319—Barbert silty clay loam

Composition

Barbert soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Shallow depressions and swales on lake plains
Slope range: 0 to 1 percent
Shape of areas: Circular or elongated
Size of areas: 4 to 50 acres

Typical Profile

0 to 10 inches—black and very dark gray, friable silty clay loam
10 to 14 inches—very dark gray, friable silty clay loam
14 to 25 inches—dark gray, friable, mottled silt loam
25 to 50 inches—very dark gray, dark olive gray, and olive gray, firm, mottled silty clay and clay
50 to 60 inches—olive gray, friable, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Slow or moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow to ponded
Depth to water table: 1 foot below to 1 foot above the surface

Inclusions

Contrasting inclusions:
• The poorly drained Waldorf soils in nearly level areas above areas of the Barbert soil
• The somewhat poorly drained Collinwood soils in the higher areas

Similar soils:
• Soils that have glacial till within a depth of 40 inches
• Soils that have a darker subsurface layer

Use and Management

Cropland

Major management factors: Drainage, soil compaction, wetness, ponding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.
• If worked or grazed during wet periods, this soil becomes compacted and cloddy. Returning crop residue to the soil and minimizing tillage reduce compaction.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

336—Delft loam

Composition

Delft soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Toe slopes on till plains
Slope range: 1 to 3 percent
Shape of areas: Elongated
Size of areas: 4 to 35 acres

Typical Profile

0 to 25 inches—black, friable loam
25 to 50 inches—black and olive gray, friable, mottled clay loam
50 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion soils in the higher areas

• The moderately well drained Terril soils on foot slopes above the Delft soil
• The very poorly drained Glencoe soils in depressions

Similar soils:
• Soils that have a thinner dark surface layer
• Soils that have a calcareous surface layer

Use and Management

Cropland

Major management factors: Drainage
• Most of the climatically adapted crops can be grown if adequate drainage is provided.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

392—Biscay loam

Composition

Biscay soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Swales and linear back slopes on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 8 to 50 acres

Typical Profile

0 to 20 inches—black, friable loam
20 to 36 inches—dark grayish brown, friable, mottled sandy clay loam
36 to 60 inches—dark grayish brown, very friable, mottled, calcareous, stratified loamy sand and gravelly loamy coarse sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Fieldon soils on toe slopes
• The somewhat poorly drained Linder soils in the higher areas
• The well drained Estherville soils in the higher areas

Similar soils:
• Soils that have a calcareous surface layer
• Soils that have a surface layer of sandy loam
• Soils that have sand or gravel at a depth of more than 40 inches

Use and Management

Cropland

Major management factors: Drainage, ground-water contamination
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

525—Muskego muck

Composition

Muskego soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions on till plains and lake plains
Slope range: 0 to 2 percent
Shape of areas: Circular
Size of areas: 5 to 50 acres

Typical Profile

0 to 32 inches—black, friable muck
32 to 60 inches—very dark gray, firm, mottled, calcareous silty clay loam (coprogenous earth)

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part, slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Blue Earth soils in some depressions
• The poorly drained Fieldon and somewhat poorly drained Linder soils on rims of depressions

Similar soils:
- Soils having an organic layer that is less than 16 inches thick
- Soils that have a calcareous surface layer
- Soils having an organic layer that is more than 51 inches thick

Use and Management

Cropland

Major management factors: Drainage, content of organic matter, soil blowing, wetness, ponding
- Most of the climatically adapted crops can be grown if adequate drainage is provided.
- Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.
- The high content of organic matter can reduce the effectiveness of herbicides. Cultivation may be needed to control weeds.
- Planting field windbreaks reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IVw
Windbreak suitability group: 2(O)

539—Klossner muck

Composition

Klossner soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions on till plains and lake plains
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 5 to 40 acres

Typical Profile

0 to 25 inches—black, friable muck
25 to 60 inches—black and grayish brown, friable, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderate or moderately slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo soils on rims of depressions
- The very poorly drained, mineral Glencoe and Okoboji soils, which are in some depressions

Similar soils:
- Soils having an organic layer that is less than 16 inches thick
- Soils that have snail shells in the surface layer

Use and Management

Cropland

Major management factors: Drainage, content of organic matter, soil blowing, wetness, ponding
- Most of the climatically adapted crops can be grown if adequate drainage is provided.
- Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible. Surface drains reduce ponding.
- The high content of organic matter can reduce the effectiveness of herbicides. Cultivation may be needed to control weeds.
- Planting field windbreaks reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2(O)

887B—Clarion-Swanlake complex, 2 to 6 percent slopes

Composition

Clarion soil and similar soils: 50 to 60 percent
Swanlake soil and similar soils: 20 to 30 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform and position on the landform: Clarion—summits and the lower side slopes on till plains in the uplands; Swanlake—shoulder slopes and the upper side slopes on till plains in the uplands
Slope range: Clarion—2 to 5 percent; Swanlake—4 to 6 percent
Shape of areas: Elongated
Size of areas: 5 to 60 acres

Typical Profile

Clarion

0 to 14 inches—very dark gray and very dark grayish brown, friable loam

14 to 29 inches—dark yellowish brown, friable loam
29 to 60 inches—light olive brown, friable, mottled, calcareous loam

Swanlake

0 to 11 inches—very dark gray, friable, calcareous loam
11 to 24 inches—yellowish brown, friable, calcareous loam
24 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Clarion—moderate or high; Swanlake—moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Nicollet soils on the lower side slopes
• The poorly drained Canisteo and Webster soils on foot slopes and in drainageways

Similar soils:
• Soils that have a brighter colored surface layer
• Soils that have a surface layer of sandy loam or silt loam

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Water erosion
• Chisel plowing across the slope reduces the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: Clarion—3; Swanlake—8

909C2—Truman-Bold complex, 6 to 12 percent slopes, eroded

Composition

Truman soil and similar soils: 40 to 55 percent
Bold soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform and position on the landform: Truman—summits and the lower side slopes on lake plains; Bold—shoulder slopes and the upper side slopes on lake plains
Slope range: Truman—6 to 10 percent; Bold—8 to 12 percent
Shape of areas: Moderately long and narrow with lobate edges
Size of areas: 5 to 35 acres

Typical Profile

Truman

0 to 10 inches—very dark gray, friable silt loam that has brown streaks
10 to 18 inches—brown, friable silt loam
18 to 60 inches—yellowish brown and light olive brown, friable, mottled, calcareous silt loam

Bold

0 to 8 inches—yellowish brown, friable, calcareous silt loam that has very dark grayish brown streaks
8 to 60 inches—yellowish brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Truman—high; Bold—very high
Organic matter content: Truman—moderate; Bold—low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Kingston and Terril soils on the lower side slopes
• The poorly drained Madelia soils in drainageways

Similar soils:
• Soils that have pebbles
• Soils that have more clay

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Both soils—water erosion; Bold—content of organic matter
• Terraces, diversions, grassed waterways, and chisel plowing across the slope reduce the hazard of erosion.
• Using minimum tillage and including high-residue crops or alfalfa in the rotation reduce the hazard of erosion and maintain the content of organic matter.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: Truman—3; Bold—8

909D2—Bold-Truman complex, 12 to 18 percent slopes, eroded

Composition

Bold soil and similar soils: 35 to 45 percent
Truman soil and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Bold—shoulder slopes and the upper side slopes on lake plains; Truman—summits and the lower side slopes on lake plains
Slope range: Bold—15 to 18 percent; Truman—12 to 16 percent
Shape of areas: Moderately long and narrow with lobate edges
Size of areas: 5 to 25 acres

Typical Profile

Bold

0 to 9 inches—brown, friable, calcareous silt loam
9 to 60 inches—yellowish brown and light yellowish brown, friable, mottled, calcareous very fine sandy loam and silt loam

Truman

0 to 7 inches—very dark gray, friable silt loam
7 to 24 inches—dark brown, friable silty clay loam and silt loam that has brown streaks
24 to 60 inches—light olive brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Bold—very high; Truman—high
Organic matter content: Bold—low; Truman—moderate
Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Collinwood soils on summits
• The moderately well drained Terril soils on the lower side slopes
• The poorly drained Madelia soils in drainageways

Similar soils:
• Soils that have pebbles
• Soils that have more clay

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Content of organic matter, water erosion, slope
• Terraces, diversions, grassed waterways, chisel plowing across the slope, and seeding on the contour or across the slope reduce the hazard of erosion.
• Including high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.

Interpretive Groups

Land capability classification: Bold—VIe; Truman—IVe
Windbreak suitability group: Bold—8; Truman—3

920B—Clarion-Estherville complex, 2 to 6 percent slopes

Composition

Clarion soil and similar soils: 40 to 55 percent
Estherville soil and similar soils: 25 to 35 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform and position on the landform: Clarion—summits and side slopes on till plains; Estherville—shoulder slopes and back slopes on outwash plains or glacial moraines
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Typical Profile

Clarion

0 to 14 inches—very dark gray and very dark grayish brown, friable loam
14 to 24 inches—brown, friable loam
24 to 60 inches—yellowish brown, friable, mottled, calcareous loam that has some silt loam

Estherville

0 to 10 inches—very dark brown, friable sandy loam
10 to 15 inches—brown, friable sandy loam
15 to 60 inches—dark yellowish brown and yellowish brown, loose, mottled, calcareous gravelly coarse sand and loamy sand

Soil Properties and Qualities

Drainage class: Clarion—well drained; Estherville—somewhat excessively drained
Permeability: Clarion—moderate; Estherville—moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Clarion—high; Estherville—low
Organic matter content: Clarion—moderate or high; Estherville—moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The well drained Storden and Swanlake soils on shoulder slopes
- The moderately well drained Terril soils on foot slopes
- The poorly drained Webster soils in drainageways

Similar soils:
- Soils having gravelly material that is closer to the surface
- Soils that have less gravel and more sand in the underlying material

Use and Management

Cropland

Major crops: Corn, soybeans, and small grain
Major management factors: Clarion—water erosion; Estherville—droughtiness, ground-water contamination
- Chisel plowing across the slope reduces the hazard of erosion.
- Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
- Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: Clarion—IIe; Estherville—IIIs
Windbreak suitability group: Clarion—3; Estherville—7

920C2—Clarion-Storden-Estherville complex, 6 to 12 percent slopes, eroded

Composition

Clarion soil and similar soils: 30 to 40 percent
Storden soil and similar soils: 15 to 25 percent
Estherville soil and similar soils: 15 to 20 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Clarion—summits and back slopes on till plains; Storden—shoulder slopes on till plains; Estherville—summits and shoulder slopes on outwash plains or glacial moraines
Slope range: Clarion—6 to 10 percent; Storden—8 to 12 percent; Estherville—6 to 12 percent
Shape of areas: Moderately long and narrow with lobate edges
Size of areas: 4 to 25 acres

Typical Profile

Clarion

0 to 9 inches—very dark gray, friable loam that has brown streaks
9 to 27 inches—dark yellowish brown, friable loam
27 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Storden

0 to 9 inches—dark grayish brown, friable, calcareous loam
9 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Estherville

0 to 17 inches—very dark brown and dark brown, very friable sandy loam
17 to 60 inches—mixed yellowish brown, brown, dark yellowish brown, and grayish brown, loose, calcareous coarse sand, sand, and loamy sand

Soil Properties and Qualities

Drainage class: Clarion and Storden—well drained; Estherville—somewhat excessively drained
Permeability: Clarion and Storden—moderate; Estherville—moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Clarion and Storden—high; Estherville—low
Organic matter content: Clarion—moderate; Storden—low; Estherville—low
Surface runoff: Medium or rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Terril soils on foot slopes
- The moderately well drained Nicollet soils on concave summits
- The poorly drained Delft soils in drainageways and on toe slopes

Similar soils:
- Soils that have less gravel and more sand
- Soils that have silt loam in the underlying material

Use and Management

Cropland

Major crops: Corn, soybeans, and small grain
Major management factors: Clarion and Storden—water erosion; Estherville—droughtiness, ground-water contamination
- Terraces, diversions, grassed waterways, and chisel plowing across the slope reduce the hazard of erosion.

• Using minimum tillage and including high-residue crops or alfalfa in the rotation reduce the hazard of erosion.
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: Clarion and Storden—IIIe; Estherville—IVs
Windbreak suitability group: Clarion—3; Storden—8; Estherville—7

920D2—Clarion-Storden-Estherville complex, 12 to 18 percent slopes, eroded

Composition

Clarion soil and similar soils: 25 to 35 percent
Storden soil and similar soils: 20 to 30 percent
Estherville soil and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 25 percent

Setting

Landform and position on the landform: Clarion—summits and back slopes on till plains; Storden—shoulder slopes on till plains; Estherville—summits and shoulder slopes on outwash plains or glacial moraines
Slope range: Clarion—12 to 15 percent; Storden—14 to 18 percent; Estherville—12 to 18 percent
Shape of areas: Elongated
Size of areas: 5 to 20 acres

Typical Profile

Clarion

0 to 10 inches—very dark gray, friable loam that has dark brown streaks
10 to 22 inches—dark brown, friable loam
22 to 60 inches—brown and yellowish brown, friable, mottled, calcareous loam

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Estherville

0 to 16 inches—very dark brown and dark brown, very friable sandy loam
16 to 60 inches—dark yellowish brown and brown, loose, calcareous coarse sand, loamy coarse sand, and loamy sand

Soil Properties and Qualities

Drainage class: Clarion and Storden—well drained; Estherville—somewhat excessively drained
Permeability: Clarion and Storden—moderate; Estherville—moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Clarion and Storden—high; Estherville—low
Organic matter content: Clarion—moderate; Storden and Estherville—low
Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Terril soils on foot slopes
• The poorly drained Delft soils in drainageways and on toe slopes

Similar soils:
• Soils that have less gravel and more sand
• Soils that have silt loam in the underlying material

Use and Management

Cropland

Major crops: Corn, soybeans, and small grain
Major management factors: All three soils—water erosion, slope; Storden—content of organic matter; Estherville—droughtiness, ground-water contamination, soil blowing
• Terraces, diversions, grassed waterways, chisel plowing across the slope, and seeding on the contour or across the slope reduce the hazard of erosion.
• Including high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
• Selecting plants that tolerate droughtiness or applying irrigation water improves yields.
• Maintaining a cover of crop residue on the surface, establishing field windbreaks, and applying a system of minimum tillage reduce the hazard of soil blowing.
• Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: Clarion—IIIe; Storden—IVe; Estherville—VIs
Windbreak suitability group: Clarion—3; Storden—8; Estherville—7

Figure 6.—An area of Clarion-Storden complex, 6 to 12 percent slopes, eroded, in the rolling Kiester Hills in southeastern Faribault County.

921C2—Clarion-Storden complex, 6 to 12 percent slopes, eroded

Composition

Clarion soil and similar soils: 40 to 50 percent
Storden soil and similar soils: 30 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform and position on the landform: Clarion—summits and back slopes on till plains; Storden—shoulder slopes and the upper side slopes on till plains (fig. 6)
Shape of areas: Moderately long and narrow with lobate or curvilinear edges
Size of areas: 5 to 50 acres

Typical Profile

Clarion

0 to 10 inches—very dark brown, friable loam that has brown streaks
10 to 18 inches—brown, friable loam
18 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Storden

0 to 9 inches—brown, friable, calcareous loam
9 to 60 inches—yellowish brown, friable, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate

Available water capacity: High
Organic matter content: Clarion—moderate; Storden—low
Surface runoff: Medium or rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Terril soils on foot slopes
- The moderately well drained Nicollet soils on concave summits
- The poorly drained Delft soils in drainageways

Similar soils:
- Soils that have sandy or silty sediments

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Both soils—water erosion; Storden—content of organic matter
- Terraces, diversions, grassed waterways, and chisel plowing across the slope reduce the hazard of erosion.
- Using minimum tillage and including high-residue crops or alfalfa in the rotation reduce the hazard of erosion and help to maintain the content of organic matter.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: Clarion—3; Storden—8

929—Fieldon-Canisteo complex

Composition

Fieldon soil and similar soils: 35 to 45 percent
Canisteo soil and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Rims of depressions and linear back slopes on outwash plains and till plains
Slope range: Both soils—0 to 2 percent
Shape of areas: Long and moderately wide with curvilinear or smooth edges
Size of areas: 10 to 90 acres

Typical Profile

Fieldon

0 to 10 inches—black, friable, calcareous loam
10 to 33 inches—very dark gray and dark grayish brown, friable, mottled, calcareous, stratified loam and very fine sandy loam
33 to 60 inches—grayish brown, friable, mottled, calcareous fine sand that is stratified with very fine sandy loam and loamy very fine sand

Canisteo

0 to 20 inches—black, friable, calcareous loam
20 to 31 inches—dark grayish brown, friable, mottled, calcareous loam that has bands of sandy loam
31 to 60 inches—gray, friable, mottled, calcareous loam that has bands of silt loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Fieldon—moderate in the upper part, rapid in the lower part; Canisteo—moderate
Available water capacity: Fieldon—moderate; Canisteo—high
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The poorly drained Darfur and Webster soils in drainageways
- The very poorly drained Glencoe soils in depressions

Similar soils:
- Soils that have a thicker dark surface layer
- Soils that have a noncalcareous surface layer

Use and Management

Cropland

Major management factors: Both soils—drainage, fertility, pH; Fieldon—ground-water contamination
- Most of the climatically adapted crops can be grown if adequate drainage is provided.
- Only plants that tolerate a high pH level should be selected for planting.
- Most crops respond well to applications of nitrogen, phosphorus, and potassium.
- Carefully controlling the use of fertilizers, pesticides, herbicides, and other chemicals reduces the hazard of ground-water contamination.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

956—Canisteo-Glencoe complex

Composition

Canisteo soil and similar soils: 50 to 60 percent
Glencoe soil and similar soils: 20 to 30 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform and position on the landform: Canisteo—rims of depressions on till plains; Glencoe—depressions on till plains
Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent
Shape of areas: Long and wide with curvilinear or smooth edges
Size of areas: 10 to 100 acres

Typical Profile

Canisteo

0 to 16 inches—black, friable, calcareous clay loam
16 to 28 inches—very dark grayish brown and grayish brown, friable, mottled, calcareous clay loam
28 to 60 inches—light brownish gray, friable, mottled, calcareous loam

Glencoe

0 to 24 inches—black, firm clay loam
24 to 30 inches—black, firm, mottled silty clay loam
30 to 60 inches—dark gray, friable, mottled clay loam

Soil Properties and Qualities

Drainage class: Canisteo—poorly drained; Glencoe—very poorly drained
Permeability: Canisteo—moderate; Glencoe—moderate or moderately slow
Available water capacity: High
Organic matter content: Canisteo—high; Glencoe—high or very high
Surface runoff: Canisteo—slow; Glencoe—ponded
Depth to water table: Canisteo—1 to 3 feet; Glencoe—1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Webster soils in drainageways
• The very poorly drained Klossner soils in depressions
• The somewhat poorly drained Crippin soils on slight rises

Similar soils:
• Soils that have sandy or silty sediments
• Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Both soils—drainage; Canisteo—fertility, pH; Glencoe—wetness, ponding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Only plants that tolerate a high pH level should be selected for planting.
• Most crops respond well to applications of nitrogen, phosphorus, and potassium.
• Ditches help to remove surface water. If tile drains are installed, outlets are needed. Pumps are needed in areas where gravity drainage is not possible.

Interpretive Groups

Land capability classification: Canisteo—IIw; Glencoe—IIIw
Windbreak suitability group: Canisteo—2K; Glencoe—2W

960D2—Storden-Clarion complex, 12 to 18 percent slopes, eroded

Composition

Storden soil and similar soils: 35 to 45 percent
Clarion soil and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Storden—shoulder slopes on till plains; Clarion—summits and side slopes on till plains
Slope range: Storden—14 to 18 percent; Clarion—12 to 16 percent
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Typical Profile

Storden

0 to 9 inches—dark brown, friable, calcareous loam
9 to 60 inches—yellowish brown and light olive brown, friable, mottled, calcareous loam

Clarion

0 to 9 inches—very dark gray, friable loam that has brown streaks
9 to 18 inches—brown and dark yellowish brown, friable loam
18 to 60 inches—light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Storden—low; Clarion—moderate
Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Terril soils on foot slopes

• The poorly drained Delft soils in drainageways

Similar soils:
• Soils that have sandy or silty sediments

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: Both soils—water erosion, slope; Storden—content of organic matter
• Terraces, diversions, grassed waterways, chisel plowing across the slope, and seeding on the contour or across the slope reduce the hazard of erosion.
• Including high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.

Interpretive Groups

Land capability classification: IVe
Windbreak suitability group: Storden—8; Clarion—3

960E—Storden-Clarion complex, 18 to 24 percent slopes

Composition

Storden soil and similar soils: 40 to 50 percent
Clarion soil and similar soils: 25 to 35 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Storden—shoulder slopes on till plains; Clarion—summits and side slopes on till plains (fig. 7)
Shape of areas: Elongated
Size of areas: 5 to 20 acres

Typical Profile

Storden

0 to 5 inches—dark grayish brown, friable, calcareous loam
5 to 60 inches—yellowish brown and light olive brown, friable, mottled, calcareous loam

Clarion

0 to 16 inches—black and very dark brown, friable loam
16 to 26 inches—brown, friable loam
26 to 60 inches—dark yellowish brown and light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Storden—moderately low; Clarion—moderate or high
Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Terril soils on foot slopes
• The poorly drained Delft soils in drainageways

Similar soils:
• Soils that have sandy or silty sediments

Use and Management

Pasture

Major grass mixtures: Bromegrass-alfalfa and bluegrass-legume hay
Major management factors: Slope, water erosion
• Using a system of rotation grazing and controlling weeds help to maintain the quality and quantity of forage.

Woodland wildlife habitat

Major trees: Native oak and hickory
Major management factors: Water erosion
• Planting adapted species that are useful to wildlife enhances the natural habitat.

Interpretive Groups

Land capability classification: VIe
Windbreak suitability group: Storden—8; Clarion—3

1030—Pits, gravel-Udorthents complex

This unit is in areas that are or formerly were mined for sand and gravel (fig. 8). It consists of excavations, stockpiles of sand and gravel, and areas filled with waste or water. Individual areas range from about 4 to 75 acres in size and are irregular in shape. Included in mapping are borrow pits from which loamy material has been removed.

Areas of this unit can be reclaimed. Some areas are revegetating naturally with grasses, brush, or trees. Reclamation generally includes extensive filling and grading. Some areas can be reclaimed for agricultural uses if the topsoil was stockpiled. There is a hazard of ground-water pollution if areas are used for disposal of refuse. Permits for such uses are required from the Minnesota Pollution Control Agency and from Faribault County. Some reclaimed areas can be used for commercial or industrial development. Wildlife habitat or recreational areas can be developed if vegetation is established in the surrounding areas and if the existing ponds are used. Onsite investigation is needed to determine the potentials and limitations of individual areas for proposed uses.

No interpretive groups have been assigned.

Figure 7.—An area of Storden-Clarion complex, 18 to 24 percent slopes, on bluffs north of Winnebago. A permanent cover of grasses helps to control erosion on these soils.

1052—Klossner-Okoboji complex, ponded

Composition

Klossner soil and similar soils: 40 to 50 percent
Okoboji soil and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Klossner—center of depressions in back swamps on lake plains and till plains; Okoboji—the outer edges of depressions in back swamps on lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Circular
Size of areas: 5 to 100 acres

Typical Profile

Klossner

0 to 22 inches—black, friable muck

22 to 60 inches—black, firm silty clay and silty clay loam

Okoboji

0 to 9 inches—black, firm silty clay loam
9 to 24 inches—black, firm silty clay loam
24 to 60 inches—black, firm silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Klossner—moderately rapid to moderately slow in the upper part, moderate or moderately slow in the lower part; Okoboji—moderately slow
Available water capacity: Klossner—very high; Okoboji—high
Organic matter content: Klossner—very high; Okoboji—high or very high
Surface runoff: Ponded
Depth to water table: 1 to 3 feet above the surface

Inclusions

Contrasting inclusions:
• The poorly drained Fieldon and Canisteo soils on the outer rims of depressions

Similar soils:
• Soils that have less clay
• Calcareous soils that have shell fragments in the surface soil

Figure 8.—An area of Pits, gravel-Udorthents complex near Kiester.

Figure 9.—An area of Klossner-Okoboji complex, ponded, which provides cover and nesting habitat for waterfowl and wetland wildlife. Shorewood and Minnetonka soils are in the wooded areas in the background.

Use and Management

Wetland wildlife habitat

Major management factors: Food plots, ponding

- This map unit has good potential as habitat for wetland wildlife (fig. 9).
- Planting adapted species that are useful to wildlife and maintaining food plots enhance the natural habitat.

Interpretive Groups

Land capability classification: VIIIw
Windbreak suitability group: 10

1833—Coland silty clay loam, occasionally flooded

Composition

Coland soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Meander belts on flood plains
Slope range: 0 to 2 percent
Shape of areas: Elongated
Size of areas: 10 to more than 100 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 25 inches—black, friable clay loam
25 to 60 inches—very dark gray and dark gray, friable, mottled sandy loam and loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 1 to 3 feet
Frequency of flooding: Occasional (for brief periods in spring or after heavy or prolonged rainfall)

Inclusions

Contrasting inclusions:
• The moderately well drained Spillville soils in the higher areas
• The somewhat poorly drained Linder soils in the slightly higher areas

Similar soils:
• Soils that have a brighter colored subsoil
• Soils that have a higher content of fine sand
• Soils that have more sand and gravel in the underlying material

Use and Management

Cropland

Major management factors: Drainage, flooding
• Most of the climatically adapted crops can be grown if adequate drainage is provided.
• Seasonal flooding limits the production of crops. Levees can help to control the flooding.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

1834—Coland loam, frequently flooded

Composition

Coland soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Meander belts and back swamps on flood plains
Slope range: 0 to 2 percent
Shape of areas: Elongated
Size of areas: 25 to more than 100 acres

Typical Profile

0 to 12 inches—black, friable loam
12 to 36 inches—black, friable clay loam
36 to 60 inches—very dark gray, friable, mottled loam and sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet
Frequency of flooding: Frequent (for brief periods in spring or after heavy or prolonged rainfall) (fig. 10)

Inclusions

Contrasting inclusions:
• The poorly drained, calcareous Millington soils in oxbows
• The moderately well drained Spillville and somewhat poorly drained Linder soils in the higher areas

Similar soils:
• Soils that are only occasionally flooded
• Soils that have a calcareous surface layer
• Soils that have gravel on or near the surface

Use and Management

Woodland wildlife habitat

Major trees: Cottonwood, willow, maple, and dogwood
Major management factors: Flooding, wetness
• Only trees and shrubs that tolerate wetness should be planted.
• Planting adapted species that are useful to wildlife and maintaining food plots enhance the natural habitat.
• Installing a controlled drainage system helps to establish species useful to wildlife.

Interpretive Groups

Land capability classification: Vw
Windbreak suitability group: 2

1852F—Swanlake-Terril complex, 18 to 40 percent slopes

Composition

Swanlake soil and similar soils: 40 to 50 percent
Terril soil and similar soils: 30 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform and position on the landform: Swanlake—shoulder slopes and the upper back slopes on till plains; Terril—the lower side slopes and foot slopes on alluvial fans
Slope range: Swanlake—20 to 40 percent; Terril—18 to 30 percent
Shape of areas: Elongated
Size of areas: 5 to 25 acres

Figure 10.—Flooding in an area of Coland loam, frequently flooded. This park is in Blue Earth.

Typical Profile

Swanlake

0 to 12 inches—black, friable, calcareous loam
12 to 16 inches—mixed very dark gray and yellowish brown, friable, calcareous loam
16 to 60 inches—light olive brown, friable, mottled, calcareous loam

Terril

0 to 29 inches—very dark gray and black, friable loam
29 to 48 inches—mixed very dark gray and brown, friable clay loam
48 to 60 inches—light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Swanlake—well drained; Terril—moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Swanlake—moderate; Terril—high
Surface runoff: Rapid or very rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion soils on side slopes

• The poorly drained Delft soils on toe slopes and in drainageways

Similar soils:
• Soils that have a dark surface layer less than 10 inches thick
• Soils that have silt loam or sandy loam in the underlying material

Use and Management

Woodland wildlife habitat

Major trees: Native oak and hickory
Major management factors: Slope, water erosion
• Planting adapted species that are useful to wildlife enhances the natural habitat.
• The use of equipment is limited because of the slope.
• The hazard of erosion can be reduced by limiting surface disturbance and planting by hand.

Pasture

Major plants: Native grasses and shrubs
Major management factors: Slope, water erosion
• Adjusting stocking rates helps to maintain the quality and quantity of forage, especially on the steeper slopes.

Interpretive Groups

Land capability classification: Swanlake—VIe; Terril—VIIe
Windbreak suitability group: Swanlake—8; Terril—3

1877—Fostoria loam

Composition

Fostoria soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Linear back slopes on lake plains
Slope range: 0 to 3 percent
Shape of areas: Moderately long and moderately wide with curvilinear or lobate edges
Size of areas: 5 to 50 acres

Typical Profile

0 to 10 inches—black, friable loam
10 to 32 inches—black and dark grayish brown, friable, mottled clay loam
32 to 60 inches—dark grayish brown and light olive brown, friable, mottled, calcareous, stratified loam, silt loam, and fine sandy loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate
Available water capacity: Very high
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
• The well drained Ocheyedan soils in the higher areas
• The moderately well drained Kingston soils, which have more silt
• The poorly drained Webster and Waldorf soils in the lower areas and in drainageways

Similar soils:
• Soils that have more clay
• Soils that have a calcareous surface layer

Use and Management

Cropland

Major crops: Corn and soybeans
Major management factors: None
• This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1

1907—Lakefield silt loam

Composition

Lakefield soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Low summits and convex back slopes on lake plains
Slope range: 0 to 3 percent
Shape of areas: Short and moderately wide with lobate edges
Size of areas: 5 to 20 acres

Typical Profile

0 to 18 inches—black, friable, calcareous silt loam
18 to 60 inches—light olive brown, grayish brown, and light yellowish brown, friable, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: 2.5 to 5.0 feet

Figure 11.—An area where urban development is encroaching on prime farmland.

Inclusions

Contrasting inclusions:
- The well drained Grogan and Bold soils in the higher areas
- The moderately well drained, noncalcareous Kingston soils
- The poorly drained Spicer soils in low areas

Similar soils:
- Soils that have less clay
- Soils that have more pebbles and very fine sand

Use and Management

Cropland

Major crops: Corn and soybeans

Major management factors: None
- This is one of the most productive soils in the county. It can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1K

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the

supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 402,900 acres in the survey area, or nearly 88 percent of the total acreage, meets the soil requirements for prime farmland. Areas of this land are scattered throughout the county. Most areas are used for crops. The main crops are corn and soybeans.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses (fig. 11). The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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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 behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational 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 *(7)*.

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.

The soils in this survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit are also shown under the heading "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Randy S. Huelskamp, soil conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1988, approximately 363,900 acres in Faribault County was used as cropland *(12)*. Of this acreage, about 156,500 acres was used for corn as grain, 6,700 acres for corn as silage, 156,800 acres for soybeans, 10,400 acres for oats and wheat, 18,600 acres for hay and alfalfa, and 14,900 acres for sweet corn and peas for canning. The acreage used for crops has increased in recent years because pasture, hayland, and woodland have been converted to cropland. Although some products are shipped to market by rail, most are shipped by truck.

The main management concerns for optimum crop production in the county are water erosion, soil blowing, fertility, soil compaction, ponding or flooding, and poor internal drainage. About 9 percent of the soils used as cropland have very few limitations affecting their use. These soils are nearly level and are not subject to significant erosion or wetness. Examples are Nicollet, Fostoria, and Kingston soils.

About 21 percent of the soils used as cropland have gentle slopes and are subject to water erosion and surface runoff. As the surface layer is removed by erosion, nutrients and organic matter are lost. The sediment that is produced settles at the base of slopes or in nearby depressions or enters rivers and lakes and

affects water quality. Soils that are subject to water erosion include the nearly level and gently sloping Clarion, Ocheyedan, and Truman soils. The hazard of water erosion can be reduced on these soils by returning crop residue to the soil and by using conservation tillage practices, such as chisel plowing, ridge-till, or no-till.

Approximately 5 percent of the soils used as cropland are sloping or moderately steep. The hazard of erosion is high on these soils. The Truman-Bold and Clarion-Storden complexes are examples. Conservation practices are needed to control erosion on these soils. Suitable practices include terraces, diversions, grassed waterways, stripcropping, conservation tillage, contour farming, planting trees, and seeding the steeper areas to a permanent cover of grass or hay. Returning crop residue to the soil helps to control runoff and erosion and increases the rate of water infiltration.

About 1 percent of the soils used as cropland are subject to soil blowing. Estherville, Dickinson, and Sparta soils are examples. Proper placement of field windbreaks and a system of conservation tillage that leaves the surface rough and maintains a cover of crop residue on the soil help to control soil blowing in areas of these soils.

Natural fertility is high in most of the soils in the county, but Storden, Bold, and Sparta soils have low fertility. The kind and amount of fertilizer needed depend on management history, type of soil, the crops to be grown, and projected yields. The results of soil tests should be used to determine the kind and amount of fertilizer to apply. On most of the soils, crops respond well to applications of fertilizer. The soils in Faribault County generally contain adequate amounts of lime. Some soils, however, are more acid and may respond well to applications of lime. Barbert, Shorewood, and Minnetonka soils are examples.

About 60 percent of the poorly drained soils are calcareous and have a fertility imbalance resulting from a high pH level. Canisteo, Spicer, Fieldon, and Brownton soils are examples. Proper crop and variety selection, a good fertility program, and an adequate drainage system are needed on these soils.

Soil compaction can be a problem on about 34 percent of the acreage used as cropland. Marna, Waldorf, Beauford, Collinwood, Guckeen, Minnetonka, and Shorewood soils have a high content of clay. Soil compaction is a problem on these soils if they are worked when too wet. Tilling only at the proper moisture content can prevent clods from forming. These soils are often tilled in the fall, but fall tillage increases the hazard of erosion. Returning crop residue to the soil, chisel plowing, and including alfalfa-grass mixtures in the rotation reduce erosion, improve soil tilth, and increase the rate of water infiltration.

About 13 percent of the cropland in the county consists of soils in depressions and soils on flood plains. These soils are capable of producing crops but are subject to ponding or flooding. Examples of these soils are Glencoe, Klossner, Lura, Okoboji, and Barbert soils in depressions and Coland, Millington, Spillville, and Lomax soils on flood plains (fig. 12). Open ditches drain much of the surface water and provide outlets for subsurface tile lines. In areas where adequate outlets are not available, pumping stations may be needed.

More than 51 percent of the cropland in the county consists of poorly drained soils, such as Webster, Waldorf, and Canisteo soils. A proper drainage system is needed in areas of these soils if adequate crop yields are to be produced. The spacing of subsurface drainage lines depends on the soil type and the depth at which the drains can be installed. Generally, the finer the soil texture, the closer together the lines should be. The "Minnesota Drainage Guide" provides guidelines for draining wet soils *(14)*.

About 12,000 acres, or about 3 percent of Faribault County, is used for grazing. The soils in the areas used for pasture are generally not suited to crops because of the slope, flooding, stones, or wetness. High stocking rates and overgrazing contribute to poor pasture production and increase the potential for runoff and erosion. Delayed spring grazing, reduced stocking rates, and pasture rotation are needed to overcome most management problems. Reseeding is needed to improve pasture species in areas where stands are weak or more productive species are desired. Establishing a summer pasture by reintroducing warm-season grasses helps to provide a full season of grazing.

Soils that are suited to the widest range of pasture species include the well drained to somewhat poorly drained Clarion, Truman, Nicollet, Kingston, and Fostoria soils. Cool-season species include alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, and Kentucky bluegrass. Warm-season grasses, such as big bluestem, indiangrass, and switchgrass, grow well during July and August. These species also grow well on the poorly drained Webster, Delft, and Canisteo soils.

The very poorly drained Glencoe, Lura, and Okoboji soils are only suited to species that are adapted to wet conditions and are tolerant of ponding. These species include reed canarygrass, alsike clover, Garrison creeping foxtail, and birdsfoot trefoil.

Well drained to excessively drained soils, such as Dickinson, Estherville, and Sparta soils, generally provide forage in spring and early summer and again in fall, when precipitation is adequate. During the summer,

Figure 12.—An area of Coland and Spillville soils along the Blue Earth River. Alluvial soils are highly productive if they are not flooded during the growing season.

droughty conditions limit forage production. Alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, orchardgrass, and Kentucky bluegrass grow well when moisture supplies are adequate. Warm-season grasses, such as big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama, grow well in summer. Current information on variety selection and species adaptation can be obtained from the local office of the Cooperative Extension Service or the Soil Conservation Service.

Good pasture management includes controlling weeds and applying fertilizer according to the results of soil tests. Timely clipping of weedy areas and herbicide control help to keep the pasture in good condition.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and

records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials on 21 key soils in the county during the period from 1984 to 1988 were also considered in estimating the yields.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit *(9)*. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

About 2 percent of Faribault County, or about 8,280 acres, is wooded. Small woodlots and steep, wooded slopes adjacent to lakes or the Blue Earth River make up most of the woodland in the county. Some wooded areas, primarily east of the streams and lakes, are slightly larger than they once were. In general, the tree species in the county are similar to those of the original forest types. The most common trees include oak, maple, basswood, elm, and ash. The forests on the flood plains along the Blue Earth River consist

Figure 13.—Field windbreaks in an area of Clarion and Storden soils near Blue Earth.

mainly of cottonwood, ash, elm, and willow.

Commercial production of trees is limited in the county, and the wood products are used mainly for firewood or lumber. Most of the woodland in the county is used as habitat for woodland wildlife, as sites for homes, or as recreational areas. A few areas are grazed. Improving the stands would be beneficial in many areas.

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 (fig. 13). 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 ensure plant survival, a healthy planting

stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 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, the Soil and Water Conservation District, or the Cooperative Extension Service or from a commercial nursery.

At the end of each description under the heading "Detailed Soil Map Units," each soil has been assigned to a windbreak suitability group. The groups are also listed under the heading "Interpretive Groups." These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the "Technical Guide," which is available in the local office of the Soil Conservation Service.

The soils in Faribault County are assigned to 13 different windbreak suitability groups. These groups are described in the paragraphs that follow. Site preparation on soils that are subject to severe water erosion should be limited to spot treatment extending 2 feet from where a plant is established.

Windbreak suitability group 1.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderate, moderately rapid, or moderately slow, and the soils generally do not have free carbonates in the upper 20 inches. A few of the soils may be subject to flooding, but the flooding is not severe enough to adversely affect tree growth.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 1K.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderate or moderately slow, and the soils generally have free carbonates within a depth of 20 inches.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained, and they do not have free carbonates in the upper 20 inches. A few of the soils may be subject to flooding, but the flooding is not severe enough to adversely affect tree growth.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2K.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained and have free carbonates within a depth of 20 inches. A few of the soils may be subject to flooding, but the flooding is not severe enough to adversely affect tree growth.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Because of the wetness, the seedling mortality rate is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2(O).—This group consists dominantly of very poorly drained, depressional soils that have organic material more than 16 inches thick. These soils have been artificially drained.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2W.—This group consists dominantly of very poorly drained, depressional soils that are subject to ponding. These soils have been artificially drained.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 3.—This group consists dominantly of well drained and moderately well drained, loamy and silty soils. Permeability is moderate, moderately rapid, or moderately slow. The soils generally do not have free carbonates in the upper 20 inches.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils.

Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 4L.—This group consists dominantly of somewhat poorly drained or moderately well drained soils that have a silty or loamy surface layer. Permeability is slow or very slow.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 5.—This group consists dominantly of well drained soils that have a moderate or high available water capacity.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 6G.—This group consists of excessively drained to well drained soils that have sand at a depth of 20 to 40 inches. Available water capacity is low.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Leaving a plant cover on the surface during the early years of establishment helps to control soil blowing.

Windbreak suitability group 7.—This group consists dominantly of well drained to excessively drained soils that have a low available water capacity.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. The seedling mortality rate is moderate because of the moisture stress caused by droughtiness. Leaving a plant cover on the surface during the early years of establishment helps to control soil blowing. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 8.—This group consists dominantly of well drained, loamy soils that have free carbonates.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 10.—This group consists dominantly of soils that generally are not suitable for windbreaks. Ponding prevents the growth of trees and shrubs. Onsite investigation may identify areas where trees and shrubs can be planted. Special management is needed near the outer edges of these areas.

Recreation

County parks are the major recreational areas in Faribault County. Camping facilities are available at Pihls Park at Rice Lake, near Walters, and Wood Lake Park, south of Blue Earth. Overnight camping facilities are also available at the county fairgrounds in Blue Earth. The Walnut Lake Wildlife Management Area, which provides food and shelter for wetland and upland wildlife species, is popular with area hunters.

Ice fishing, snowmobiling, and hunting are popular winter sports in the county. Canoeing, fishing, hunting, and golf are popular in summer. Golf courses are along Highway 169 south and north of Blue Earth (fig. 14). The Blue Earth River, which runs north from Elmore through Blue Earth and Winnebago, provides opportunities for canoeing, fishing, and hunting in spring and fall.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, 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 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing

Figure 14.—A golf course in an area of Guckeen soils near Blue Earth.

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 are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than 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

The soils and vegetation in Faribault County provide excellent habitat for many species of wildlife. Changes in land use have affected the population of wildlife species. The change from diversified farming, which produced alfalfa, small grain, and row crops, to mostly continuous row crops has greatly reduced the habitat for pheasant. The removal of fence lines and cultivation of areas close to roads, streams, and marginal land have also reduced the extent of wildlife habitat and have resulted in smaller populations of pheasants. Populations of ducks and deer are concentrated near streams and marshes.

The major wildlife area managed by the Minnesota Department of Natural Resources is Walnut Lake, which has 1,976 acres available for waterfowl and upland wildlife. Other areas include the 332-acre Smith management area, which is northwest of Delavan, and the 30-acre Wells management area.

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 9, 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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

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, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are timothy, orchardgrass, birdsfoot trefoil, 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 flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, switchgrass, goldenrod, indiangrass, beggarweed, and quackgrass.

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, hackberry, apple, hawthorn, dogwood, and hickory. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, chokecherry, crabapple, wild plum, and raspberry.

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 red pine, Scotch pine, spruce, northern whitecedar, and eastern redcedar.

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, cattail, reed canarygrass, 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, wet meadows, 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. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

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. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 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 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock 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 11 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 11 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 11 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 resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, 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 should be considered.

The ratings in table 11 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, soil reaction, and content of salts and sodium affect trench 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 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 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil

layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, 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 low in content of soluble salts, 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 high 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 13 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 and for embankments, dikes, and levees. 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, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

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, to a cemented pan, 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 the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, 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 salts, sodium, or sulfur. 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 or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, 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 to characterize key soils.

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

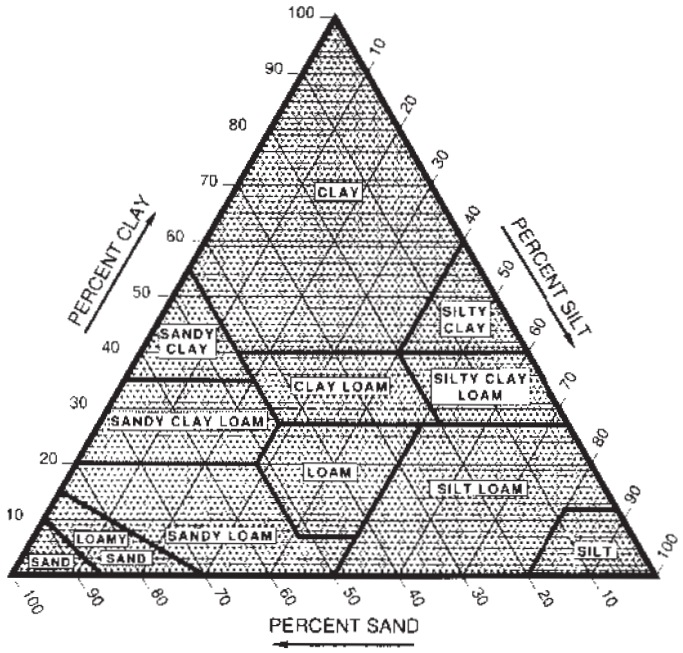

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 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 the heading "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. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering

properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an 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.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 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 *(8, 11)*.

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, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-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 and septic tank absorption fields.

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 classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, 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 in 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 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

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

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 little or no horizon development.

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 estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 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 16.

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.

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 hazard of corrosion. 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.

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Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(10)*. 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 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed (calcareous), mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(8)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(10)*. 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."

Barbert Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow or moderately slow

Landform: Lake plains
Parent material: Silty and clayey glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Argialbolls

Typical Pedon

Barbert silty clay loam, 800 feet west and 755 feet north of the southeast corner of sec. 28, T. 103 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; strongly acid; abrupt smooth boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

E—14 to 25 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; few fine prominent light olive brown (2.5Y 5/6) mottles; weak thin platy structure; friable; strongly acid; abrupt smooth boundary.

Btg1—25 to 36 inches; very dark gray (10YR 3/1) silty clay, very dark gray (10YR 3/1) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; moderate fine prismatic structure parting to weak fine angular blocky; firm; few faint black (10YR 2/1) clay films on faces of peds; moderately acid; clear smooth boundary.

Btg2—36 to 45 inches; dark olive gray (5Y 3/2) clay; few fine distinct light olive brown (2.5Y 5/4) mottles; strong fine prismatic structure parting to weak fine angular blocky; very firm; common distinct black (10YR 2/1) clay films on faces of peds; slightly acid; gradual wavy boundary.

Btg3—45 to 50 inches; olive gray (5Y 4/2) silty clay; common fine prominent light olive brown (2.5Y 5/6) mottles; moderate fine prismatic structure; firm; common distinct black (10YR 2/1) clay films on faces of peds; neutral; gradual smooth boundary.

Cg—50 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and few fine prominent reddish yellow (7.5YR 6/6) mottles; massive; friable; slightly alkaline.

Range in Characteristics

Depth to carbonates: 35 to more than 60 inches
Thickness of the mollic epipedon: 11 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silty clay loam

E horizon:
Hue—10YR
Value—4 or 5
Chroma—1
Texture—silt loam or silty clay loam

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 5
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 to 3
Texture—silty clay loam, silty clay, or silt loam

Beauford Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Very fine, montmorillonitic, mesic Typic Haplaquolls

Typical Pedon

Beauford silty clay, 1,350 feet west and 2,600 feet north of the southeast corner of sec. 1, T. 104 N., R. 27 W.

Ap—0 to 9 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak medium subangular blocky structure; firm; neutral; abrupt smooth boundary.

A—9 to 22 inches; black (N 2/0) clay, very dark gray (N 3/0) dry; moderate medium subangular blocky structure; firm; slightly acid; gradual wavy boundary.

Bg1—22 to 29 inches; olive gray (5Y 4/2) clay; few fine faint olive (5Y 5/3) mottles; moderate fine angular blocky structure; very firm; few very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; gradual wavy boundary.

Bg2—29 to 45 inches; olive gray (5Y 5/2) clay; common fine faint olive (5Y 5/3) mottles; weak fine angular blocky structure; very firm; few very dark gray (5Y 3/1) wormcasts; few black (10YR 2/1) manganese oxide granules; neutral; clear smooth boundary.

Cg—45 to 60 inches; grayish brown (2.5Y 5/2), stratified silty clay loam and silty clay; common fine faint light olive brown (2.5Y 5/4) mottles; massive; firm; common black (10YR 2/1) manganese oxide granules; few yellowish brown (10YR 5/8) iron oxide streaks; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 54 inches
Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay or clay

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay or silty clay

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2
Texture—silty clay loam or silty clay

Biscay Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Outwash plains
Parent material: Loamy over sandy, calcareous glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls

Typical Pedon

Biscay loam, 2,250 feet south and 1,650 feet east of the northwest corner of sec. 30, T. 102 N., R. 24 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; 3 percent gravel; neutral; abrupt smooth boundary.

A—10 to 20 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; few fine dark grayish brown (2.5Y 4/2) wormcasts; neutral; gradual wavy boundary.

Bg1—20 to 26 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine and medium subangular blocky structure; friable; 5 percent gravel; neutral; clear wavy boundary.

Bg2—26 to 36 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; common fine faint grayish brown (2.5Y 5/2) and few fine distinct olive (5Y 5/3) mottles; weak medium subangular blocky structure; friable; 5 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

2Cg—36 to 60 inches; dark grayish brown (2.5Y 4/2), stratified loamy sand and gravelly loamy coarse sand; few fine faint light brownish gray (2.5Y 6/2) and common fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; 14 percent gravel; slight to strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 16 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam
Content of gravel—0 to 5 percent

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam
Content of gravel—0 to 5 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loamy sand, loamy coarse sand, coarse sand, sand, or the gravelly analogs of those textures
Content of gravel—5 to 35 percent

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Drained lakebeds
Parent material: Silty, calcareous lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silty clay loam, 2,345 feet east and 425 feet south of the northwest corner of sec. 26, T. 101 N., R. 25 W.

Ap—0 to 10 inches; black (10YR 2/1) mucky silty clay loam (coprogenous earth), dark gray (10YR 4/1) dry; weak fine granular structure; very friable; few snail shells and fragments of snail shells; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg1—10 to 39 inches; black (10YR 2/1) mucky silty clay loam (coprogenous earth), dark gray (10YR 4/1) dry; massive; friable; few to many snail shells; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg2—39 to 60 inches; very dark grayish brown (10YR 3/2) mucky silty clay loam (coprogenous earth); few fine distinct olive brown (2.5Y 4/4) mottles; massive; friable; few snail shells; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: At the surface

Thickness of the mollic epipedon: 8 to more than 60 inches

Content of snail shells: 0 to 15 percent

Ap horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—2 or 3
- Chroma—0 to 2
- Texture—mucky silty clay loam

Cg horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—2 to 4
- Chroma—1 or 2
- Texture—silt loam, silty clay loam, mucky silty clay loam, clay loam, or loam

Bold Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 6 to 18 percent
Taxonomic class: Coarse-silty, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Bold silt loam, in an area of Truman-Bold complex, 6 to 12 percent slopes, eroded; 2,250 feet east and 200 feet south of the northwest corner of sec. 4, T. 103 N., R. 27 W.

Ap—0 to 8 inches; yellowish brown (10YR 5/4) silt loam, pale brown (10YR 6/3) dry; mixed with streaks of very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2) crushed; weak fine granular structure; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1—8 to 22 inches; yellowish brown (10YR 5/6) silt loam; massive; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—22 to 35 inches; yellowish brown (10YR 5/4) silt loam stratified with bands of very fine sandy loam; few fine prominent strong brown (7.5YR 5/8) and common medium faint brownish yellow (10YR 6/6) relict mottles; massive; friable; slight effervescence; moderately alkaline; gradual smooth boundary.

C3—35 to 60 inches; yellowish brown (10YR 5/4) very fine sandy loam with bands of silt loam; common fine faint brownish yellow (10YR 6/6) relict mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

A horizon:
- Hue—10YR
- Value—4 to 6
- Chroma—1 to 4
- Texture—silt loam

C horizon:
- Hue—10YR
- Value—5 to 7
- Chroma—2 to 8
- Texture—silt loam or very fine sandy loam

Brownton Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic (calcareous), mesic Typic Haplaquolls

Typical Pedon

Brownton silty clay loam, 1,450 feet south and 50 feet east of the northwest corner of sec. 34, T. 101 N., R. 27 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; slight effervescence;

slightly alkaline; abrupt smooth boundary.
A—10 to 16 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to weak fine angular blocky; friable; slight effervescence; slightly alkaline; gradual wavy boundary.
AB—16 to 24 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; common fine faint dark gray (10YR 4/1) mottles; moderate medium prismatic structure parting to weak fine angular blocky; firm; strong effervescence; slightly alkaline; gradual wavy boundary.
Bg—24 to 31 inches; olive gray (5Y 5/2) silty clay; common medium faint gray (5Y 5/1) mottles; weak medium prismatic structure; firm; few soft white (10YR 8/1) accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.
Cg1—31 to 39 inches; light olive gray (5Y 6/2) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline; clear smooth boundary.
Cg2—39 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/4) and common fine distinct gray (10YR 5/1) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Thickness of the mollic epipedon: 12 to 24 inches
Content of gravel: 0 to 5 percent

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay or clay

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—silty clay, clay, silty clay loam, or silt loam

Canisteo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Canisteo clay loam, in an area of Canisteo-Glencoe complex; 2,320 feet south and 1,220 feet east of the northwest corner of sec. 29, T. 104 N., R. 24 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.
A—10 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.
BA—16 to 21 inches; very dark grayish brown (2.5Y 3/2) clay loam; few medium faint grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; 4 percent gravel; few white (10YR 8/2) carbonate coatings on faces of peds; strong effervescence; moderately alkaline; gradual wavy boundary.
Bg—21 to 28 inches; grayish brown (2.5Y 5/2) clay loam; few fine distinct olive (5Y 5/3) mottles; weak fine subangular blocky structure; friable; 6 percent gravel; common soft white (10YR 8/2) accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.
Cg—28 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; 5 percent gravel; common yellowish brown (10YR 5/6) iron oxide stains; common black (10YR 2/1) manganese oxide granules; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 14 to 24 inches
Content of gravel: 2 to 15 percent

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5

Chroma—1 or 2
Texture—clay loam, loam, or sandy loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam

Clarion Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 1 to 24 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Clarion loam, 1 to 6 percent slopes, 1,620 feet south and 110 feet east of the northwest corner of sec. 20, T. 102 N., R. 24 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 3 percent gravel; neutral; abrupt smooth boundary.

A—10 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; gradual irregular boundary.

Bw—16 to 28 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; 3 percent gravel; common streaks of yellowish brown (10YR 5/4) on faces of peds; neutral; clear smooth boundary.

C1—28 to 42 inches; yellowish brown (10YR 5/4) loam; common fine distinct yellowish brown (10YR 5/8) relict mottles; massive: friable; 4 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish brown (10YR 5/8) relict mottles; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Thickness of the mollic epipedon: 10 to 20 inches
Content of gravel: 2 to 15 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5
Chroma—4
Texture—loam or sandy loam

Taxadjunct features: The Clarion soil in map units 920C2 and 960D2 has a mollic epipedon that is thinner than is defined as the range for the series.

Coland Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Landform: Flood plains
Parent material: Loamy alluvial sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Coland silty clay loam, occasionally flooded, 2,060 feet west and 2,600 feet south of the northeast corner of sec. 35, T. 102 N., R. 25 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—10 to 25 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; neutral; gradual smooth boundary.

AC—25 to 42 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; friable; neutral; clear wavy boundary.

Cg1—42 to 54 inches; very dark gray (5Y 3/1) loam; few fine distinct light olive brown (5Y 5/4) mottles; massive; friable; neutral; clear smooth boundary.

Cg2—54 to 60 inches; dark gray (5Y 4/1) sandy loam; few fine distinct olive (5Y 5/3) mottles; massive; friable; neutral.

Range in Characteristics

Depth to carbonates: 32 to more than 60 inches
Thickness of the mollic epipedon: 36 to more than 60 inches
Content of gravel: 0 to 5 percent

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, clay loam, or loam

Cg horizon:
Hue—5Y or neutral
Value—2 to 5
Chroma—0 or 1
Texture—clay loam, sandy loam, or loam

Collinwood Series

Depth class: Very deep
Drainage class: Moderately well drained or somewhat poorly drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Landform: Lake plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 6 percent
Taxonomic class: Fine, montmorillonitic, mesic Aquic Hapludolls

Typical Pedon

Collinwood silty clay loam, 0 to 3 percent slopes, 1,450 feet east and 850 feet north of the southwest corner of sec. 9, T. 102 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

A—10 to 16 inches: black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

BA—16 to 21 inches; very dark grayish brown (10YR 3/2) silty clay; few very dark gray (10YR 3/1) organic coatings on faces of peds; weak fine subangular blocky structure; friable; moderately acid; clear smooth boundary.

Bw—21 to 32 inches; olive brown (2.5Y 4/4) clay; few fine faint dark grayish brown (2.5Y 4/2) and few fine faint light olive brown (2.5Y 5/6) mottles; moderate fine prismatic structure; firm; moderately acid; clear wavy boundary.

C1—32 to 45 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct gray (10YR 6/1) and few fine distinct strong brown (7.5YR 5/6) mottles; massive (varved); few fine distinct black (10YR 2/1) manganese oxide granules; slight effervescence; slightly alkaline; clear smooth boundary.

C2—45 to 60 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct gray (10YR 6/1) and faint pale brown (10YR 6/3) mottles; massive; friable; few strong brown (7.5YR 5/8) iron oxide stains; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 46 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam

Crippin Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Crippin loam, 1,910 feet west and 1,580 feet north of the southeast corner of sec. 25, T. 101 N., R. 24 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine and medium subangular

blocky structure; friable; 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 15 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; 3 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Bw—15 to 25 inches; dark grayish brown (2.5Y 4/2) loam mixed with light olive brown (2.5Y 5/4) in the lower part; weak fine subangular blocky structure; friable; 3 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

C—25 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium faint light olive brown (2.5Y 5/4) mottles; massive; friable; few fine strong brown (7.5YR 5/8) iron oxide stains; few fine black (10YR 2/1) manganese oxide granules; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 12 to 24 inches
Content of gravel: 2 to 15 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

Darfur Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately rapid in the lower part
Landform: Outwash plains
Parent material: Loamy over sandy glacial outwash
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, mixed, mesic Typic Haplaquolls

Typical Pedon

Darfur loam, 2,600 feet south and 415 feet west of the northeast corner of sec. 27, T. 102 N., R. 26 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A—10 to 22 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; common black (10YR 2/1) organic coatings on faces of peds; slightly acid; gradual wavy boundary.

Bg—22 to 36 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common medium distinct dark brown (7.5YR 3/4) mottles; weak medium subangular blocky structure parting to weak fine granular; friable; neutral; gradual wavy boundary.

Cg1—36 to 46 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine prominent brown (7.5YR 5/4) mottles; massive; very friable; neutral; gradual smooth boundary.

Cg2—46 to 60 inches; grayish brown (2.5Y 5/2), stratified loamy fine sand, loamy sand, and fine sandy loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; massive; very friable; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—fine sandy loam, loam, or loamy fine sand

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—fine sand to sandy loam

Delft Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow or moderate in the lower part

Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Delft loam, 1,600 feet south and 1,150 feet west of the northeast corner of sec. 11, T. 101 N., R. 24 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.

A1—12 to 25 inches; black (N 2/0) loam, black (10YR 2/1) dry; moderate fine subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

A2—25 to 37 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; 2 percent gravel; neutral; gradual wavy boundary.

Bg—37 to 50 inches; olive gray (5Y 5/2) clay loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak very fine subangular blocky structure; friable; 2 percent gravel; common black (10YR 2/1) manganese oxide granules; neutral; clear wavy boundary.

Cg—50 to 60 inches; olive gray (5Y 5/2) loam; common fine prominent light olive brown (2.5Y 5/6) mottles; massive; friable; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 60 inches
Thickness of the mollic epipedon: 24 to 60 inches
Content of gravel: 2 to 15 percent

Ap horizon:
Hue—10YR to 5Y or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam

A horizon:
Hue—10YR to 5Y or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam or clay loam

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam

Cg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or silt loam

Dickinson Series

Depth class: Very deep
Drainage class: Well drained or somewhat excessively drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Landform: Outwash plains and till plains
Parent material: Loamy over sandy glacial outwash
Slope range: 0 to 12 percent
Taxonomic class: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickinson fine sandy loam, 0 to 6 percent slopes, 1,900 feet west and 1,700 feet north of the southeast corner of sec. 15, T. 103 N., R. 27 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak very fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A—10 to 14 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—14 to 20 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw2—20 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; weak very fine subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

C—39 to 60 inches; dark yellowish brown (10YR 4/4) loamy fine sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: More than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of gravel: 0 to 5 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—3 or 4
Texture—fine sandy loam or sandy loam

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy fine sand, loamy sand, fine sand, or sand

Estherville Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part, rapid or very rapid in the lower part
Landform: Outwash plains and glacial moraines
Parent material: Loamy over sandy, calcareous glacial outwash
Slope range: 0 to 18 percent
Taxonomic class: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Estherville sandy loam, 0 to 6 percent slopes, 2,420 feet south and 390 feet west of the northeast corner of sec. 25, T. 101 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 6 percent gravel; neutral; abrupt smooth boundary.

A—9 to 14 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 8 percent gravel; neutral; clear smooth boundary.

Bw—14 to 19 inches; dark brown (10YR 3/3) sandy loam; weak fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on faces of peds; 10 percent gravel; neutral; gradual wavy boundary.

2BC—19 to 24 inches; brown (10YR 4/3) gravelly loamy coarse sand; single grain; loose; common strong brown (7.5YR 5/8) iron oxide stains; 18 percent gravel; slightly alkaline; clear smooth boundary.

2C—24 to 60 inches; dark grayish brown (10YR 4/2) gravelly coarse sand; single grain; loose; common strong brown (7.5YR 5/8) iron oxide stains; 33 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Thickness of the mollic epipedon: 7 to 20 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of gravel—1 to 15 percent

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam or coarse sandy loam
Content of gravel—5 to 15 percent

C horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 6
Texture—coarse sand or gravelly coarse sand
Content of gravel—10 to 35 percent

Farrar Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid in the upper part, moderate in the lower part
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 1 to 6 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Farrar fine sandy loam, 1 to 6 percent slopes, 2,325 feet north and 300 feet west of the southeast corner of sec. 7, T. 102 N., R. 24 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

A—10 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; common streaks of brown (10YR 4/3); moderately acid; gradual wavy boundary.

Bw1—16 to 25 inches; brown (10YR 4/3) fine sandy loam; weak medium subangular blocky structure; friable; few very dark gray (10YR 3/1) wormcasts; slightly acid; clear wavy boundary.

2Bw2—25 to 41 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few very dark gray (10YR 3/1) wormcasts; 1 percent gravel; slightly acid; clear wavy boundary.

2C—41 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine distinct grayish brown (10YR 5/2) mottles; massive; common yellowish brown (10YR 5/8) iron oxide stains; friable; few black (10YR 2/1)

manganese oxide granules; 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Thickness of the mollic epipedon: 12 to 22 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—fine sandy loam or loamy fine sand

2Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—loam
Content of gravel—0 to 10 percent

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—4 to 6
Texture—loam
Content of gravel—2 to 10 percent

Fieldon Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Outwash plains
Parent material: Loamy over sandy, calcareous glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Fieldon loam, in an area of Fieldon-Canisteo complex; 920 feet west and 925 feet south of the northeast corner of sec. 35, T. 102 N., R. 26 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

AB—18 to 23 inches; very dark gray (10YR 3/1) loam and very fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; few streaks of dark grayish brown (2.5Y 4/2) in channels; strong effervescence; moderately alkaline; gradual wavy boundary.

Bg—23 to 33 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam and loam; common medium distinct olive (5Y 5/3) and few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few very dark gray (10YR 3/1) organic stains on faces of peds; strong effervescence; moderately alkaline; clear wavy boundary.

Cg—33 to 60 inches; grayish brown (2.5Y 5/2) fine sand stratified with very fine sandy loam and loamy fine sand; common fine prominent yellowish brown (10YR 5/6) and common fine distinct olive (5Y 5/3) mottles; massive; very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Thickness of the mollic epipedon: 14 to 24 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or fine sandy loam

Bg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2 in the upper part, 3 or 4 in the lower part
Texture—fine sandy loam or very fine sandy loam with bands of loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4
Texture—fine sand, loamy fine sand, fine sandy loam, or very fine sandy loam

Fostoria Series

Depth class: Very deep
Drainage class: Somewhat poorly drained

Permeability: Moderate
Landform: Till plains and areas that border lake plains
Parent material: Loamy and silty, calcareous glacial sediments
Slope range: 0 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Fostoria loam, 1,355 feet south and 1,070 feet east of the northwest corner of sec. 18, T. 104 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.

A—10 to 21 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; 2 percent gravel; neutral; gradual wavy boundary.

Bw1—21 to 27 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate fine subangular blocky structure; friable; common black (10YR 2/1) organic coatings on faces of peds; 2 percent gravel; neutral; gradual wavy boundary.

Bw2—27 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent light olive brown (2.5Y 5/6) and prominent gray (N 5/0) mottles; moderate medium subangular blocky structure; friable; 1 percent gravel; neutral; clear smooth boundary.

2Bw3—32 to 44 inches; dark grayish brown (2.5Y 4/2) silt loam stratified with loam and fine sandy loam; common medium distinct light olive brown (2.5Y 5/6) and common fine distinct light gray (N 6/0) mottles; weak medium subangular blocky structure; friable; few yellowish brown (10YR 5/8) streaks of iron oxide; 1 percent gravel; neutral; clear smooth boundary.

2C—44 to 60 inches; light olive brown (2.5Y 5/4) silt loam stratified with thin layers of loam; common medium prominent light brownish gray (10YR 6/2) mottles; massive; friable; 1 percent gravel; strong effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches
Thickness of the mollic epipedon: 12 to 23 inches
Content of gravel: 0 to 5 percent

Ap horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—loam

A horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—loam or clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

2Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—silt loam, loam, or fine sandy loam

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 6
Texture—silt loam, loam, or sandy loam

Glencoe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Glencoe clay loam, in an area of Canisteo-Glencoe complex; 1,560 feet north and 1,270 feet east of the southwest corner of sec. 29, T. 104 N., R. 24 W.

Ap—0 to 10 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; firm; 2 percent gravel; neutral; abrupt smooth boundary.

A—10 to 24 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; firm; 2 percent gravel; neutral; gradual wavy boundary.

AB—24 to 30 inches; black (5Y 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel; neutral; gradual wavy boundary.

Bg—30 to 60 inches; dark gray (5Y 4/1) clay loam; common fine distinct olive (5Y 5/4) mottles; weak fine subangular blocky structure; friable; common

yellowish brown (10YR 5/6) iron oxide stains; common black (10YR 2/1) manganese oxide granules; 4 percent gravel; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 24 to 46 inches
Content of gravel: 1 to 5 percent

Ap horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or silty clay loam

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or silty clay loam

Grogan Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Lake plains
Parent material: Silty and sandy, calcareous glacial lacustrine sediments
Slope range: 1 to 6 percent
Taxonomic class: Coarse-silty, mixed, mesic Typic Hapludolls

Typical Pedon

Grogan silt loam, 1 to 6 percent slopes, 855 feet south and 1,300 feet west of the northeast corner of sec. 33, T. 104 N., R. 27 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—10 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; few dark brown (10YR 3/3) wormcasts; neutral; gradual smooth boundary.

Bw—18 to 30 inches; dark yellowish brown (10YR 4/4) silt loam and very fine sandy loam; weak very fine subangular blocky structure; friable; few very dark grayish brown (10YR 3/2) wormcasts; neutral; clear smooth boundary.

C1—30 to 48 inches; yellowish brown (10YR 5/4) silt loam and very fine sandy loam; massive; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

C2—48 to 60 inches; light olive brown (2.5Y 5/4), stratified loamy very fine sand and silt loam; common medium prominent strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) iron oxide stains; massive; very friable; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—silt loam

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 5
Texture—silt loam, very fine sandy loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—3 to 6
Texture—very fine sandy loam, loamy very fine sand, or silt loam

Guckeen Series

Depth class: Very deep
Drainage class: Somewhat poorly drained or moderately well drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the lower part
Landform: Lake plains and till plains mantled with lacustrine material
Parent material: Silty, calcareous glacial till mantled with lacustrine material
Slope range: 0 to 6 percent
Taxonomic class: Fine, montmorillonitic, mesic Aquic Hapludolls

Typical Pedon

Guckeen silty clay loam, 0 to 3 percent slopes, 2,000 feet north and 1,900 feet west of the southeast corner of sec. 6, T. 104 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 1 percent gravel; slightly acid; abrupt smooth boundary.
A—10 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to weak very fine angular blocky; firm; 1 percent gravel; slightly acid; clear wavy boundary.
Bw1—16 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate fine subangular blocky structure parting to moderate very fine angular blocky; firm; few black (10YR 2/1) organic coatings in channels; 1 percent gravel; neutral; clear smooth boundary.
2Bw2—24 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; gradual smooth boundary.
2Cg1—32 to 45 inches; olive gray (5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; massive; friable; 3 percent gravel; strong effervescence; slightly alkaline; clear wavy boundary.
2Cg2—45 to 60 inches; olive gray (5Y 5/2) loam; many medium prominent yellowish brown (10YR 5/8) and common fine faint light brownish gray (2.5Y 6/2) mottles; massive; friable; 2 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 44 inches
Thickness of the mollic epipedon: 12 to 20 inches
Content of gravel: 0 to 5 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—2 or 3
Texture—silty clay loam, silty clay, or clay

2Bw horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam or loam

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam

Kingston Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 0 to 3 percent
Taxonomic class: Fine-silty, mixed, mesic Aquic Hapludolls

Typical Pedon

Kingston silt loam, 420 feet west and 150 feet north of the southeast corner of sec. 34, T. 103 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; abrupt smooth boundary.
A—10 to 17 inches; very dark gray (10YR 3/1) silty clay loam; few streaks of very dark grayish brown (10YR 3/2); weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bw1—17 to 24 inches; olive brown (2.5Y 4/4) silty clay loam; common fine faint dark grayish brown (2.5Y 4/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; slightly acid; few very dark brown (10YR 2/2) organic coatings on faces of peds; clear wavy boundary.
Bw2—24 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Cg—37 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct gray (10YR 5/1) and prominent light olive brown (2.5Y 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silt loam or silty clay loam

A horizon:
Hue—10YR

Value—2 or 3
Chroma—1
Texture—silt loam or silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 or 4 in the upper part, 4 or 5 in the lower part
Chroma—2 to 4
Texture—silty clay loam or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam or silty clay loam

Klossner Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderate or moderately slow in the lower part
Landform: Till plains and lake plains
Parent material: Highly decomposed organic materials over silty glacial lacustrine sediments or loamy glacial till
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic, mesic Terric Medisaprists

Typical Pedon

Klossner muck, 1,410 feet north and 1,875 feet west of the southeast corner of sec. 11, T. 102 N., R. 26 W.

Op—0 to 10 inches; muck, black (N 2/0) broken faced, rubbed, and pressed, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

Oa—10 to 25 inches; muck, black (N 2/0) broken faced, rubbed, and pressed, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

2A—25 to 33 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; common fine prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

2Cg1—33 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent dark yellowish brown (10YR 4/6) and common fine faint light brownish gray (2.5Y 6/2) mottles; massive; friable; neutral; clear smooth boundary.

2Cg2—43 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent strong brown (7.5YR 5/8) and common fine distinct olive brown (2.5Y 4/4) mottles; massive; friable; neutral.

Range in Characteristics

Organic material:
Kind—sapric
Thickness—6 to 51 inches
Fiber content—5 to 20 percent unrubbed; 0 to 5 percent rubbed
Reaction—moderately acid to neutral
Hue—10YR or neutral
Value—2
Chroma—0 to 2

2A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—mucky silty clay loam, mucky silty clay, silty clay loam, or clay loam

2Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 6
Chroma—1 or 2
Texture—silty clay loam, clay loam, silt loam, or sandy loam

Lakefield Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 0 to 3 percent
Taxonomic class: Fine-silty, mixed, mesic Aquic Hapludolls

Typical Pedon

Lakefield silt loam, 1,850 feet east and 540 feet north of the southwest corner of sec. 8, T. 102 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 18 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; common olive brown (2.5Y 4/4) wormcasts; weak medium subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

Bw—18 to 31 inches; light olive brown (2.5Y 5/4) silt loam; common fine distinct light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/6) mottles; weak

medium subangular blocky structure; friable; few very dark gray (10YR 3/1) wormcasts; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—31 to 55 inches; grayish brown (2.5Y 5/2) silt loam; common medium distinct light yellowish brown (2.5Y 6/4) and common fine prominent yellowish brown (10YR 5/8) mottles; massive (varved); friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—55 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; common fine distinct light brownish gray (2.5Y 6/2) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; friable; few black (10YR 2/1) manganese oxide granules; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 12 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silt loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—silt loam or silty clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam or very fine sandy loam

Linder Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderately rapid in the middle part, very rapid in the lower part
Landform: Outwash plains
Parent material: Loamy over sandy, calcareous glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Linder loam, 2,630 feet south and 810 feet west of the northeast corner of sec. 4, T. 104 N., R. 24 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.

A—10 to 22 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; clear wavy boundary.

Bw—22 to 26 inches; dark grayish brown (2.5Y 4/2) sandy loam; common fine faint light olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; 4 percent gravel; neutral; clear wavy boundary.

2C1—26 to 36 inches; grayish brown (2.5Y 5/2) loamy sand; common fine faint light olive brown (2.5Y 5/4) and dark grayish brown (2.5Y 4/2) mottles; single grain; loose; 14 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—36 to 60 inches; light olive brown (2.5Y 5/4) coarse sand; common medium faint grayish brown (2.5Y 5/2) mottles; single grain; loose; 8 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam
Content of gravel—0 to 4 percent

Bw horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 or 3
Texture—sandy loam
Content of gravel—0 to 4 percent

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—loamy coarse sand, loamy sand, coarse sand, or gravelly coarse sand
Content of gravel—5 to 30 percent

Litchfield Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid

Landform: Outwash plains
Parent material: Loamy over sandy glacial outwash
Slope range: 0 to 3 percent
Taxonomic class: Sandy, mixed, mesic Aquic Hapludolls

Typical Pedon

Litchfield fine sandy loam, 1,800 feet west and 625 feet north of the southeast corner of sec. 15, T. 103 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; slightly acid; abrupt smooth boundary.

A—10 to 17 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; slightly acid; gradual wavy boundary.

Bw1—17 to 31 inches; brown (10YR 4/3) fine sand; few fine distinct dark grayish brown (2.5Y 4/2) mottles; single grain; loose; slightly acid; gradual wavy boundary.

Bw2—31 to 41 inches; stratified dark grayish brown (2.5Y 4/2) loamy very fine sand and fine sand; common fine faint dark yellowish brown (2.5Y 4/4) mottles; single grain; loose; slightly acid; gradual smooth boundary.

C—41 to 60 inches; stratified, grayish brown (2.5Y 5/2) fine sand, very fine sandy loam, and loamy very fine sand; common medium prominent yellowish brown (2.5Y 5/6) mottles; single grain; loose; few black (10YR 2/1) manganese oxide granules; neutral.

Range in Characteristics

Depth to carbonates: 50 to more than 60 inches
Thickness of the mollic epipedon: 12 to 20 inches

A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—fine sandy loam

Bw horizon:
- Hue—10YR or 2.5Y
- Value—4 or 5
- Chroma—2 to 4
- Texture—fine sand, loamy fine sand, loamy sand, loamy very fine sand, or sand

C horizon:
- Hue—2.5Y or 5Y
- Value—5 or 6
- Chroma—1 to 3
- Texture—sand, fine sand, loamy sand, very fine sandy loam, or loamy very fine sand

Lomax Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Terraces
Parent material: Loamy alluvial sediments
Slope range: 0 to 3 percent
Taxonomic class: Coarse-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Lomax loam, 610 feet north and 40 feet east of the southwest corner of sec. 27, T. 104 N., R. 28 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A1—10 to 25 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; slightly acid; gradual wavy boundary.

A2—25 to 34 inches; very dark gray (10YR 3/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; few streaks of brown (10YR 4/3) in channels; friable; slightly acid; gradual irregular boundary.

Bw—34 to 60 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; slightly acid.

Range in Characteristics

Depth to carbonates: More than 60 inches
Thickness of the mollic epipedon: 24 to 36 inches

Ap horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—loam

A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—loam or sandy loam

Bw horizon:
- Hue—10YR
- Value—4 or 5
- Chroma—3 to 6
- Texture—loam, sandy loam, or loamy sand

Lura Series

Depth class: Very deep
Drainage class: Very poorly drained

Permeability: Slow in the upper part, slow or moderately slow in the lower part
Landform: Lake plains
Parent material: Clayey glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Cumulic Haplaquolls

Typical Pedon

Lura silty clay, 650 feet west and 2,540 feet north of the southeast corner of sec. 5, T. 103 N., R. 25 W.

Ap—0 to 10 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate fine subangular blocky structure parting to weak fine granular; firm; neutral; abrupt smooth boundary.
A1—10 to 19 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate fine subangular blocky structure; firm; neutral; gradual smooth boundary.
A2—19 to 34 inches; black (5Y 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine angular blocky; firm; neutral; clear smooth boundary.
A3—34 to 45 inches; black (5Y 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure; firm; neutral; gradual smooth boundary.
Bg—45 to 50 inches; olive gray (5Y 4/2) silty clay; few fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure; firm; neutral; gradual smooth boundary.
Cg—50 to 60 inches; olive gray (5Y 5/2) silty clay; common fine prominent reddish brown (5YR 4/4) mottles; massive; firm; few black (5Y 2/1) streaks in ped interiors; neutral.

Range in Characteristics

Depth to carbonates: 40 to 80 inches
Thickness of the mollic epipedon: 30 to 66 inches

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay

Bg horizon:
Hue—5Y
Value—4
Chroma—1 or 2
Texture—silty clay or clay

Cg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam, clay, or silty clay

Madelia Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed, mesic Typic Haplaquolls

Typical Pedon

Madelia silty clay loam, 1,150 feet north and 1,880 feet west of the southeast corner of sec. 13, T. 101 N., R. 27 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; neutral; abrupt smooth boundary.
A—10 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine faint very dark grayish brown (10YR 3/2) mottles; moderate medium subangular blocky structure parting to weak fine angular blocky; friable; neutral; clear smooth boundary.
Bg—15 to 27 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium angular blocky structure; firm; few black (10YR 2/1) organic coatings in channels; neutral; clear wavy boundary.
Cg1—27 to 34 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct gray (10YR 6/1) mottles; few strong brown (7.5YR 5/6) iron oxide stains; massive; friable; slight effervescence; slightly alkaline; clear smooth boundary.
Cg2—34 to 60 inches; grayish brown (2.5Y 5/2) silt loam; many prominent yellowish brown (10YR 5/8) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bg horizon:
Hue—2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4
Texture—silt loam or silty clay loam

Marna Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow in the upper part, moderately slow or moderate in the lower part
Landform: Lake plains and till plains mantled with lacustrine material
Parent material: Silty and clayey, calcareous glacial till mantled with lacustrine material
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Haplaquolls

Typical Pedon

Marna silty clay loam, 1,240 feet east and 660 feet south of the northwest corner of sec. 1, T. 104 N., R. 25 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 1 percent gravel; neutral; abrupt smooth boundary.

A—10 to 22 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; firm; 1 percent gravel; neutral; gradual wavy boundary.

Bg1—22 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct olive (5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few black (10YR 2/1) organic coatings in channels; 1 percent gravel; neutral; clear smooth boundary.

2Bg2—34 to 46 inches; olive gray (5Y 4/2) clay loam; few fine distinct light olive brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm; few very dark gray (10YR 3/1) worm channels; 2 percent gravel; slightly alkaline; clear smooth boundary.

2Cg—46 to 60 inches; grayish brown (2.5Y 5/2) loam; common fine distinct light olive brown (2.5Y 5/4) mottles; massive; friable; 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 26 to 48 inches
Thickness of the mollic epipedon: 16 to 24 inches

Ap horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam
Content of gravel—0 to 5 percent

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay or silty clay loam
Content of gravel—0 to 5 percent

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay or clay
Content of gravel—0 to 5 percent

2Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of gravel—2 to 15 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of gravel—2 to 15 percent

Mayer Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Outwash plains
Parent material: Loamy over sandy, calcareous glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Mayer loam, 800 feet west and 1,300 feet south of the northeast corner of sec. 26, T. 103 N., R. 24 W.

Ap—0 to 10 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; 3 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

A1—10 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 3 percent gravel; strong

effervescence; moderately alkaline; gradual smooth boundary.

A2—17 to 23 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; 2 percent gravel; violent effervescence; moderately alkaline; clear smooth boundary.

Bg1—23 to 31 inches; grayish brown (2.5Y 5/2) loam; common fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 4 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Bg2—31 to 39 inches; olive gray (5Y 5/2) sandy clay loam; common fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 7 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

2C—39 to 60 inches; dark grayish brown (2.5Y 4/2) coarse sand; common medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; 14 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam
Content of gravel—0 to 10 percent

Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 or 5
Chroma—0 to 3
Texture—loam, sandy clay loam, or silt loam
Content of gravel—0 to 10 percent

2C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5
Chroma—1 to 3
Texture—sand, coarse sand, or gravelly coarse sand
Content of gravel—10 to 50 percent

Millington Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy, calcareous alluvial sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Cumulic Haplaquolls

Typical Pedon

Millington clay loam, 2,175 feet east and 200 feet south of the northwest corner of sec. 1, T. 101 N., R. 26 W.

Ap—0 to 10 inches; black (N 2/0) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 24 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common black (N 2/0) organic coatings on faces of peds; strong effervescence; moderately alkaline; gradual wavy boundary.

Bg1—24 to 34 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; common dark grayish brown (2.5Y 4/2) streaks in channels; strong effervescence; moderately alkaline; gradual wavy boundary.

Bg2—34 to 43 inches; grayish brown (2.5Y 5/2) loam; common fine prominent yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few black (N 2/0) manganese oxide granules; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—43 to 60 inches; grayish brown (2.5Y 5/2) fine sandy loam stratified with loam and clay loam; common fine prominent yellowish brown (10YR 5/6 and 5/4) mottles; massive; very friable; few black (N 2/0) manganese oxide granules; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Thickness of the mollic epipedon: 24 to 40 inches
Content of gravel: 0 to 15 percent

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam

Bg horizon:
Hue—10YR to 5Y or neutral
Value—3 to 5
Chroma—0 to 2
Texture—clay loam or loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y

Value—4 or 5
Chroma—1 to 6
Texture—stratified silty clay loam to sandy loam

Minnetonka Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow in the upper part, slow in the middle part, moderately slow or moderate in the lower part
Landform: Lake plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Argiaquolls

Typical Pedon

Minnetonka silty clay loam, 2,580 feet east and 65 feet north of the southwest corner of sec. 14, T. 103 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

Btg1—10 to 23 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; slightly acid; clear smooth boundary.

Btg2—23 to 32 inches; dark gray (5Y 4/1) silty clay; common fine distinct olive (5Y 5/3) mottles; strong medium prismatic structure parting to moderate fine angular blocky; firm; few distinct black (10YR 2/1) organic coatings in channels; common distinct black (10YR 2/1) and very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; slightly acid; gradual wavy boundary.

Btg3—32 to 43 inches; olive gray (5Y 4/2) silty clay loam; common fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to weak fine angular blocky; firm; common black (10YR 2/1) organic coatings in channels; common prominent very dark gray (10YR 3/1) clay films in pores and on faces of peds; neutral; gradual wavy boundary.

Cg—43 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; few black (10YR 2/1) manganese oxide granules; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 28 to 52 inches
Thickness of the mollic epipedon: 12 to 24 inches
Ap horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—silty clay loam
A horizon (if it occurs):
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—silty clay or silty clay loam
Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 4
Chroma—1 or 2
Texture—silty clay or silty clay loam
Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2
Texture—silt loam, silty clay loam, or silty clay

Muskego Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part, slow in the lower part
Landform: Till plains and lake plains
Parent material: Highly decomposed organic sediments over calcareous coprogenous materials
Slope range: 0 to 2 percent
Taxonomic class: Coprogenous, euic, mesic Limnic Medisaprists

Typical Pedon

Muskego muck, 1,100 feet north and 20 feet west of the southeast corner of sec. 26, T. 101 N., R. 24 W.

Op—0 to 10 inches; muck, black (N 2/0) broken face, rubbed, and pressed, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

Oa1—10 to 18 inches; muck, black (N 2/0) broken face, rubbed, and pressed, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

Oa2—18 to 32 inches; muck, black (N 2/0) broken face, very dark gray (10YR 3/1) rubbed and pressed; gray (10YR 5/1) dry; weak thin platy structure; friable; neutral; gradual smooth boundary.

Cg1—32 to 46 inches; very dark gray (5Y 3/1) coprogenous earth (silty clay loam); common medium faint dark olive gray (5Y 3/2) mottles;

massive; friable; few or common snail shells; strong effervescence; slightly alkaline; clear smooth boundary.

Cg2—46 to 60 inches; very dark gray (5Y 3/1) coprogenous earth (silty clay loam); common fine faint dark olive gray (5Y 3/2) mottles; massive; friable; common or many snail shells; strong effervescence; moderately alkaline.

Range in Characteristics

Organic material:
- Kind—sapric
- Thickness—16 to 51 inches
- Fiber content—5 to 20 percent unrubbed; 0 to 5 percent rubbed
- Reaction—moderately acid to neutral
- Hue—10YR or neutral
- Value—2 or 3
- Chroma—0 to 3

Cg horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—2 to 5
- Chroma—1 to 3
- Texture—coprogenous earth (silty clay loam)

Nicollet Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 1,425 feet north and 110 feet east of the southwest corner of sec. 36, T. 101 N., R. 25 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; 5 percent gravel; slightly acid; abrupt smooth boundary.

A—9 to 16 inches; very dark grayish brown (10YR 3/2) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common black (10YR 2/1) organic coatings on faces of peds; 5 percent gravel; slightly acid; gradual smooth boundary.

Bw—16 to 29 inches; dark grayish brown (10YR 4/2) clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; few very dark grayish brown (2.5Y 3/2) wormcasts; friable; 5 percent gravel; neutral; clear smooth boundary.

C1—29 to 41 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct light brownish gray (2.5Y 6/2) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; 4 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

C2—41 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many fine distinct light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; 6 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 48 inches
Thickness of the mollic epipedon: 12 to 24 inches
Content of gravel: 1 to 8 percent

A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—clay loam

Bw horizon:
- Hue—10YR or 2.5Y
- Value—3 or 4
- Chroma—2 to 4
- Texture—loam or clay loam

C horizon:
- Hue—2.5Y or 5Y
- Value—5 or 6
- Chroma—2 to 4
- Texture—loam or clay loam

Ocheyedan Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains and areas that border lake plains
Parent material: Loamy and silty, calcareous glacial sediments
Slope range: 2 to 12 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Ocheyedan loam, 2 to 6 percent slopes, 1,010 feet east and 1,135 feet south of the northwest corner of sec. 18, T. 104 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium

subangular blocky structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.
Bw1—10 to 15 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few very dark grayish brown (10YR 3/2) wormcasts and black (10YR 2/1) organic coatings; 2 percent gravel; neutral; gradual wavy boundary.
Bw2—15 to 30 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; clear smooth boundary.
2C1—30 to 41 inches; yellowish brown (10YR 5/4) silt loam stratified with thin layers of loam; few fine distinct gray (10YR 5/1) relict mottles; massive; friable; 2 percent gravel; strong effervescence; slightly alkaline; clear wavy boundary.
2C2—41 to 60 inches; yellowish brown (10YR 5/4) silt loam stratified with thin layers of loam; common fine distinct light brownish gray (10YR 6/2) relict mottles; massive; friable; few strong brown (7.5Y 5/8) iron oxide stains; 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 10 to 16 inches
Content of gravel: 1 to 6 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bw horizon:
Hue—10YR
Value—4
Chroma—3 or 4
Texture—loam, sandy clay loam, or fine sandy loam

2C horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 6
Texture—silt loam, loam, sandy loam, or sandy clay loam

Taxadjunct features: The Ocheyedan soil in map unit 275C2 has a dark surface layer that is thinner than is defined as the range for the series.

Okoboji Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow in the upper part, moderate in the lower part
Landform: Lake plains and till plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Cumulic Haplaquolls

Typical Pedon

Okoboji silty clay loam, 1,100 feet south and 1,700 feet east of the northwest corner of sec. 1, T. 104 N., R. 28 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A1—10 to 18 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; gradual wavy boundary.
A2—18 to 26 inches; black (5Y 2/1) silty clay loam, gray (10YR 5/1) dry; common medium faint dark olive gray (5Y 3/2) mottles; moderate medium subangular blocky structure; friable; neutral; gradual irregular boundary.
Bg1—26 to 32 inches; dark gray (5Y 4/1) silty clay; common fine faint olive (5Y 4/3) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; firm; common very dark gray (2.5Y 3/1) organic coatings; neutral; gradual wavy boundary.
Bg2—32 to 42 inches; dark gray (5Y 4/1) silty clay; common fine distinct olive (5Y 5/3) and common fine distinct olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; firm; neutral; clear wavy boundary.
Cg—42 to 60 inches; dark gray (5Y 4/1) silty clay loam; common fine faint olive gray (5Y 5/2) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 24 to 40 inches

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bg horizon:
Hue—2.5Y, 5Y, or neutral
Value—3 to 5
Chroma—0 to 2
Texture—silty clay loam or silty clay

Cg horizon:
Hue—2.5Y or 5Y

Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam

Shorewood Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Moderately slow in the upper part, slow or moderately slow in the middle part, moderately slow or moderate in the lower part
Landform: Lake plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 12 percent
Taxonomic class: Fine, montmorillonitic, mesic Aquic Argiudolls

Typical Pedon

Shorewood silty clay loam, 0 to 3 percent slopes, 2,340 feet west and 50 feet south of the northeast corner of sec. 23, T. 103 N., R. 28 W.

Ap—0 to 11 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

Bt1—11 to 23 inches; dark grayish brown (10YR 4/2) silty clay; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; firm; few black (10YR 2/1) organic coatings in channels; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; strongly acid; gradual wavy boundary.

Bt2—23 to 37 inches; grayish brown (2.5Y 5/3) silty clay; few fine faint light brownish gray (2.5Y 6/2) mottles; strong medium prismatic structure parting to moderate fine angular blocky; firm; common black (10YR 2/1) organic coatings in channels; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; slightly acid; clear wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; few fine distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 50 inches
Thickness of the mollic epipedon: 10 to 22 inches
Content of gravel: 0 to 8 percent

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam

Bt horizon:
Hue—2.5Y or 10YR
Value—3 to 5
Chroma—2 or 3
Texture— silty clay or silty clay loam

C horizon:
Hue—2.5Y
Value—5
Chroma—2 to 4
Texture—silt loam, silty clay loam, silty clay, or clay

Taxadjunct features: The Shorewood soil in map unit 286C2 has a mollic epipedon that is thinner than is defined as the range for the series.

Sparta Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Landform: Outwash plains or terraces
Parent material: Sandy glacial outwash
Slope range: 0 to 6 percent
Taxonomic class: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Sparta loamy fine sand, 0 to 6 percent slopes, 575 feet north and 1,550 feet west of the southeast corner of sec. 14, T. 102 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; medium acid; abrupt smooth boundary.

AB—9 to 12 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; moderately acid; clear smooth boundary.

Bw1—12 to 18 inches; dark brown (10YR 4/3) loamy fine sand; weak medium subangular blocky structure; very friable; moderately acid; gradual wavy boundary.

Bw2—18 to 31 inches; dark yellowish brown (10YR 4/4) loamy fine sand; single grain; loose; moderately acid; gradual wavy boundary.

C—31 to 60 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; moderately acid.

Range in Characteristics

Depth to carbonates: More than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches

Content of gravel: 0 to 10 percent

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

Bw horizon:
Hue—10YR
Value—3 to 6
Chroma—3 to 6
Texture— sand, fine sand, loamy sand, or loamy fine sand

C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sand or sand

Spicer Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Spicer silt loam, 220 feet south and 880 feet west of the northeast corner of sec. 30, T. 101 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—9 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; clear wavy boundary.

AB—15 to 20 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; many fine distinct dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

Bg—20 to 34 inches; olive gray (5Y 5/2) silt loam; common fine prominent light olive brown (2.5Y 5/6) and common fine faint olive (5Y 5/3) mottles; weak medium subangular blocky structure; friable; few black (10YR 2/1) manganese oxide granules; slight effervescence; moderately alkaline; clear smooth boundary.

Cg—34 to 60 inches; light olive gray (5Y 6/2) silt loam; common fine prominent light olive brown (2.5Y 5/6) and common medium faint pale olive (5Y 6/3) mottles; massive; friable; few black (10YR 2/1) manganese oxide granules; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silt loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silt loam or silty clay loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silt loam or silty clay loam

Spillville Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Landform: Flood plains
Parent material: Loamy alluvial sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Spillville loam, 2,300 feet north and 850 feet east of the southwest corner of sec. 22, T. 104 N., R. 28 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

A1—11 to 19 inches; black (10YR 2/1) loam, very dark

gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; clear smooth boundary.

A2—19 to 30 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; moderately acid; gradual wavy boundary.

A3—30 to 51 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; moderately acid; gradual smooth boundary.

C—51 to 60 inches; very dark grayish brown (10YR 3/2) loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 30 to more than 60 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—1 or 2
Texture—loam, sandy clay loam, or sandy loam

Storden Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 6 to 24 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Storden loam, in an area of Clarion-Storden complex, 6 to 12 percent slopes, eroded; 1,450 feet west and 675 feet south of the northeast corner of sec. 28, T. 102 N., R. 24 W.

Ap—0 to 9 inches; brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common dark grayish brown (10YR 4/2) streaks in pores and on faces of peds; 5 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

C—9 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; few strong brown (7.5YR 5/6) iron oxide stains; 6 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: At the surface
Content of gravel: 2 to 15 percent

Ap horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 6
Texture—loam or clay loam

Swanlake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 4 to 40 percent
Taxonomic class: Fine-loamy, mixed, mesic Entic Hapludolls

Typical Pedon

Swanlake loam, in an area of Clarion-Swanlake complex, 2 to 6 percent slopes; 840 feet east and 2,400 feet south of the northwest corner of sec. 24, T. 101 N., R. 24 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

C1—11 to 24 inches; yellowish brown (10YR 5/4) loam; massive; friable; 4 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

C2—24 to 42 inches; light olive brown (2.5Y 5/4) loam; few fine distinct grayish brown (2.5Y 5/2) relict mottles; massive; friable; 3 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C3—42 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine distinct light brownish gray (2.5Y 6/2) relict mottles; friable; few fine strong brown (7.5YR 5/8) iron oxide stains; 5 percent coarse fragments; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 14 inches
Content of gravel: 1 to 15 percent

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—4 to 6
Texture—loam or clay loam

Terril Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Alluvial fans
Parent material: Loamy, calcareous colluvial sediments
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Terril loam, 2 to 6 percent slopes, 1,125 feet north and 200 feet west of the southeast corner of sec. 1, T. 101 N., R. 24 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.

A1—11 to 22 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; gradual smooth boundary.

A2—22 to 36 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; 3 percent gravel; neutral; gradual wavy boundary.

Bw—36 to 40 inches; brown (10YR 4/3) clay loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) streaks; 5 percent gravel; neutral; clear smooth boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct yellowish brown (10YR 5/6) and olive gray (5Y 5/2) mottles; massive; 5 percent gravel; friable: slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 24 to 44 inches
Content of gravel: 1 to 15 percent

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—3 or 4
Texture—clay loam or loam

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—4
Texture—loam or silt loam

Truman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Silty, calcareous glacial lacustrine sediments
Slope range: 1 to 16 percent
Taxonomic class: Fine-silty, mixed, mesic Typic Hapludolls

Typical Pedon

Truman silt loam, 1 to 6 percent slopes, 1,975 feet east and 190 feet south of the northwest corner of sec. 4, T. 103 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; slightly acid; abrupt smooth boundary.

AB—10 to 15 inches; dark brown (10YR 3/3) silt loam; weak fine subangular blocky structure; friable; common black (10YR 2/1) organic stains on faces of peds; few very dark grayish brown (10YR 3/2) streaks; slightly acid; gradual smooth boundary.

Bw1—15 to 23 inches; dark brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; common dark yellowish brown (10YR 4/4) wormcasts; few very dark grayish brown (10YR 3/2) organic stains on faces of peds; slightly acid; gradual smooth boundary.

Bw2—23 to 39 inches; yellowish brown (10YR 5/4) silt

loam; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

BC—39 to 46 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual smooth boundary.

C—46 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct light brownish gray (10YR 6/2) relict mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 56 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—silt loam

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 to 6
Texture—silt loam or silty clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—4 to 6
Texture—silt loam

Taxadjunct features: The Truman soil in map unit 909D2 has a mollic epipedon that is thinner than is defined as the range for the series.

Waldorf Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow in the middle part, moderately slow or moderate in the lower part
Landform: Lake plains
Parent material: Silty and clayey, calcareous glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Haplaquolls

Typical Pedon

Waldorf silty clay loam, 1,120 feet east and 2,010 feet south of the northwest corner of sec. 2, T. 104 N., R. 28 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

AB—10 to 17 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct dark grayish brown (2.5Y 4/2) mottles; weak medium subangular blocky structure; firm; slightly acid; gradual wavy boundary.

Bg1—17 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine faint olive brown (2.5Y 4/4) mottles; moderate fine prismatic structure parting to weak fine angular blocky; firm; common very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; gradual wavy boundary.

Bg2—23 to 32 inches; grayish brown (2.5Y 5/2) clay; few fine faint olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; neutral; gradual wavy boundary.

Bg3—32 to 38 inches; olive gray (5Y 5/2) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles; moderate fine prismatic structure; firm; neutral; clear smooth boundary.

Cg—38 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; common fine yellowish brown (10YR 5/8) iron oxide stains; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 26 to 55 inches
Thickness of the mollic epipedon: 16 to 24 inches

Ap horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

AB horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silty clay

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay, silty clay loam, or clay

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silty clay loam, silty clay, or clay

Webster Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Haplaquolls

Typical Pedon

Webster clay loam, 1,210 feet east and 1,005 feet north of the southwest corner of sec. 12, T. 104 N., R. 24 W.

Ap—0 to 11 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; 3 percent gravel; neutral; abrupt smooth boundary.

A—11 to 18 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; common fine distinct dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; gradual irregular boundary.

Bg1—18 to 29 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium faint grayish brown (2.5Y 5/2) and common fine distinct light yellowish brown (2.5Y 6/4) mottles; moderate fine subangular blocky structure; friable; few very dark gray (10YR 3/1) organic coatings on faces of peds; 3 percent gravel; neutral; gradual wavy boundary.

Bg2—29 to 44 inches; grayish brown (2.5Y 5/2) loam; few fine distinct light yellowish brown (2.5Y 6/4) and light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; friable; 4 percent gravel; neutral; gradual wavy boundary.

Cg—44 to 60 inches; gray (5Y 5/1) loam; common medium prominent light olive brown (2.5Y 5/4) mottles; massive; friable; common fine strong brown (7.5YR 5/8) iron oxide stains; 5 percent gravel; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 15 to 24 inches
Content of gravel: 2 to 15 percent

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, loam, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam, clay loam, or sandy loam

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Formation of the Soils

The characteristics of a soil depend on the physical and chemical composition of the parent material and on climate, relief, plant and animal life, and time. Soils form through the interaction of these five factors *(4)*. The relative importance of each factor differs from one soil to another. The factors and their effects on the soils in the survey area are described in this section.

Parent Material

Parent material is the physical medium in which a soil forms. The most common parent material in the survey area is glacial till, which was deposited by ice as an unsorted mixture of clay, silt, sand, pebbles, and rocks about 15,000 years ago *(5)*. The glacial till surrounds the county on the east, south, and west. It is also scattered throughout the lacustrine sediments in the northern part of the county. Soils that formed in glacial till include Clarion, Nicollet, and Webster soils.

As the glaciers melted, large amounts of water flowed through the survey area. This meltwater carried tons of soil material. As the volume of water decreased, the coarser material settled first. This material, mainly sand and gravel, is called glacial outwash. Soils that formed in glacial outwash are Estherville, Dickinson, and Sparta soils.

After the coarser sand and gravel settled out and as the volume and speed of the water decreased further, coarse and fine-silty material settled out. This material is called glacial lacustrine material. Soils that formed in glacial lacustrine material include the coarse-silty Grogan and Bold soils on the outer edges of the lake plain, the fine-silty Truman and Spicer soils on the higher parts of the lake plain, and the fine and very fine Waldorf and Beauford soils on the lowest part of the lake plain.

The rivers in the county still carry some material as they constantly cut and dig at streambanks. This type of parent material, called alluvium, is deposited on flood plains as the volume of water decreases. Alluvium is generally finer textured than outwash and in most cases is much younger. Soils that formed in alluvium include Coland, Spillville, and Lomax soils.

Climate

Climate is essentially uniform throughout Faribault County, but some local variations in climate are caused by differences in relief and aspect. South- and west-facing slopes tend to be slightly drier and warmer than north- and east-facing slopes.

Climatic changes have been responsible for the formation and melting of glaciers, the deposition of lacustrine sediments, the evolution of topography, and the growth cycles of plants and animals. The present climate has been relatively constant for the past few thousand years. It is a continental climate characterized by long, cold winters and hot summers. Freezing of the soil during the winter slows the soil-forming processes. Alternate periods of freezing and thawing help to disintegrate the parent material, and frost heave mixes the soil material.

Climate and fires were the factors that determined whether prairie or forest vegetation grew in different areas of the county. Most of the soils in the county have a dark surface layer because they formed under grass. A cover of prairie vegetation and cool temperatures promote the accumulation of organic matter. A cover of forest vegetation promotes leaching, and a more acid soil forms. Rainfall has leached free lime from the soil. The thickness of the solum is often determined by the depth to which free lime has been leached.

Relief

Soil formation is influenced by position on the landscape. In areas that have more pronounced relief, much of the rainfall runs off the hillsides. The extent of the plant cover is less in these areas than in areas where the water infiltrates the soil. If water cannot move through the soil, the leaching of carbonates and the translocation of clay particles is limited.

Soils in sloping areas are characterized by less horizon development than the soils in more level areas. Bold and Storden soils, for example, have weakly developed horizons. Runoff does infiltrate the soils at the base of slopes, and soils in these areas show more distinct horizon development.

In steeply sloping areas, erosional sediments are carried downslope by runoff. These sediments affect not only the soils from which they have been removed, but also the soils in areas where they are deposited. Soils that formed in colluvial sediments, such as Delft soils, have a thicker dark surface layer and are more fertile than the soils upslope.

Landscape position also affects soil drainage. Madelia and Webster soils, which are in swales, are poorly drained and have a seasonal high water table at a depth of 1.0 to 2.5 feet. Truman and Grogan soils, however, which are on convex side slopes, are well drained and have a water table at a depth of more than 6 feet.

Plants and Animals

The process of soil formation begins as plants grow on the freshly deposited parent material. Plant roots loosen the soil and release minerals into the underlying material. As the plants decay, organic matter and plant nutrients are returned to the soil. Most of the soils in Faribault County formed under prairie vegetation. They have a very deep, dark surface layer and are neutral to moderately alkaline. Along the rivers and lakes, in areas that were protected from prairie fires, forest vegetation grew. The soils that formed under forest vegetation, such as Shorewood and Minnetonka soils, have a lighter colored surface layer and are slightly acid or moderately acid.

Earthworms eat the decomposed plant matter, and their burrows help to channel air and water through the soil. The surface layer and subsoil of many soils contain wormcasts. Burrowing animals mix soil material from various horizons and bring fresh parent material to the surface.

Human activities also influence soil formation. Farming increases the action of some soil-forming processes. In fields where the soil is exposed to the air and wind, the oxidation of organic matter is accelerated. Erosion of the surface layer is accelerated on some steeply sloping soils, and areas below these slopes receive deposits of eroded material. Artificial drainage that lowers the water table in wet soils, management decisions that change soil fertility, and changes in the types of vegetative cover also affect soil formation.

Time

Time is required for climate and biological activity to act on the parent material. In areas that are stable, conditions are favorable for soil development and mature profiles have developed. Mature soils, such as Clarion and Truman soils, have a well developed surface layer and subsoil. In unstable areas, the soils are weakly developed and have only a thin surface layer over the parent material. Storden and Bold soils are examples.

Soils that formed in alluvium along streams, such as Millington soils, are also weakly developed because the parent material is geologically young. Fresh deposits of alluvium are added almost annually. This recurring deposition prevents the formation of distinct horizons.

When compared to soils in southeastern and southwestern Minnesota, the soils in Faribault County are geologically young. The last glaciation in the survey area was between 12,000 and 15,000 years ago.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

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.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

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.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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.

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.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or 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 establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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 grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods.

Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

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, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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.

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 meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by

streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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 capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

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, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, 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 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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

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.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes defined in this survey are:

Nearly level	0 to 2 percent
Gently sloping	2 to 6 percent
Sloping	6 to 12 percent
Moderately steep	12 to 18 percent
Steep	18 to 24 percent
Very steep	24 to 40 percent

Slope (in tables). Slope is great enough that special practices are required to ensure 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 (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation

are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing 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, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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 that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils 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, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

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 a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

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Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-87 at Winnebago, Minnesota)

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*	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	20.1	1.2	10.7	46	-26	0	0.90	0.33	1.33	3	9.9
February	26.8	7.9	17.4	51	-20	0	1.00	.37	1.48	3	9.1
March	37.4	18.8	28.1	70	-9	15	1.85	.94	2.54	5	11.7
April	55.3	34.0	44.7	88	15	55	2.65	1.35	3.68	7	3.0
May	69.2	45.7	57.5	92	27	269	3.97	2.26	5.34	8	.1
June	78.3	56.0	67.2	96	42	516	4.96	2.89	6.46	8	.0
July	83.1	61.0	72.1	98	48	685	4.17	1.94	5.91	7	.0
August	80.4	58.3	69.4	95	44	601	3.92	2.02	5.48	7	.0
September	71.4	48.6	60.0	92	31	305	3.09	1.36	4.54	6	.0
October	59.7	37.4	48.6	86	20	92	2.15	.63	3.37	5	.4
November	41.4	23.4	32.4	69	-3	0	1.37	.30	2.10	4	5.2
December	26.1	9.2	17.7	52	-19	0	1.10	.53	1.58	3	10.1
Yearly:											
Average	54.1	33.5	43.8	---	---	---	---	---	---	---	---
Extreme	---	---	---	98	-26	---	---	---	---	---	---
Total	---	---	---	---	---	2,538	31.13	26.40	35.85	66	49.5

* 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 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-87 at Winnebago, Minnesota)

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--	Apr. 22	May 11	May 17
2 years in 10 later than--	Apr. 18	May 5	May 12
5 years in 10 later than--	Apr. 8	Apr. 23	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 12	Oct. 4	Sept. 25
2 years in 10 earlier than--	Oct. 18	Oct. 8	Sept. 29
5 years in 10 earlier than--	Oct. 28	Oct. 16	Oct. 7

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-87 at Winnebago, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	185	155	140
8 years in 10	191	162	146
5 years in 10	202	175	157
2 years in 10	214	188	169
1 year in 10	220	195	175

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
8B	Sparta loamy fine sand, 0 to 6 percent slopes	469	0.1
27B	Dickinson fine sandy loam, 0 to 6 percent slopes	3,335	0.7
27C	Dickinson fine sandy loam, 6 to 12 percent slopes	514	0.1
35	Blue Earth mucky silty clay loam	1,061	0.2
37B	Farrar fine sandy loam, 1 to 6 percent slopes	608	0.1
41B	Estherville sandy loam, 0 to 6 percent slopes	728	0.2
84	Brownton silty clay loam	8,356	1.8
86	Canisteo clay loam	9,129	2.0
94B	Terril loam, 2 to 6 percent slopes	1,250	0.3
96A	Collinwood silty clay loam, 0 to 3 percent slopes	14,072	3.0
96B	Collinwood silty clay loam, 3 to 6 percent slopes	7,121	1.5
101B	Truman silt loam, 1 to 6 percent slopes	12,786	2.8
102B	Clarion loam, 1 to 6 percent slopes	27,048	5.9
110	Marna silty clay loam	22,507	4.9
113	Webster clay loam	27,728	6.0
114	Glencoe clay loam	2,562	0.6
118	Crippin loam	2,132	0.5
128B	Grogan silt loam, 1 to 6 percent slopes	3,599	0.8
130	Nicollet clay loam	21,042	4.6
134	Okoboji silty clay loam	9,445	2.0
136	Madelia silty clay loam	7,717	1.7
140	Spicer silt loam	10,191	2.2
160	Fieldon loam	2,966	0.6
181	Litchfield fine sandy loam	659	0.1
197	Kingston silt loam	8,894	1.9
211	Lura silty clay	1,123	0.2
229	Waldorf silty clay loam	34,986	7.6
230A	Guckeen silty clay loam, 0 to 3 percent slopes	14,318	3.1
230B	Guckeen silty clay loam, 3 to 6 percent slopes	8,042	1.7
247	Linder loam	319	0.1
248	Lomax loam	1,092	0.2
255	Mayer loam	502	0.1
269	Millington clay loam	302	0.1
275B	Ocheyedan loam, 2 to 6 percent slopes	10,688	2.3
275C2	Ocheyedan loam, 6 to 12 percent slopes, eroded	2,029	0.4
281	Darfur loam	1,103	0.2
286A	Shorewood silty clay loam, 0 to 3 percent slopes	2,986	0.6
286B	Shorewood silty clay loam, 3 to 6 percent slopes	5,785	1.3
286C2	Shorewood silty clay loam, 6 to 12 percent slopes, eroded	1,438	0.3
287	Minnetonka silty clay loam	3,641	0.8
310	Beauford silty clay	4,957	1.1
313	Spillville loam	734	0.2
319	Barbert silty clay loam	1,827	0.4
336	Delft loam	14,846	3.2
392	Biscay loam	427	0.1
525	Muskego muck	2,772	0.6
539	Klossner muck	8,067	1.7
887B	Clarion-Swanlake complex, 2 to 6 percent slopes	11,810	2.6
909C2	Truman-Bold complex, 6 to 12 percent slopes, eroded	2,599	0.6
909D2	Bold-Truman complex, 12 to 18 percent slopes, eroded	506	0.1
920B	Clarion-Estherville complex, 2 to 6 percent slopes	3,513	0.8
920C2	Clarion-Storden-Estherville complex, 6 to 12 percent slopes, eroded	3,567	0.8
920D2	Clarion-Storden-Estherville complex, 12 to 18 percent slopes, eroded	541	0.1
921C2	Clarion-Storden complex, 6 to 12 percent slopes, eroded	10,503	2.2
929	Fieldon-Canisteo complex	7,909	1.7
956	Canisteo-Glencoe complex	58,216	12.6
960D2	Storden-Clarion complex, 12 to 18 percent slopes, eroded	1,524	0.3
960E	Storden-Clarion complex, 18 to 24 percent slopes	405	0.1
1030	Pits, gravel-Udorthents complex	466	0.1
1052	Klossner-Okoboji complex, ponded	2,728	0.6
1833	Coland silty clay loam, occasionally flooded	8,171	1.8
1834	Coland loam, frequently flooded	8,281	1.8

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1852F	Swanlake-Terril complex, 18 to 40 percent slopes	891	0.2
1877	Fostoria loam	6,392	1.4
1907	Lakefield silt loam	1,175	0.3
	Water areas more than 40 acres in size	4,500	1.0
	Total	461,600	100.0

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
27B	Dickinson fine sandy loam, 0 to 6 percent slopes
37B	Farrar fine sandy loam, 1 to 6 percent slopes
84	Brownton silty clay loam (where drained)
86	Canisteo clay loam (where drained)
94B	Terril loam, 2 to 6 percent slopes
96A	Collinwood silty clay loam, 0 to 3 percent slopes
96B	Collinwood silty clay loam, 3 to 6 percent slopes
101B	Truman silt loam, 1 to 6 percent slopes
102B	Clarion loam, 1 to 6 percent slopes
110	Marna silty clay loam (where drained)
113	Webster clay loam (where drained)
114	Glencoe clay loam (where drained)
118	Crippin loam
128B	Grogan silt loam, 1 to 6 percent slopes
130	Nicollet clay loam
134	Okoboji silty clay loam (where drained)
136	Madelia silty clay loam (where drained)
140	Spicer silt loam (where drained)
160	Fieldon loam (where drained)
181	Litchfield fine sandy loam
197	Kingston silt loam
211	Lura silty clay (where drained)
229	Waldorf silty clay loam (where drained)
230A	Guckeen silty clay loam, 0 to 3 percent slopes
230B	Guckeen silty clay loam, 3 to 6 percent slopes
247	Linder loam
248	Lomax loam
255	Mayer loam (where drained)
269	Millington clay loam (where drained)
275B	Ocheyedan loam, 2 to 6 percent slopes
281	Darfur loam (where drained)
286A	Shorewood silty clay loam, 0 to 3 percent slopes
286B	Shorewood silty clay loam, 3 to 6 percent slopes
287	Minnetonka silty clay loam (where drained)
310	Beauford silty clay (where drained)
313	Spillville loam
319	Barbert silty clay loam (where drained)
336	Delft loam (where drained)
392	Biscay loam (where drained)
887B	Clarion-Swanlake complex, 2 to 6 percent slopes
929	Fieldon-Canisteo complex (where drained)
956	Canisteo-Glencoe complex (where drained)
1833	Coland silty clay loam, occasionally flooded (where drained)
1877	Fostoria loam
1907	Lakefield silt loam

TABLE 6.--LAND CAPABILITY AND 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	Land capability	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
8B---------- Sparta	IVs	72	23	47	2.0	2.5
27B---------- Dickinson	IIIe	118	33	65	2.8	7.6
27C---------- Dickinson	IVe	98	29	57	2.5	6.6
35---------- Blue Earth	IIIw	134	40	68	4.0	---
37B---------- Farrar	IIe	129	38	83	3.2	8.3
41B---------- Estherville	IIIs	72	22	35	2.0	2.5
84---------- Brownton	IIw	149	41	85	4.2	5.3
86---------- Canisteo	IIw	155	42	75	4.5	5.2
94B---------- Terril	IIe	153	46	101	4.4	8.3
96A---------- Collinwood	IIw	150	50	80	4.2	6.0
96B---------- Collinwood	IIe	146	46	80	4.2	6.0
101B---------- Truman	IIe	152	50	78	4.5	7.5
102B---------- Clarion	IIe	145	46	101	4.4	10.1
110---------- Marna	IIw	150	50	75	4.3	6.0
113---------- Webster	IIw	155	51	102	4.5	7.3
114---------- Glencoe	IIIw	139	41	75	3.3	---
118---------- Crippin	I	155	48	105	4.4	10.0
128B---------- Grogan	IIe	139	42	65	4.0	6.0
130---------- Nicollet	I	160	55	80	4.8	6.5

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
134--Okoboji	IIIw	142	41	73	3.5	---
136--Madelia	IIw	155	51	80	4.5	7.2
140--Spicer	IIw	152	44	80	4.4	6.5
160--Fieldon	IIw	129	41	75	4.0	5.5
181--Litchfield	IIs	120	33	55	3.0	4.5
197--Kingston	I	160	55	80	4.7	6.7
211--Lura	IIIw	134	40	65	3.5	---
229--Waldorf	IIw	150	48	95	4.3	5.5
230A--Guckeen	IIw	150	48	85	4.3	7.0
230B--Guckeen	IIe	146	44	85	4.2	7.0
247--Linder	IIs	118	35	70	2.8	4.1
248--Lomax	I	140	44	66	4.2	7.3
255--Mayer	IIw	129	37	60	3.0	5.0
269--Millington	IIw	145	41	68	4.0	4.5
275B--Ocheyedan	IIe	145	44	65	4.3	5.8
275C2--Ocheyedan	IIIe	130	36	55	4.0	4.6
281--Darfur	IIw	129	42	70	4.0	5.9
286A--Shorewood	IIw	150	51	80	4.2	6.7
286B--Shorewood	IIe	146	46	80	4.0	6.7
286C2--Shorewood	IIIe	130	41	70	3.8	6.1

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
287 Minnetonka	IIw	150	48	75	4.2	6.0
310 Beauford	IIw	144	47	85	3.2	5.2
313 Spillville	IIw	145	50	94	3.8	10.3
319 Barbert	IIIw	129	39	70	3.0	---
336 Delft	IIw	155	45	80	4.2	6.5
392 Biscay	IIw	129	41	80	3.1	5.5
525 Muskego	IVw	132	42	70	3.0	---
539 Klossner	IIIw	134	42	72	3.2	---
887B Clarion-Swanlake	IIe	144	46	87	4.3	8.2
909C2 Truman-Bold	IIIe	130	39	58	4.2	5.0
909D2		120	33	55	4.0	4.9
Bold	VIe					
Truman	IVe					
920B		131	37	76	3.3	7.2
Clarion	IIe					
Estherville	IIIs					
920C2		118	32	62	3.0	5.9
Clarion-Storden	IIIe					
Estherville	IVs					
920D2		98	26	45	2.5	5.4
Clarion	IIIe					
Storden	IVe					
Estherville	VIs					
921C2 Clarion-Storden	IIIe	130	38	73	3.9	7.2
929 Fieldon-Canisteo	IIw	139	42	76	4.2	5.5
956		144	42	75	3.5	4.8
Canisteo	IIw					
Glencoe	IIIw					
960D2 Storden-Clarion	IVe	118	32	54	3.0	5.8

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
960E---------- Storden-Clarion	VIe	---	---	---	2.5	5.2
1030. Pits-Udorthents						
1052---------- Klossner-Okoboji	VIIIw	---	---	---	---	---
1833---------- Coland	IIw	149	44	95	3.9	6.8
1834---------- Coland	Vw	---	---	---	---	---
1852F----------		---	---	---	---	---
Swanlake----------	VIe					
Terril----------	VIIe					
1877---------- Fostoria	I	155	51	90	4.5	8.5
1907---------- Lakefield	I	155	45	80	4.4	6.7

* 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.

TABLE 7.--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 height, in feet, of--				
	<8	8-15	16-25	26-35	>35
8B---- Sparta	Siberian peashrub	Eastern redcedar, lilac.	Austrian pine, jack pine, red pine, honeylocust, green ash, Russian-olive, Siberian elm.	Eastern white pine	---
27B, 27C---- Dickinson	Lilac----------	Eastern redcedar, Russian-olive, Siberian peashrub.	Eastern white pine, green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	---	---
35---- Blue Earth	---	Redosier dogwood	Black ash, tall purple willow.	Black ash, golden willow, white willow.	---
37B---- Farrar	Lilac----------	Siberian peashrub, eastern redcedar, Russian-olive.	Green ash, red pine, honeylocust, Norway spruce, eastern white pine, Amur maple, hackberry.	---	---
41B---- Estherville	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, jack pine, green ash, Russian-olive, Siberian elm, red pine, Austrian pine.	Eastern white pine	---
84---- Brownton	---	Siberian peashrub, honeysuckle, lilac, northern whitecedar.	White spruce, hackberry, bur oak, eastern redcedar.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
86---- Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
94B---- Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern whitecedar, eastern redcedar.	Eastern white pine, green ash.	---
96A, 96B---- Collinwood	---	Northern whitecedar, Siberian peashrub, cotoneaster, lilac, eastern redcedar.	White spruce, Austrian pine, hackberry, Russian-olive, bur oak.	Eastern white pine, green ash.	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
101B---------- Truman	---	Gray dogwood, redosier dogwood, Siberian peashrub, lilac.	Northern whitecedar, blue spruce, hackberry, Russian-olive, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
102B---------- Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
110---------- Marna	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, tall purple willow, Amur maple, hackberry.	Golden willow, green ash.	Eastern cottonwood, silver maple.
113---------- Webster	---	Redosier dogwood, American plum, cotoneaster.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
114---------- Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
118---------- Crippin	---	Northern whitecedar, cotoneaster, Siberian peashrub, lilac.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
128B---------- Grogan	---	Redosier dogwood, gray dogwood, Siberian peashrub, lilac.	Northern whitecedar, blue spruce, Russian-olive, hackberry, Amur maple, eastern redcedar.	Eastern white pine, green ash.	---
130---------- Nicollet	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
134---------- Okoboji	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
136---------- Madelia	---	American plum, redosier dogwood.	Northern whitecedar, white spruce, hackberry, Amur maple, tall purple willow.	Golden willow, green ash.	Silver maple, eastern cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
140---------- Spicer	---	Northern whitecedar, lilac, Siberian peashrub.	Bur oak, hackberry, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
160---------- Fieldon	---	Northern whitecedar, lilac, Siberian peashrub.	White spruce, eastern redcedar, bur oak, hackberry.	Honeylocust, green ash, golden willow.	Eastern cottonwood.
181---------- Litchfield	---	Redosier dogwood, lilac, American plum.	White spruce, blue spruce, Amur maple, northern whitecedar.	Austrian pine, hackberry, green ash, eastern white pine.	Silver maple.
197---------- Kingston	---	Lilac, redosier dogwood.	Northern whitecedar, white spruce, Amur maple, blue spruce.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
211---------- Lura	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
229---------- Waldorf	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, Amur maple, tall purple willow, hackberry.	Golden willow, green ash.	Eastern cottonwood, silver maple.
230A, 230B-------- Guckeen	---	Siberian peashrub, eastern redcedar, lilac.	Ncrthern whitecedar, white spruce, Austrian pine, hackberry, Russian-olive, bur oak.	Eastern white pine, green ash.	---
247---------- Linder	---	Redosier dogwood, lilac.	Northern whitecedar, blue spruce, Amur maple, white spruce.	Eastern white pine, Austrian pine, green ash, hackberry.	Silver maple.
248---------- Lomax	Lilac----------	Siberian peashrub, eastern redcedar, Russian-olive.	Green ash, hackberry, red pine, eastern white pine, Norway spruce, honeylocust, Amur maple.	---	---
255---------- Mayer	---	Lilac, northern whitecedar, Siberian peashrub.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
269---------- Millington	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar.	Honeylocust, silver maple, green ash, red maple, white ash.	Eastern cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
275B, 275C2----- Ocheyedan	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Northern whitecedar, hackberry, Russian-olive, Amur maple, blue spruce.	Eastern white pine, ponderosa pine, green ash.	---
281----- Darfur	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, tall purple willow, Amur maple, hackberry.	Golden willow, green ash.	Eastern cottonwood, silver maple.
286A, 286B, 286C2- Shorewood	---	Northern whitecedar, Siberian peashrub, eastern redcedar, lilac.	White spruce, Austrian pine, hackberry, bur oak, Russian-olive.	Eastern white pine, green ash.	---
287----- Minnetonka	---	Redosier dogwood, American plum, lilac.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
310----- Beauford	---	American plum, redosier dogwood, lilac.	Northern whitecedar, white spruce, tall purple willow, hackberry, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
313----- Spillville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
319----- Barbert	---	Redosier dogwood, Siberian peashrub, gray dogwood.	Northern whitecedar, white spruce, Russian-olive, black ash, tall purple willow.	Eastern cottonwood, golden willow, green ash, Siberian elm, white willow, black willow.	---
336----- Delft	---	American plum, redosier dogwood.	Hackberry, Amur maple, white spruce, northern whitecedar, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
392----- Biscay	---	Redosier dogwood, American plum, cotoneaster.	Northern whitecedar, Amur maple, white spruce, hackberry, tall purple willow.	Green ash, golden willow.	Eastern cottonwood, silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
525---------- Muskego	---	Nannyberry viburnum, silky dogwood, common ninebark, northern whitecedar, American cranberrybush, redosier dogwood, late lilac.	White spruce, Japanese tree lilac, Manchurian crabapple.	Siberian crabapple	Imperial Carolina poplar.
539---------- Klossner	Common ninebark---	Whitebelle honeysuckle, Amur privet, silky dogwood, nannyberry viburnum.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
887B*:					
Clarion----------	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Swanlake----------	American plum-----	Eastern redcedar, Siberian peashrub, hackberry.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
909C2*:					
Truman----------	---	Gray dogwood, redosier dogwood, Siberian peashrub, lilac.	Northern whitecedar, blue spruce, hackberry, Russian-olive, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
Bold----------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
909D2*:					
Bold----------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
Truman----------	---	Gray dogwood, redosier dogwood, Siberian peashrub, lilac.	Northern whitecedar, blue spruce, hackberry, Russian-olive, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
920B*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Estherville	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, jack pine, green ash, Russian-olive, Siberian elm, red pine, Austrian pine.	Eastern white pine	---
920C2*, 920D2*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
Estherville	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, jack pine, green ash, Russian-olive, Siberian elm, red pine, Austrian pine.	Eastern white pine	---
921C2*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
929*:					
Fieldon	---	Northern whitecedar, lilac, Siberian peashrub.	White spruce, eastern redcedar, bur oak, hackberry.	Honeylocust, green ash, golden willow.	Eastern cottonwood.
Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
956*:					
Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
960D2*, 960E*:					
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
1030*:					
Pits.					
Udorthents.					
1052*:					
Klossner.					
Okoboji.					
1833, 1834 Coland	---	Redosier dogwood, cotoneaster, American plum.	White spruce, hackberry, northern whitecedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
1852F*:					
Swanlake	American plum	Eastern redcedar, Siberian peashrub, hackberry.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern whitecedar, eastern redcedar.	Eastern white pine, green ash.	---
1877 Fostoria	---	Redosier dogwood, lilac.	White spruce, blue spruce, northern whitecedar, Amur maple.	Austrian pine, green ash, eastern white pine, hackberry.	Silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1907---------- Lakefield	---	Siberian peashrub, lilac, northern whitecedar.	Eastern redcedar, white spruce, bur oak, hackberry.	Green ash, honeylocust, golden willow.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--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
8B Sparta	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
27C Dickinson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
35 Blue Earth	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.
37B Farrar	Slight	Slight	Moderate: slope.	Slight	Slight.
41B Estherville	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
84 Brownton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
86 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
94B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
96A Collinwood	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
96B Collinwood	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
101B Truman	Slight	Slight	Moderate: slope.	Slight	Slight.
102B Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
110 Marna	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
113 Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
114 Glencoe	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
118 Crippin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
128B---- Grogan	Slight	Slight	Moderate: slope.	Slight	Slight.
130---- Nicollet	Slight	Slight	Slight	Slight	Slight.
134---- Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
136---- Madelia	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
140---- Spicer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
160---- Fieldon	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
181---- Litchfield	Slight	Slight	Slight	Slight	Moderate: droughty.
197---- Kingston	Slight	Slight	Slight	Slight	Slight.
211---- Lura	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
229---- Waldorf	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
230A---- Guckeen	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight	Slight.
230B---- Guckeen	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
247---- Linder	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
248---- Lomax	Severe: flooding.	Slight	Moderate: small stones.	Slight	Slight.
255---- Mayer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
269---- Millington	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
275B---- Ocheyedan	Slight	Slight	Moderate: slope.	Slight	Slight.
275C2---- Ocheyedan	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
281---- Darfur	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
286A---- Shorewood	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
286B Shorewood	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
286C2 Shorewood	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
287 Minnetonka	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
310 Beauford	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
313 Spillville	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
319 Barbert	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
336 Delft	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
392 Biscay	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
525 Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
539 Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
887B*: Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Swanlake	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
909C2*: Truman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Bold	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
909D2*: Bold	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Truman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
920B*: Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
920B*:					
Estherville	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
920C2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Estherville	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
920D2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Estherville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
921C2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
929*:					
Fieldon	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
956*:					
Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Glencoe	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
960D2*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
960E*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1030*:					
Pits.					
Udorthents.					
1052*:					
Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1833 Coland	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
1834 Coland	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
1852F*:					
Swanlake	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Terril	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1877 Fostoria	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
1907 Lakefield	Slight	Slight	Slight	Slight	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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
8B---- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
27B---- Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
27C---- Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
35---- Blue Earth	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
37B---- Farrar	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
41B---- Estherville	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
84---- Brownton	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
86---- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
94B---- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
96A, 96B---- Collinwood	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
101B---- Truman	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
102B---- Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
110---- Marna	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
113---- Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
114---- Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
118---- Crippin	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor.
128B---- Grogan	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
130---- Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
134---- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.

TABLE 9.--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
136---- Madelia	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good.
140---- Spicer	Good	Good	Fair	Fair	Poor	Good	Good	Good	Fair	Good.
160---- Fieldon	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
181---- Litchfield	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
197---- Kingston	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
211---- Lura	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
229---- Waldorf	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
230A---- Guckeen	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
230B---- Guckeen	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
247---- Linder	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
248---- Lomax	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
255---- Mayer	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
269---- Millington	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
275B---- Ocheyedan	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
275C2---- Ocheyedan	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
281---- Darfur	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
286A, 286B---- Shorewood	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
286C2---- Shorewood	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
287---- Minnetonka	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
310---- Beauford	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
313---- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 9.--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
319--Barbert	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Fair.
336--Delft	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
392--Biscay	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good.
525--Muskego	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
539--Klossner	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
887B*:										
Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Swanlake	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
909C2*:										
Truman	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
Bold	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
909D2*:										
Bold	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Truman	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
920B*:										
Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Estherville	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
920C2*:										
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.
Estherville	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
920D2*:										
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.

See footnote at end of table.

TABLE 9.--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
920D2*:										
Estherville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
921C2*:										
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.
929*:										
Fieldon	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
956*:										
Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
960D2*:										
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
960E*:										
Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1030*:										
Pits.										
Udorthents.										
1052*:										
Klossner	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Okoboji	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
1833 Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
1834 Coland	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
1852P*:										
Swanlake	Poor	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Terril	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 9.--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
1877---------- Fostoria	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1907---------- Lakefield	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
8B Sparta	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
27B Dickinson	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
27C Dickinson	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
35 Blue Earth	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
37B Farrar	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
41B Estherville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
84 Brownton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
86 Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
94B Terril	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
96A, 96B Collinwood	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
101B Truman	Slight	Slight	Slight	Slight	Severe: low strength, frost action.	Slight.
102B Clarion	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
110 Marna	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
113 Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

TABLE 10.--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
114--- Glencoe	Severe: ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
118--- Crippin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.	Slight.
128B--- Grogan	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Severe: frost action.	Slight.
130--- Nicollet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
134--- Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
136--- Madelia	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
140--- Spicer	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
160--- Fieldon	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
181--- Litchfield	Severe: cutbanks cave.	Slight---	Moderate: wetness.	Slight---	Moderate: frost action.	Moderate: droughty.
197--- Kingston	Moderate: wetness.	Slight---	Moderate: wetness.	Slight---	Severe: frost action, low strength.	Slight.
211--- Lura	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
229--- Waldorf	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
230A--- Guckeen	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
230B--- Guckeen	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
247--- Linder	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.

TABLE 10.--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
248 Lomax	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: frost action, flooding.	Slight.
255 Mayer	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
269 Millington	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding.
275B Ocheyedan	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
275C2 Ocheyedan	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
281 Darfur	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
286A, 286B Shorewood	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
286C2 Shorewood	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Moderate: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: slope.
287 Minnetonka	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
310 Beauford	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.
313 Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
319 Barbert	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding.
336 Delft	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
392 Biscay	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

TABLE 10.--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
525 Muskego	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
539 Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
887B*:						
Clarion	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
Swanlake	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.	Slight.
909C2*:						
Truman	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Bold	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
909D2*:						
Bold	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Truman	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
920B*:						
Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Estherville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
920C2*:						
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.
Estherville	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
920D2*:						
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.

See footnote at end of table.

TABLE 10.--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
920D2*:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Estherville	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
921C2*:						
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.
929*:						
Fieldon	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
956*:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Glencoe	Severe: ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
960D2*:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
960E*:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1030*:						
Pits.						
Udorthents.						
1052*:						
Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 10.--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
1052*:						
Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1833 Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
1834 Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
1852F*:						
Swanlake	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Terril	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
1877 Fostoria	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.	Slight.
1907 Lakefield	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: low strength, frost action.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
8B Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
27B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
27C Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
35 Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
37B Farrar	Slight	Moderate: slope, seepage.	Slight	Severe: seepage.	Good.
41B Estherville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
84 Brownton	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
86 Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94B Terril	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
96A Collinwood	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
96B Collinwood	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
101B Truman	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
102B Clarion	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
110 Marna	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 11.--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
113 Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114 Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
118 Crippin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
128B Grogan	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
130 Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
134 Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
136 Madelia	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
140 Spicer	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
160 Fieldon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
181 Litchfield	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy.
197 Kingston	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness, too clayey.
211 Lura	Severe: ponding, percs slowly.	Slight	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
229 Waldorf	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
230A Guckeen	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
230B Guckeen	Severe: wetness, percs slowly.	Moderate: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
247 Linder	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

TABLE 11.--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
248 Lomax	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
255 Mayer	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage, too sandy.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
269 Millington	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
275B Ocheyedan	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
275C2 Ocheyedan	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
281 Darfur	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
286A, 286B Shorewood	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Slight	Poor: too clayey.
286C2 Shorewood	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
287 Minnetonka	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
310 Beauford	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
313 Spillville	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.
319 Barbert	Severe: ponding, percs slowly.	Slight	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
336 Delft	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
392 Biscay	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

TABLE 11.--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
525---------- Muskego	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
539---------- Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
887B*:					
Clarion----------	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
Swanlake----------	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
909C2*:					
Truman----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Bold----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
909D2*:					
Bold----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Truman----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
920B*:					
Clarion----------	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
Estherville--------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
920C2*:					
Clarion----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Estherville--------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
920D2*:					
Clarion----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--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
920D2*:					
Estherville	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
921C2*:					
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
929*:					
Fieldon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
956*:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
960D2*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
960E*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1030*:					
Pits.					
Udorthents.					
1052*:					
Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

See footnote at end of table.

TABLE 11.--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
1833, 1834---------- Coland	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
1852F*:					
Swanlake----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Terril----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1877---------- Fostoria	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1907---------- Lakefield	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
8B Sparta	Good	Probable	Improbable: too sandy.	Poor: too sandy.
27B Dickinson	Good	Probable	Improbable: too sandy.	Good.
27C Dickinson	Good	Probable	Improbable: too sandy.	Fair: slope.
35 Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
37B Farrar	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
41B Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
84 Brownton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
86 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
94B Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
96A, 96B Collinwood	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
101B Truman	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
102B Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
110 Marna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
113 Webster	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
114 Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
118 Crippin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
128B Grogan	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
130--Nicollet	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
134--Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
136--Madelia	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
140--Spicer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
160--Fieldon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
181--Litchfield	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
197--Kingston	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
211--Lura	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
229--Waldorf	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
230A--Guckeen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
230B--Guckeen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
247--Linder	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, area reclaim.
248--Lomax	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
255--Mayer	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
269--Millington	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
275B--Ocheyedan	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
275C2--Ocheyedan	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
281 Darfur	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
286A, 286B Shorewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
286C2 Shorewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
287 Minnetonka	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
310 Beauford	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
313 Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
319 Barbert	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
336 Delft	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
392 Biscay	Fair: wetness.	Probable	Probable	Poor: area reclaim.
525 Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
539 Klossner	Poor: wetness, thin layer.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
887B*: Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Swanlake	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
909C2*: Truman	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Bold	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
909D2*: Bold	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
909D2*:				
Truman	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
920B*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
920C2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
920D2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Estherville	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
921C2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
929*:				
Fieldon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
956*:				
Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
960D2*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
960E*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Clarion	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1030*:				
Pits.				
Udorthents.				
1052*:				
Klossner	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Okoboji	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1833, 1834 Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1852F*:				
Swanlake	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Terril	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1877 Fostoria	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1907 Lakefield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
8B Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
27B Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.
27C Dickinson	Severe: slope, seepage.	Severe: seepage.	Deep to water	Slope, soil blowing.	Slope, too sandy, soil blowing.	Slope.
35 Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
37B Farrar	Severe: seepage.	Moderate: piping.	Deep to water	Slope, soil blowing.	Soil blowing	Erodes easily.
41B Estherville	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
84 Brownton	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness	Wetness, percs slowly.
86 Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
94B Terril	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
96A Collinwood	Slight	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Percs slowly.
96B Collinwood	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Percs slowly.
101B Truman	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
102B Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
110 Marna	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness	Wetness, percs slowly.
113 Webster	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
114--Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding	Ponding	Wetness.
118--Crippin	Moderate: seepage.	Moderate: wetness, piping.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
128B--Grogan	Severe: seepage.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
130--Nicollet	Moderate: seepage.	Moderate: piping.	Frost action	Wetness	Wetness	Favorable.
134--Okoboji	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Ponding, erodes easily.	Not needed	Not needed.
136--Madelia	Moderate: seepage.	Severe: wetness, piping.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.
140--Spicer	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness, erodes easily.	Wetness, erodes easily.
160--Fieldon	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
181--Litchfield	Severe: seepage.	Severe: piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
197--Kingston	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
211--Lura	Slight	Severe: excess humus, hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
229--Waldorf	Moderate: seepage.	Severe: hard to pack, wetness.	Frost action	Wetness	Wetness	Wetness.
230A--Guckeen	Slight	Moderate: piping, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
230B--Guckeen	Moderate: slope.	Moderate: piping, wetness.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, rooting depth.
247--Linder	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Rooting depth.
248--Lomax	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
255---------- Mayer	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
269---------- Millington	Moderate: seepage.	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding--------	Wetness.
275B---------- Ocheyedan	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
275C2---------- Ocheyedan	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope----------	Slope.
281---------- Darfur	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
286A---------- Shorewood	Moderate: seepage.	Moderate: piping.	Deep to water	Percs slowly---	Erodes easily	Erodes easily, percs slowly.
286B---------- Shorewood	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
286C2---------- Shorewood	Severe: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.
287---------- Minnetonka	Moderate: seepage.	Severe: piping, hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness--------	Wetness, percs slowly.
310---------- Beauford	Slight---------	Severe: hard to pack.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
313---------- Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Flooding-------	Favorable------	Favorable.
319---------- Barbert	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
336---------- Delft	Slight---------	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
392---------- Biscay	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
525---------- Muskego	Severe: seepage.	Severe: excess humus, ponding.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
539---------- Klossner	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing, erodes easily.	Wetness, erodes easily.
887B*:						
Clarion----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Swanlake----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
909C2*:						
Truman----------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Bold----------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
909D2*:						
Bold----------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Truman----------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
920B*:						
Clarion----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Estherville------	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
920C2*, 920D2*:						
Clarion----------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Storden----------	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Estherville------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
921C2*:						
Clarion----------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Storden----------	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
929*:						
Fieldon----------	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
929*:						
Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
956*:						
Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding	Ponding	Wetness.
960D2*, 960E*:						
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
1030*:						
Pits.						
Udorthents.						
1052*:						
Klossner	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
Okoboji	Slight	Severe: ponding.	Ponding, frost action.	Ponding, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily.
1833, 1834 Coland	Severe: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1852F*:						
Swanlake	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Terril	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope	Slope.
1877 Fostoria	Moderate: seepage.	Moderate: wetness, piping.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
1907 Lakefield	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Wetness	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--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	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
8B---------- Sparta	0-12	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
	12-31	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
	31-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	85-100	85-100	50-95	2-30	---	NP
27B---------- Dickinson	0-14	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	14-39	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	39-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
27C---------- Dickinson	0-10	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	10-31	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	31-43	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	43-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
35---------- Blue Earth	0-10	Mucky silty clay loam.	OL, ML	A-5	0	95-100	95-100	85-95	80-95	41-50	2-8
	10-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	95-100	80-100	80-95	80-95	41-50	2-8
37B---------- Farrar	0-16	Fine sandy loam	SC, SM-SC	A-2, A-4	0	100	100	85-95	25-45	<30	5-10
	16-25	Fine sandy loam	SC, SM-SC	A-2, A-4	0	100	100	85-95	25-45	<30	5-10
	25-60	Loam----------	CL	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	8-20
41B---------- Estherville	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	9-19	Sandy loam, loam, coarse sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	19-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
84---------- Brownton	0-16	Silty clay loam	MH, CH	A-7	0	100	95-100	90-100	85-95	50-65	20-35
	16-60	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	100	95-100	90-100	85-95	50-80	25-40
86---------- Canisteo	0-18	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	18-25	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	25-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
94B---------- Terril	0-22	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	22-40	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	40-60	Clay loam, loam, sandy loam.	CL, SC, SM-SC, CL-ML	A-6, A-4	0-5	95-100	90-100	65-95	35-85	20-40	5-20

TABLE 14.--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	
96A---------- Collinwood	0-16	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	90-95	40-55	15-25
	16-32	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-95	50-65	20-35
	32-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-95	40-60	15-30
96B---------- Collinwood	0-10	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	90-95	40-55	15-25
	10-39	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-95	50-65	20-35
	39-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-95	40-60	15-30
101B---------- Truman	0-10	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	100	100	95-100	80-100	25-40	5-15
	10-39	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	25-45	5-20
	39-60	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	75-95	25-40	5-15
102B---------- Clarion	0-16	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	16-28	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
110---------- Marna	0-10	Silty clay loam	MH, ML	A-7	0	95-100	90-100	90-100	85-95	45-65	15-30
	10-34	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	95-100	90-100	90-100	85-95	50-80	20-45
	34-60	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	60-80	35-50	15-25
113---------- Webster	0-18	Clay loam--------	CL, CH	A-7, A-6	0-5	95-100	95-100	85-95	70-90	35-60	15-30
	18-44	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
	44-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
114---------- Glencoe	0-24	Clay loam--------	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
	24-52	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	52-60	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
118---------- Crippin	0-15	Loam----------	CL	A-6, A-7	0	95-100	95-100	80-90	60-80	30-45	10-20
	15-25	Loam, clay loam	CL	A-6	0-5	95-100	90-100	80-90	60-80	30-40	10-20
	25-60	Loam, clay loam	CL	A-6	2-5	90-100	85-100	75-90	55-80	30-40	10-20
128B---------- Grogan	0-18	Silt loam--------	ML	A-4	0	100	100	95-100	70-90	20-40	NP-10
	18-30	Loam, silt loam	ML	A-4	0	100	100	95-100	70-95	20-40	NP-10
	30-60	Stratified loamy very fine sand to silt loam.	ML	A-4	0	100	100	90-100	65-95	20-30	NP-5
130---------- Nicollet	0-16	Clay loam--------	ML, CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	35-50	10-25
	16-29	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	29-60	Loam, clay loam	CL	A-6	0-5	95-100	90-100	75-90	50-75	30-40	15-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
134----------	0-18	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
Okoboji	18-26	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	26-60	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
136----------	0-15	Silty clay loam	ML	A-7	0	100	100	100	90-100	40-50	10-20
Madelia	15-27	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	90-100	30-50	10-25
	27-60	Silt loam, silty clay loam.	ML, CL	A-6, A-4, A-7	0	100	100	100	90-100	30-50	5-25
140----------	0-9	Silt loam--------	ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-20
Spicer	9-34	Silt loam, silty clay loam.	ML	A-7, A-6	0	100	100	95-100	85-100	35-50	10-20
	34-60	Silt loam, silty clay loam.	ML	A-4, A-6	0	100	100	95-100	85-100	30-40	5-12
160----------	0-10	Loam----------	CL-ML, CL, ML	A-4	0	100	100	85-95	50-75	20-35	NP-10
Fieldon	10-28	Fine sandy loam, very fine sandy loam, loam.	ML, SM	A-4	0	100	100	70-90	35-60	<30	NP-5
	28-60	Stratified fine sand to fine sandy loam.	SM	A-2, A-4	0	100	100	60-100	15-40	---	NP
181----------	0-17	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	85-95	35-50	15-30	4-10
Litchfield	17-60	Stratified fine sand to very fine sandy loam.	SM	A-2	0	100	100	80-95	20-35	<20	NP-4
197----------	0-10	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	6-20
Kingston	10-37	Silty clay loam, silt loam.	CL, ML, CL-ML	A-6, A-7, A-4	0	100	100	95-100	85-100	25-50	6-20
	37-60	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	5-20
211----------	0-34	Silty clay-------	CH, OH	A-7	0	100	100	95-100	90-100	50-75	25-45
Lura	34-50	Silty clay, clay	OH, CH	A-7	0	100	100	95-100	90-100	50-75	25-45
	50-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-75	15-45
229----------	0-10	Silty clay loam	ML, MH	A-7	0	100	100	95-100	90-100	45-65	14-30
Waldorf	10-38	Silty clay, silty clay loam.	MH	A-7	0	100	100	95-100	95-100	50-70	20-35
	38-60	Silty clay loam, silty clay, silt loam.	MH, CL, ML, CH	A-7, A-6	0	100	100	95-100	90-100	35-65	11-30
230A----------	0-16	Silty clay loam	ML, CL	A-7	0	100	95-100	95-100	80-95	40-50	15-20
Guckeen	16-24	Silty clay, silty clay loam, clay.	MH, ML, CL, CH	A-7	0	100	95-100	95-100	80-95	40-65	15-30
	24-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	90-98	85-95	60-75	30-50	10-25
230B----------	0-17	Silty clay loam	CL	A-7	0	100	95-100	95-100	80-95	40-50	15-25
Guckeen	17-24	Silty clay, silty clay loam, clay.	MH, ML, CL, CH	A-7	0	100	95-100	95-100	80-95	40-65	15-30
	24-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	90-98	85-95	60-75	30-50	10-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
247---------- Linder	0-22	Loam----------	CL	A-4, A-6	0	100	95-100	80-95	50-80	25-40	8-15
	22-26	Sandy loam-------	SC, SM-SC	A-2, A-4	0	95-100	80-100	45-75	30-45	20-30	5-10
	26-60	Gravelly sand, gravelly loamy sand, loamy coarse sand.	SP, SP-SM	A-1	0-5	75-95	30-95	25-50	2-12	---	NP
248---------- Lomax	0-25	Loam----------	CL, CL-ML	A-4, A-6	0	100	80-95	80-95	60-75	25-35	5-15
	25-60	Sandy loam, loam	SM, SC, CL, ML	A-4, A-6, A-2	0	100	80-95	80-95	30-60	20-30	3-13
255---------- Mayer	0-23	Loam----------	CL, ML	A-6, A-4	0-2	95-100	85-100	70-90	50-85	30-40	5-15
	23-39	Loam, sandy clay loam, silt loam.	CL, SC, ML, SM	A-6, A-4	0-5	90-100	85-100	70-90	40-85	30-40	5-15
	39-60	Gravelly coarse sand, sand, coarse sand.	SP, SW, SP-SM	A-1	0-10	65-95	45-85	20-45	2-10	<20	NP
269---------- Millington	0-24	Clay loam--------	CL, ML, OL	A-7, A-6	0	100	90-100	90-100	90-100	35-50	11-20
	24-43	Loam, silty clay loam, clay loam.	CL	A-7, A-6	0	95-100	90-100	80-100	70-95	28-50	10-22
	43-60	Stratified sandy loam to silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	80-100	80-100	80-100	60-95	20-45	5-20
275B---------- Ocheyedan	0-10	Loam----------	CL	A-6	0	100	100	75-90	65-80	30-40	10-15
	10-30	Sandy clay loam, fine sandy loam, loam.	SC, CL, SM-SC, CL-ML	A-4, A-6	0	100	100	60-80	35-55	25-40	5-15
	30-60	Sandy loam, sandy clay loam, silt loam.	CL-ML, CL	A-4, A-6	0	100	100	85-95	50-90	25-40	5-15
275C2---------- Ocheyedan	0-9	Loam----------	CL	A-6	0	100	100	75-90	65-80	30-40	10-15
	9-23	Sandy clay loam, fine sandy loam, loam.	SC, CL, SM-SC, CL-ML	A-4, A-6	0	100	100	60-80	35-55	25-40	5-15
	23-60	Sandy loam, sandy clay loam, silt loam.	CL-ML, CL	A-4, A-6	0	100	100	85-95	50-90	25-40	5-15
281---------- Darfur	0-22	Loam----------	OL, ML	A-4	0	100	100	100	60-80	25-40	NP-10
	22-36	Fine sandy loam, loam, loamy fine sand.	SM	A-4	0	100	100	70-100	35-50	20-30	NP-5
	36-60	Stratified fine sand to fine sandy loam.	SM	A-2, A-4	0	100	100	50-100	15-40	---	NP-5
286A---------- Shorewood	0-11	Silty clay loam	CL, ML	A-6, A-7	0	100	100	90-100	85-100	35-50	12-20
	11-37	Silty clay, silty clay loam.	MH	A-7	0	100	100	90-100	85-100	55-75	20-40
	37-60	Clay loam, silty clay loam, silty clay.	CL, ML	A-6, A-7	0-5	95-100	90-100	85-100	80-95	35-50	10-20
286B---------- Shorewood	0-10	Silty clay loam	CL, ML	A-6, A-7	0	100	100	90-100	85-100	35-50	12-20
	10-35	Silty clay, silty clay loam.	MH	A-7	0	100	100	90-100	85-100	55-75	20-40
	35-60	Clay loam, silty clay loam, silty clay.	CL, ML	A-6, A-7	0-5	95-100	90-100	85-100	80-95	35-50	10-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
286C2---------- Shorewood	0-9	Silty clay loam	CL, ML	A-6, A-7	0	100	100	90-100	85-100	35-50	12-20
	9-29	Silty clay, silty clay loam.	MH	A-7	0	100	100	90-100	85-100	55-75	20-40
	29-60	Clay loam, silty clay loam, silty clay.	CL, ML	A-6, A-7	0-5	95-100	90-100	85-100	80-95	35-50	10-20
287---------- Minnetonka	0-10	Silty clay loam	MH, ML	A-5, A-7	0	95-100	95-100	90-98	85-95	40-55	6-20
	10-43	Silty clay, silty clay loam.	MH, CH, CL, ML	A-7	0	95-100	95-100	90-98	85-95	40-65	12-35
	43-60	Silty clay loam, silt loam, clay loam.	MH, ML, CL	A-7, A-4, A-6	0	95-100	85-100	75-100	60-95	30-55	5-25
310---------- Beauford	0-9	Silty clay-------	CH	A-7	0	100	100	98-100	90-100	50-70	30-45
	9-45	Clay----------	CH	A-7	0	100	100	98-100	90-100	65-80	35-50
	45-60	Clay----------	CH	A-7	0	100	100	98-100	90-100	60-75	35-50
313---------- Spillville	0-19	Loam----------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	19-60	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
319---------- Barbert	0-14	Silty clay loam	ML, CL	A-7, A-6	0	100	100	90-100	90-100	35-50	10-20
	14-25	Silt loam, silty clay loam.	ML, ML-CL	A-4	0	100	100	90-100	90-100	18-27	5-15
	25-45	Clay, silty clay	CH, MH	A-7	0	100	100	90-100	90-100	50-80	20-50
	45-60	Silty clay loam, silt loam, silty clay.	CH, CL, ML, MH	A-7	0	100	100	95-100	65-100	40-60	15-35
336---------- Delft	0-12	Loam----------	CL, ML	A-6, A-7	0	95-100	90-100	75-90	60-80	30-45	10-20
	12-25	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-90	60-80	30-45	10-20
	25-50	Loam, clay loam, silt loam.	CL, ML	A-6, A-4	0	95-100	90-100	70-90	50-75	25-40	7-15
	50-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-6, A-4	0-5	90-100	85-100	55-90	50-85	20-40	3-15
392---------- Biscay	0-20	Loam----------	CL, ML	A-7, A-6	0	95-100	95-100	70-95	50-80	35-50	10-25
	20-36	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	70-90	50-75	30-50	10-20
	36-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	45-95	35-95	20-45	2-10	---	NP
525---------- Muskego	0-32	Sapric material	PT	A-8	0	---	---	---	---	---	---
	32-60	Coprogenous earth	OL	A-5	0	95-100	95-100	85-100	75-96	40-50	2-8
539---------- Klossner	0-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Clay loam, silty clay loam, gravelly sandy loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-7, A-2	0	85-100	60-100	35-95	15-90	20-45	5-20
887B*:											
Clarion----------	0-14	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	14-29	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	29-60	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

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
887B*:											
Swanlake	0-11	Loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	75-90	50-70	20-35	5-15
	11-24	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	70-90	50-70	20-35	5-15
	24-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	20-35	5-15
909C2*:											
Truman	0-10	Silt loam	ML, CL-ML, CL	A-4, A-6	0	100	100	95-100	80-100	25-40	5-15
	10-18	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	25-45	5-20
	18-60	Silt loam	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	75-95	25-40	5-15
Bold	0-8	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	20-35	3-15
	8-60	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	20-35	3-15
909D2*:											
Bold	0-9	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	20-35	3-15
	9-60	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	20-35	3-15
Truman	0-7	Silt loam	ML, CL-ML, CL	A-4, A-6	0	100	100	95-100	80-100	25-40	5-15
	7-24	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	25-45	5-20
	24-60	Silt loam	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	75-95	25-40	5-15
920B*:											
Clarion	0-14	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	14-24	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	24-60	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
Estherville	0-10	Sandy loam	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	10-15	Sandy loam, loam, coarse sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	15-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
920C2*:											
Clarion	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	9-27	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	27-60	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	0-9	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	9-60	Loam, clay loam	CL-ML, CL, ML	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 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
920C2*:											
Estherville-----	0-17	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	17-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
920D2*:											
Clarion---------	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	10-22	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	22-60	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---------	0-8	Loam-------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Estherville-----	0-16	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	16-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
921C2*:											
Clarion---------	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	10-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	18-60	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---------	0-9	Loam-------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	9-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
929*:											
Fieldon---------	0-10	Loam-------------	CL-ML, CL, ML	A-4	0	100	100	85-95	50-75	20-35	NP-10
	10-33	Fine sandy loam, very fine sandy loam, loam.	ML, SM	A-4	0	100	100	70-90	35-60	<30	NP-5
	33-60	Stratified fine sand to fine sandy loam.	SM	A-2, A-4	0	100	100	60-100	15-40	---	NP
Canisteo--------	0-20	Loam-------------	CL	A-7, A-6	0	95-100	95-100	85-100	60-100	30-50	10-25
	20-31	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	31-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
956*:											
Canisteo--------	0-16	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	16-28	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	28-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
Glencoe---------	0-24	Clay loam--------	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
	24-30	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	30-60	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
960D2*:											
Storden	0-9	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	9-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	9-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	18-60	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
960E*:											
Storden	0-5	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	5-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-16	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	16-26	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	26-60	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
1030*:											
Pits.											
Udorthents.											
1052*:											
Klossner	0-22	Sapric material	PT	A-8	0	---	---	---	---	---	---
	22-60	Clay loam, silty clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
Okoboji	0-9	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	9-24	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	24-60	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
1833 Coland	0-10	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	10-25	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	25-60	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
1834 Coland	0-12	Loam	CL	A-6	0	100	95-100	85-95	60-75	30-40	10-20
	12-36	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	36-60	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
1852F*:											
Swanlake	0-12	Loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	75-90	50-70	20-35	5-15
	12-16	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	70-90	50-70	20-35	5-15
	16-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	20-35	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
1852F*:											
Terril	0-29	Loam	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	29-48	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	48-60	Clay loam, loam, sandy loam.	CL, SC, SM-SC, CL-ML	A-6, A-4	0-5	95-100	90-100	65-95	35-85	20-40	5-20
1877	0-10	Loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-95	25-40	5-15
Fostoria	10-32	Loam, clay loam	CL	A-6	0-5	100	100	75-100	55-95	30-40	10-20
	32-60	Silt loam, loam, sandy loam.	CL	A-6	0-5	100	100	75-100	55-95	30-40	10-20
1907	0-18	Silt loam	CL-ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	6-20
Lakefield	18-60	Silty clay loam, silt loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	6-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
8B	0-12	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	12-31	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-7.3	Low	0.15			
	31-60	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-7.3	Low	0.15			
27B	0-14	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.20	4	3	1-2
Dickinson	14-39	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low	0.20			
	39-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low	0.15			
27C	0-10	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.20	4	3	1-2
Dickinson	10-31	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low	0.20			
	31-43	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low	0.20			
	43-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low	0.15			
35	0-10	27-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Moderate	0.28	5	4L	10-25
Blue Earth	10-60	18-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Low	0.28			
37B	0-16	10-14	1.45-1.50	2.0-6.0	0.16-0.18	5.6-7.3	Low	0.20	5	3	1-2
Farrar	16-25	10-16	1.50-1.60	2.0-6.0	0.15-0.17	5.6-6.5	Low	0.20			
	25-60	18-24	1.60-1.80	0.6-2.0	0.17-0.19	6.1-8.4	Low	0.37			
41B	0-9	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	2-4
Estherville	9-19	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low	0.20			
	19-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			
84	0-16	35-40	1.20-1.30	0.06-0.2	0.18-0.22	7.4-8.4	High	0.28	5	4	4-8
Brownton	16-60	35-60	1.20-1.30	0.06-0.2	0.13-0.16	7.4-8.4	High	0.28			
86	0-18	27-35	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.24	5	4L	4-8
Canisteo	18-25	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	25-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
94B	0-22	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	22-40	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low	0.24			
	40-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
96A	0-16	35-40	1.20-1.30	0.2-0.6	0.14-0.17	5.6-7.3	Moderate	0.32	5	4	5-7
Collinwood	16-32	35-60	1.25-1.35	0.06-0.6	0.13-0.16	5.6-7.3	High	0.32			
	32-60	35-45	1.25-1.40	0.06-0.6	0.11-0.15	7.4-8.4	High	0.32			
96B	0-10	35-40	1.20-1.30	0.2-0.6	0.14-0.17	5.6-7.3	Moderate	0.32	5	4	5-7
Collinwood	10-39	35-60	1.25-1.35	0.06-0.6	0.13-0.16	5.6-7.3	High	0.32			
	39-60	35-45	1.25-1.40	0.06-0.6	0.11-0.15	7.4-8.4	High	0.32			
101B	0-10	18-27	1.25-1.35	0.6-2.0	0.20-0.23	5.6-7.3	Low	0.32	5	6	4-8
Truman	10-39	18-32	1.30-1.45	0.6-2.0	0.18-0.21	5.6-7.8	Low	0.43			
	39-60	18-32	1.35-1.45	0.6-2.0	0.18-0.20	7.4-8.4	Low	0.43			
102B	0-16	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
Clarion	16-28	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	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
110	0-10	30-40	1.20-1.30	0.06-0.2	0.18-0.22	6.1-7.3	High	0.28	5	4	4-8
Marna	10-34	35-60	1.25-1.40	0.06-0.2	0.13-0.16	6.1-7.3	High	0.28			
	34-60	24-35	1.45-1.70	0.2-2.0	0.14-0.19	6.6-8.4	Moderate	0.28			
113	0-18	27-35	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate	0.24	5	6	6-7
Webster	18-44	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate	0.32			
	44-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
114	0-24	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28	5	6	5-10
Glencoe	24-52	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	52-60	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	0.28			
118	0-15	22-27	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	Low	0.28	5	4L	5-6
Crippin	15-25	24-30	1.40-1.55	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.28			
	25-60	22-28	1.55-1.75	0.6-2.0	0.17-0.19	7.9-8.4	Low	0.37			
128B	0-18	8-18	1.25-1.40	2.0-6.0	0.22-0.24	5.6-7.3	Low	0.32	5	5	2-4
Grogan	18-30	8-18	1.40-1.50	2.0-6.0	0.17-0.19	6.1-7.8	Low	0.43			
	30-60	5-15	1.50-1.60	2.0-6.0	0.17-0.19	7.4-8.4	Low	0.43			
130	0-16	27-35	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate	0.24	5	6	4-8
Nicollet	16-29	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate	0.32			
	29-60	22-32	1.35-1.55	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.32			
134	0-18	35-40	1.25-1.30	0.2-0.6	0.21-0.23	6.1-7.8	High	0.37	5	4	7-10
Okoboji	18-26	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
	26-60	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High	0.37			
136	0-15	27-35	1.20-1.30	0.6-2.0	0.18-0.24	6.1-7.3	Moderate	0.28	5	7	4-8
Madelia	15-27	18-35	1.25-1.35	0.6-2.0	0.16-0.22	6.6-7.8	Moderate	0.28			
	27-60	18-35	1.30-1.40	0.6-2.0	0.16-0.22	7.4-8.4	Low	0.37			
140	0-9	18-27	1.30-1.30	0.6-2.0	0.18-0.24	7.4-8.4	Moderate	0.28	5	4L	4-8
Spicer	9-34	18-35	1.25-1.35	0.6-2.0	0.16-0.22	7.4-8.4	Moderate	0.37			
	34-60	18-35	1.25-1.35	0.6-2.0	0.16-0.22	7.4-8.4	Low	0.37			
160	0-10	15-22	1.25-1.40	0.6-2.0	0.18-0.20	7.4-8.4	Low	0.28	4	4L	5-8
Fieldon	10-28	10-18	1.35-1.55	0.6-2.0	0.15-0.17	7.4-8.4	Low	0.20			
	28-60	5-15	1.40-1.60	6.0-20	0.05-0.07	7.4-8.4	Low	0.20			
181	0-17	10-22	1.45-1.55	2.0-6.0	0.12-0.15	6.1-7.3	Low	0.20	5	3	2-4
Litchfield	17-60	5-10	1.40-1.65	2.0-6.0	0.07-0.16	5.1-7.3	Low	0.17			
197	0-10	18-27	1.20-1.30	0.6-2.0	0.18-0.24	5.6-7.3	Low	0.28	5	6	4-8
Kingston	10-37	18-32	1.25-1.35	0.6-2.0	0.16-0.20	5.6-7.8	Low	0.37			
	37-60	18-32	1.25-1.35	0.6-2.0	0.16-0.20	7.4-8.4	Low	0.37			
211	0-34	45-60	1.25-1.35	0.06-0.2	0.14-0.17	6.1-7.3	High	0.28	5	4	4-8
Lura	34-50	45-60	1.25-1.35	0.06-0.2	0.14-0.17	6.1-7.3	High	0.28			
	50-60	28-60	1.30-1.45	0.06-0.6	0.11-0.19	6.6-7.8	High	0.28			
229	0-10	35-40	1.20-1.30	0.6-2.0	0.18-0.25	6.1-7.3	Moderate	0.28	5	4	6-8
Waldorf	10-38	40-55	1.25-1.35	0.2-0.6	0.13-0.16	6.6-7.8	Moderate	0.28			
	38-60	24-45	1.25-1.35	0.2-2.0	0.20-0.22	7.4-8.4	Moderate	0.28			
230A	0-16	35-40	1.20-1.30	0.2-0.6	0.16-0.19	5.6-7.3	Moderate	0.37	5	4	4-6
Guckeen	16-24	35-50	1.25-1.35	0.06-0.6	0.13-0.16	5.6-7.3	Moderate	0.28			
	24-60	24-40	1.35-1.80	0.06-0.6	0.15-0.17	6.6-8.4	Moderate	0.37			
230B	0-17	35-40	1.20-1.30	0.2-0.6	0.16-0.19	5.6-7.3	Moderate	0.28	5	4	4-6
Guckeen	17-24	35-50	1.25-1.35	0.06-0.6	0.13-0.16	5.6-7.3	Moderate	0.28			
	24-60	24-40	1.35-1.80	0.06-0.6	0.15-0.17	6.6-8.4	Moderate	0.37			
247	0-22	14-18	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.8	Low	0.24	4	5	3-4
Linder	22-26	10-18	1.45-1.55	2.0-6.0	0.15-0.17	6.1-7.8	Low	0.24			
	26-60	2-8	1.55-1.75	>20	0.02-0.04	7.4-8.4	Low	0.10			
248	0-25	12-18	1.35-1.55	2.0-6.0	0.18-0.22	5.1-6.5	Low	0.28	5	5	2-4
Lomax	25-60	8-18	1.50-1.70	2.0-6.0	0.12-0.19	5.1-6.5	Low	0.28			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
255	0-23	18-27	1.25-1.35	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	4	4L	4-8
Mayer	23-39	18-27	1.25-1.35	0.6-2.0	0.16-0.19	7.4-8.4	Low	0.28			
	39-60	1-5	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low	0.15			
269	0-24	27-35	1.40-1.60	0.6-2.0	0.17-0.23	7.4-8.4	Moderate	0.28	5	4L	4-6
Millington	24-43	18-35	1.40-1.60	0.6-2.0	0.17-0.20	7.4-8.4	Moderate	0.28			
	43-60	18-35	1.50-1.70	0.6-2.0	0.14-0.20	7.4-8.4	Moderate	0.28			
275B	0-10	24-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.24	5	6	3-4
Ocheyedan	10-30	18-24	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
	30-60	18-24	1.45-1.70	0.6-2.0	0.19-0.21	6.6-8.4	Low	0.32			
275C2	0-9	24-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.24	5	6	1-2
Ocheyedan	9-23	18-24	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
	23-60	18-24	1.45-1.70	0.6-2.0	0.19-0.21	6.6-8.4	Low	0.32			
281	0-22	18-25	1.20-1.35	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.20	5	5	5-8
Darfur	22-36	13-18	1.35-1.50	2.0-6.0	0.15-0.17	6.6-7.8	Low	0.20			
	36-60	5-15	1.45-1.60	2.0-6.0	0.08-0.10	6.6-8.4	Low	0.20			
286A	0-11	30-40	1.20-1.40	0.2-0.6	0.18-0.22	5.6-7.3	Moderate	0.28	5	7	4-8
Shorewood	11-37	36-55	1.20-1.35	0.06-0.6	0.13-0.16	5.1-7.3	High	0.32			
	37-60	35-45	1.25-1.55	0.2-2.0	0.14-0.16	6.6-7.8	Moderate	0.37			
286B	0-10	30-40	1.20-1.40	0.2-0.6	0.18-0.22	5.6-7.3	Moderate	0.28	5	7	4-8
Shorewood	10-35	36-55	1.20-1.35	0.06-0.6	0.13-0.16	5.1-7.3	High	0.32			
	35-60	35-45	1.25-1.55	0.2-2.0	0.14-0.16	6.6-7.8	Moderate	0.37			
286C2	0-9	30-40	1.20-1.40	0.2-0.6	0.18-0.22	5.6-7.3	Moderate	0.28	5	7	2-4
Shorewood	9-29	36-55	1.20-1.35	0.06-0.6	0.13-0.16	5.1-7.3	High	0.32			
	29-60	35-45	1.25-1.55	0.2-2.0	0.14-0.16	6.6-7.8	Moderate	0.37			
287	0-10	27-35	1.20-1.40	0.2-0.6	0.18-0.22	5.6-7.3	Moderate	0.28	5	7	4-8
Minnetonka	10-43	35-60	1.20-1.35	0.06-0.2	0.13-0.19	5.6-7.3	High	0.28			
	43-60	25-40	1.25-1.55	0.2-2.0	0.16-0.21	6.6-7.8	Moderate	0.28			
310	0-9	50-60	1.15-1.25	0.06-0.2	0.13-0.16	6.6-7.3	High	0.28	5	4	4-8
Beauford	9-45	60-75	1.15-1.30	0.06-0.2	0.10-0.14	6.6-7.3	High	0.28			
	45-60	50-75	1.15-1.30	0.06-0.2	0.09-0.13	7.4-7.8	High	0.28			
313	0-19	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.24	5	6	4-6
Spillville	19-60	18-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low	0.28			
319	0-14	27-35	1.20-1.60	0.6-2.0	0.22-0.24	5.1-6.5	Moderate	0.28	3	7	4-8
Barbert	14-25	18-32	1.20-1.60	0.6-2.0	0.22-0.24	5.1-6.5	Low	0.28			
	25-45	45-60	1.20-1.35	0.06-0.2	0.10-0.14	5.1-7.3	High	0.28			
	45-60	25-50	1.25-1.45	0.2-0.6	0.16-0.19	6.6-7.8	High	0.43			
336	0-12	24-27	1.40-1.55	0.6-2.0	0.18-0.20	5.6-7.8	Moderate	0.24	5	6	4-8
Delft	12-25	18-35	1.40-1.55	0.2-2.0	0.19-0.22	5.6-7.8	Moderate	0.24			
	25-50	18-32	1.30-1.40	0.2-0.6	0.19-0.22	6.6-7.8	Low	0.32			
	50-60	15-32	1.40-1.55	0.2-2.0	0.15-0.19	7.4-8.4	Low	0.32			
392	0-20	18-27	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	Moderate	0.28	4	6	4-8
Biscay	20-36	18-30	1.25-1.35	0.6-2.0	0.17-0.19	6.6-7.8	Moderate	0.28			
	36-60	1-6	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low	0.10			
525	0-32	---	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	---	---	4	2	60-90
Muskego	32-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	6.6-8.4	Moderate	0.28			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
539	0-25	---	0.25-0.55	0.2-6.0	0.35-0.48	5.6-7.8	---	---	5	2	25-50
Klossner	25-60	15-35	1.10-1.50	0.2-2.0	0.15-0.26	6.1-8.4	Moderate	0.37			
887B*:											
Clarion	0-14	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	14-29	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	29-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Swanlake	0-11	18-27	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Low	0.28	5	4L	2-4
	11-24	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
	24-60	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
909C2*:											
Truman	0-10	18-27	1.25-1.35	0.6-2.0	0.20-0.23	5.6-7.3	Low	0.32	5	6	2-4
	10-18	18-32	1.30-1.45	0.6-2.0	0.18-0.21	5.6-7.8	Low	0.43			
	18-60	18-32	1.35-1.45	0.6-2.0	0.18-0.20	7.4-8.4	Low	0.43			
Bold	0-8	12-18	1.10-1.30	0.6-2.0	0.20-0.24	7.4-8.4	Low	0.43	4	4L	.5-1
	8-60	12-18	1.10-1.30	0.6-2.0	0.20-0.24	7.4-8.4	Low	0.43			
909D2*:											
Bold	0-9	12-18	1.10-1.30	0.6-2.0	0.20-0.24	7.4-8.4	Low	0.43	4	4L	.5-1
	9-60	12-18	1.10-1.30	0.6-2.0	0.20-0.24	7.4-8.4	Low	0.43			
Truman	0-7	18-27	1.25-1.35	0.6-2.0	0.20-0.23	5.6-7.3	Low	0.32	5	6	2-4
	7-24	18-32	1.30-1.45	0.6-2.0	0.18-0.21	5.6-7.8	Low	0.43			
	24-60	18-32	1.35-1.45	0.6-2.0	0.18-0.20	7.4-8.4	Low	0.43			
920B*:											
Clarion	0-14	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	14-24	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	24-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Estherville	0-10	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	2-4
	10-15	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low	0.20			
	15-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			
920C2*:											
Clarion	0-9	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	9-27	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	27-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	5-1
	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Estherville	0-17	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	1-2
	17-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			
920D2*:											
Clarion	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	10-22	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	22-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	.5-1
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Estherville	0-16	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	.5-1
	16-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
921C2*:											
Clarion	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	10-18	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	18-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	.5-1
	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
929*:											
Fieldon	0-10	15-22	1.25-1.40	0.6-2.0	0.18-0.20	7.4-8.4	Low	0.28	4	4L	5-8
	10-33	10-18	1.35-1.55	0.6-2.0	0.15-0.17	7.4-8.4	Low	0.20			
	33-60	5-15	1.40-1.60	6.0-20	0.05-0.07	7.4-8.4	Low	0.20			
Canisteo	0-20	18-27	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Moderate	0.32	5	4L	4-8
	20-31	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	31-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
956*:											
Canisteo	0-16	27-35	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.24	5	4L	4-8
	16-28	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	28-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
Glencoe	0-24	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28	5	6	5-10
	24-30	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	30-60	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	0.28			
960D2*:											
Storden	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	.5-1
	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Clarion	0-9	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	9-18	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	18-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
960E*:											
Storden	0-5	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
	5-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Clarion	0-16	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	16-26	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	26-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
1030*:											
Pits.											
Udorthents.											
1052*:											
Klossner	0-22	---	0.25-0.55	0.2-6.0	0.35-0.48	5.6-7.8	---	---	5	8	25-50
	22-60	15-35	1.10-1.50	0.2-2.0	0.15-0.26	6.1-8.4	Moderate	---			
Okoboji	0-9	35-40	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37	5	8	5-10
	9-24	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
	24-60	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
1833	0-10	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.28	5	7	5-7
Coland	10-25	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.28			
	25-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low	0.28			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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/cc	In/hr	In/in	pH					Pct
1834----------	0-12	22-26	1.40-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.28	5	6	5-7
Coland	12-36	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.28			
	36-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
1852F*:											
Swanlake--------	0-12	18-27	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Low----------	0.28	5	4L	2-4
	12-16	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
	16-60	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Terril----------	0-29	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
	29-48	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low----------	0.24			
	48-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
1877----------	0-10	25-27	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	5-6
Fostoria	10-32	25-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24			
	32-60	16-26	1.40-1.75	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
1907----------	0-18	18-27	1.20-1.30	0.6-2.0	0.18-0.24	7.4-8.4	Low----------	0.32	5	6	4-8
Lakefield	18-60	18-35	1.25-1.35	0.6-2.0	0.16-0.20	7.4-8.4	Low----------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--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 or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
8B Sparta	A	None	---	---	>6.0	---	---	Low	Low	Moderate.
27B, 27C Dickinson	B	None	---	---	>6.0	---	---	Moderate	Low	Moderate.
35 Blue Earth	B/D	Rare	---	---	+2-1.0	Apparent	Jan-Dec	High	High	Low.
37B Farrar	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
41B Estherville	B	None	---	---	>6.0	---	---	Low	Low	Low.
84 Brownton	C/D	None	---	---	1.0-2.5	Apparent	Nov-Jun	High	High	Low.
86 Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	High	High	Low.
94B Terril	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
96A Collinwood	C	None	---	---	2.0-5.0	Apparent	Nov-May	High	High	Low.
96B Collinwood	C	None	---	---	3.5-5.0	Apparent	Nov-May	High	High	Low.
101B Truman	B	None	---	---	>6.0	---	---	High	Low	Low.
102B Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
110 Marna	C/D	None	---	---	1.0-2.5	Apparent	Nov-Jun	High	High	Low.
113 Webster	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	High	High	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
114---------- Glencoe	B/D	Rare--------	---	---	+1-1.0	Apparent	Oct-Jul	High--------	High-----	Low.
118---------- Crippin	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	High--------	High-----	Low.
128B---------- Grogan	B	None--------	---	---	>6.0	---	---	High--------	Low------	Low.
130---------- Nicollet	B	None--------	---	---	2.5-5.0	Apparent	Mar-Jun	High--------	High-----	Low.
134---------- Okoboji	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High--------	High-----	Low.
136---------- Madelia	B/D	None--------	---	---	1.0-2.5	Apparent	Nov-May	High--------	High-----	Low.
140---------- Spicer	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
160---------- Fieldon	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
181---------- Litchfield	A	None--------	---	---	2.5-5.0	Apparent	Apr-May	Moderate----	Low------	Low.
197---------- Kingston	B	None--------	---	---	2.5-5.0	Apparent	Apr-May	High--------	High-----	Low.
211---------- Lura	C/D	None--------	---	---	+1-1.0	Apparent	Nov-May	High--------	High-----	Low.
229---------- Waldorf	C/D	None--------	---	---	0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
230A---------- Guckeen	C	None--------	---	---	2.0-3.5	Apparent	Mar-Jun	High--------	High-----	Low.
230B---------- Guckeen	C	None--------	---	---	3.5-5.0	Apparent	Apr-May	High--------	High-----	Low.
247---------- Linder	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	High--------	Moderate	Low.
248---------- Lomax	B	Rare--------	---	---	>6.0	---	---	Moderate----	Low------	High.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
255--- Mayer	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun	High	High	Low.
269--- Millington	B/D	Occasional	Brief	Apr-Jun	+.5-2.0	Apparent	Mar-Jul	High	High	Low.
275B, 275C2--- Ocheyedan	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
281--- Darfur	B/D	None	---	---	1.0-3.0	Apparent	Dec-May	High	High	Low.
286A--- Shorewood	C	None	---	---	2.0-4.0	Perched	Apr-Jun	High	High	Moderate.
286B--- Shorewood	C	None	---	---	3.0-5.0	Perched	Apr-Jun	High	High	Moderate.
286C2--- Shorewood	C	None	---	---	4.0-6.0	Perched	Apr-Jun	Moderate	High	Moderate.
287--- Minnetonka	D	None	---	---	0-3.0	Perched	Apr-Jun	High	High	Moderate.
310--- Beauford	D	None	---	---	1.0-3.0	Perched	Apr-May	High	High	Low.
313--- Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	Moderate	High	Moderate.
319--- Barbert	D	None	---	---	+1-1.0	Perched	Nov-Jun	High	High	Low.
336--- Delft	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	High	Low.
392--- Biscay	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	Moderate	Low.
525--- Muskego	A/D	None	---	---	+1-1.0	Apparent	Nov-Aug	High	Moderate	Moderate.
539--- Klossner	A/D	None	---	---	+1-1.0	Apparent	Oct-Jul	High	High	Moderate.
887B*: Clarion---	B	None	---	---	>6.0	---	---	Moderate	Low	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
887B*:										
Swanlake	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
909C2*:										
Truman	B	None	---	---	>6.0	---	---	High	Low	Low.
Bold	B	None	---	---	>6.0	---	---	High	Low	Low.
909D2*:										
Bold	B	None	---	---	>6.0	---	---	High	Low	Low.
Truman	B	None	---	---	>6.0	---	---	High	Low	Low.
920B*:										
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Estherville	B	None	---	---	>6.0	---	---	Low	Low	Low.
920C2*, 920D2*:										
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Estherville	B	None	---	---	>6.0	---	---	Low	Low	Low.
921C2*:										
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
929*:										
Fieldon	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	High	Low.
Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	High	High	Low.
956*:										
Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	High	High	Low.
Glencoe	B/D	Rare	---	---	+1-1.0	Apparent	Oct-Jul	High	High	Low.
960D2*, 960E*:										
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
1030*:										
Pits.										
Udorthents.										
1052*:										
Klossner	D	None	---	---	+3-+1.0	Apparent	Jan-Dec	High	High	Moderate.
Okoboji	D	None	---	---	+3-+1.0	Apparent	Jan-Dec	High	High	Low.
1833 Coland	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Low.
1834 Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Low.
1852F*:										
Swanlake	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Terril	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
1877 Fostoria	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	High	High	Low.
1907 Lakefield	B	None	---	---	2.5-5.0	Apparent	Apr-May	High	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Barbert	Fine, montmorillonitic, mesic Typic Argialbolls
Beauford	Very fine, montmorillonitic, mesic Typic Haplaquolls
Biscay	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Blue Earth	Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents
Bold	Coarse-silty, mixed (calcareous), mesic Typic Udorthents
Brownton	Fine, montmorillonitic (calcareous), mesic Typic Haplaquolls
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Clarion	Fine-loamy, mixed, mesic Typic Hapludolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Collinwood	Fine, montmorillonitic, mesic Aquic Hapludolls
Crippin	Fine-loamy, mixed, mesic Aquic Hapludolls
Darfur	Coarse-loamy, mixed, mesic Typic Haplaquolls
Delft	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Estherville	Sandy, mixed, mesic Typic Hapludolls
Farrar	Fine-loamy, mixed, mesic Typic Hapludolls
Fieldon	Coarse-loamy, mixed (calcareous), mesic Typic Haplaquolls
Fostoria	Fine-loamy, mixed, mesic Aquic Hapludolls
Glencoe	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Grogan	Coarse-silty, mixed, mesic Typic Hapludolls
Guckeen	Fine, montmorillonitic, mesic Aquic Hapludolls
Kingston	Fine-silty, mixed, mesic Aquic Hapludolls
Klossner	Loamy, mixed, euic, mesic Terric Medisaprists
Lakefield	Fine-silty, mixed, mesic Aquic Hapludolls
Linder	Coarse-loamy, mixed, mesic Aquic Hapludolls
Litchfield	Sandy, mixed, mesic Aquic Hapludolls
Lomax	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Lura	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Madelia	Fine-silty, mixed, mesic Typic Haplaquolls
Marna	Fine, montmorillonitic, mesic Typic Haplaquolls
Mayer	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls
Millington	Fine-loamy, mixed (calcareous), mesic Cumulic Haplaquolls
Minnetonka	Fine, montmorillonitic, mesic Typic Argiaquolls
Muskego	Coprogenous, euic, mesic Limnic Medisaprists
Nicollet	Fine-loamy, mixed, mesic Aquic Hapludolls
Ocheyedan	Fine-loamy, mixed, mesic Typic Hapludolls
Okoboji	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Shorewood	Fine, montmorillonitic, mesic Aquic Argiudolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Spicer	Fine-silty, mixed (calcareous), mesic Typic Haplaquolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Swanlake	Fine-loamy, mixed, mesic Entic Hapludolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Truman	Fine-silty, mixed, mesic Typic Hapludolls
Udorthents	Typic Udorthents
Waldorf	Fine, montmorillonitic, mesic Typic Haplaquolls
Webster	Fine-loamy, mixed, mesic Typic Haplaquolls

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Interpretive Groups

INTERPRETIVE GROUPS

Map symbol and soil name	Land capability	Prime farmland	Windbreak suitability group
8B Sparta	IVs	---	7
27B Dickinson	IIIe	Yes	6G
27C Dickinson	IVe	---	6G
35 Blue Earth	IIIw	---	2W
37B Farrar	IIe	Yes	3
41B Estherville	IIIs	---	7
84 Brownton	IIw	Yes*	2K
86 Canisteo	IIw	Yes*	2K
94B Terril	IIe	Yes	3
96A Collinwood	IIw	Yes	4L
96B Collinwood	IIe	Yes	4L
101B Truman	IIe	Yes	3
102B Clarion	IIe	Yes	3
110 Marna	IIw	Yes*	2
113 Webster	IIw	Yes*	2
114 Glencoe	IIIw	Yes*	2W
118 Crippin	I	Yes	1K
128B Grogan	IIe	Yes	3
130 Nicollet	I	Yes	1
134 Okoboji	IIIw	Yes*	2W

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability	Prime farmland	Windbreak suitability group
136 Madelia	IIw	Yes*	2
140 Spicer	IIw	Yes*	2K
160 Fieldon	IIw	Yes*	2K
181 Litchfield	IIs	Yes	1
197 Kingston	I	Yes	1
211 Lura	IIIw	Yes*	2W
229 Waldorf	IIw	Yes*	2
230A Guckeen	IIw	Yes	4L
230B Guckeen	IIe	Yes	4L
247 Linder	IIs	Yes	1
248 Lomax	I	Yes	5
255 Mayer	IIw	Yes*	2K
269 Millington	IIw	Yes*	2K
275B Ocheyedan	IIe	Yes	3
275C2 Ocheyedan	IIIe	---	3
281 Darfur	IIw	Yes*	2
286A Shorewood	IIw	Yes	4L
286B Shorewood	IIe	Yes	4L
286C2 Shorewood	IIIe	---	4L
287 Minnetonka	IIw	Yes*	2

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability	Prime farmland	Windbreak suitability group
310 Beauford	IIw	Yes*	2
313 Spillville	IIw	Yes	1
319 Barbert	IIIw	Yes*	2W
336 Delft	IIw	Yes*	2
392 Biscay	IIw	Yes*	2
525 Muskego	IVw	---	2(O)
539 Klossner	IIIw	---	2(O)
887B: Clarion	IIe	Yes	3
Swanlake	IIe	Yes	8
909C2: Truman	IIIe	---	3
Bold	IIIe	---	8
909D2: Bold	VIe	---	8
Truman	IVe	---	3
920B: Clarion	IIe	---	3
Estherville	IIIs	---	7
920C2: Clarion	IIIe	---	3
Storden	IIIe	---	8
Estherville	IVs	---	7
920D2: Clarion	IIIe	---	3
Storden	IVe	---	8
Estherville	VIs	---	7
921C2: Clarion	IIIe	---	3
Storden	IIIe	---	8

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability	Prime farmland	Windbreak suitability group
929:			
Fieldon	IIw	Yes*	2K
Canisteo	IIw	Yes*	2K
956:			
Canisteo	IIw	Yes*	2K
Glencoe	IIIw	Yes*	2W
960D2:			
Storden	IVe	---	8
Clarion	IVe	---	3
960E:			
Storden	VIe	---	8
Clarion	VIe	---	3
1030:			
Pits, gravel.			
Udorthents.			
1052:			
Klossner	VIIIw	---	10
Okoboji	VIIIw	---	10
1833	IIw	Yes*	2
Coland			
1834	Vw	---	2
Coland			
1852F:			
Swanlake	VIe	---	8
Terril	VIIe	---	3
1877	I	Yes	1
Fostoria			
1907	I	Yes	1K
Lakefield			

* Where drained.

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