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In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Renville County, Minnesota

Part I



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How To Use This Soil Survey

This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the general soil map units, detailed soil map units, and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

On the **general soil map**, which is the color map preceding the detailed soil maps, the survey area is 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** in Part I of this survey for a general description of the soils in your area.

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

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

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

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 Natural Resources Conservation Service (formerly 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 November 1993. Soil names and descriptions were approved in April 1995. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Renville County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Renville County. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources.

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

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Cover: An area of nearly level cropland in the Canisteo-Okoboji-Nicollet association.

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Foreword

This soil survey contains information that can be used in land-planning programs in Renville County, Minnesota. 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 Natural Resources Conservation Service.

William Hunt
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Soil Survey of Renville County, Minnesota

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United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
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How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; 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 and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of

accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate 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-vegetation-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 color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, 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 and 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 predict 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.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

General Nature of the Survey Area

Renville County is in the west-central part of Minnesota (fig. 1). It has a total land area of 632,100 acres. Of this total, 2,200 acres is made up of bodies of water. In 1990, the population of the county was 17,673. Olivia, the county seat, had a population of

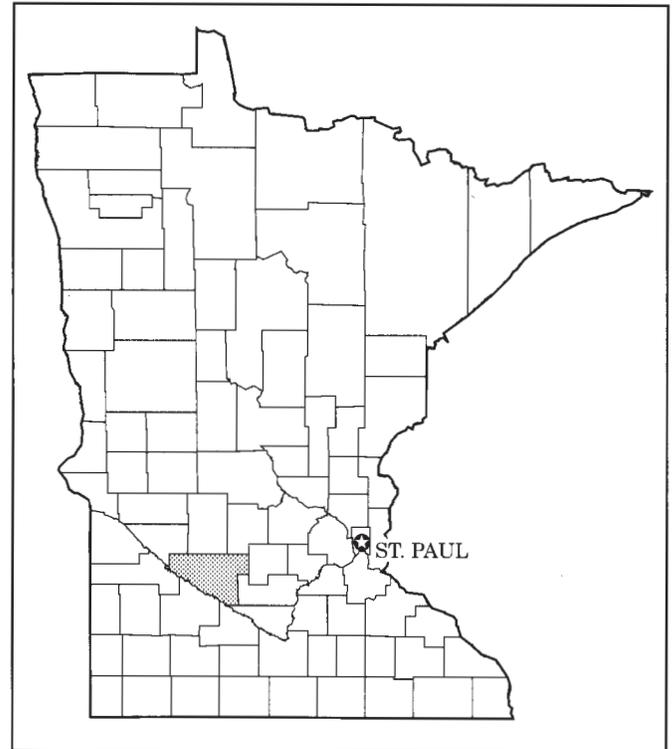


Figure 1.—Location of Renville County in Minnesota.

2,623. Other cities and towns in the county are Bechyn, Bird Island, Buffalo Lake, Danube, Fairfax, Franklin, Hector, Morton, Renville, and Sacred Heart.

History

Renville County was named after Joseph Renville. Joseph Renville was born in 1779 at the Dakota village of Kaposia, near the site of the present city of South St. Paul (Curtiss-Wedge, 1916). His mother was a member of the Dakota tribe, and his father was a French Canadian fur trader. During the War of 1812, Renville commanded a company of Dakota and fought against the Americans. After the war, he returned to the Minnesota River Valley and established a trading post at Lac qui Parle, where he died in 1846 (Burnquist, 1924).

Renville County was once part of Wabasha County, which encompassed the southern half of Minnesota. The Territorial Legislature established Renville County in February of 1855. The original boundaries of Renville County also included the two southern townships of Meeker County, the four southern townships of Kandiyohi County, and several townships of Chippewa County (Curtiss-Wedge, 1916).

In 1862, settlement in the county suffered a severe

setback because of a Dakota uprising. As a result of treaties, the Dakota had been confined to a reservation along the Minnesota River and were dependent on annuity payments from the U.S. Government. When the payments did not arrive in 1862, the accumulated frustration of being pushed from the land poured out in the uprising, during which many settlers in Renville County were killed and much property was damaged. The Dakota suffered unknown casualties and lost most of their reservation land as a result of the uprising.

In 1866, the county was reorganized and the county seat was located at Beaver Falls (Curtiss-Wedge, 1916). Before the railroads were built, most settlement was confined to areas close to the Minnesota River. With the introduction of the railroad in the late 1870's, towns started to spring up in the northern one-third of the county. In 1900, the county seat was moved from Beaver Falls to Olivia (Burnquist, 1924).

Since the 1860's, Renville County has been transformed from open prairie to an intensively developed agricultural area. More than 1,100 miles of open ditches and immeasurable miles of tile lines drain the county, thus increasing agricultural production.

Farming

About 90 percent of Renville County is farmland. The number of farms is decreasing, but the average farm size is increasing. The number of farms decreased from a high of 2,170 in 1976 to 1,630 in 1987. The average farm size increased from 291 acres in 1976 to 374 acres in 1987 (Minnesota Crop and Livestock Reporting Service, 1977 and 1989). Most of the land was bought or rented by farmers and is still in use. The major crops are corn and soybeans. Minor acreages of sugar beets and wheat are grown, and specialty crops include sweet corn and peas.

Most of the farms that once had dairy enterprises now grow cash crops. The major livestock enterprise is raising hogs. In 1990, there were about 133,400 hogs in the county (Minnesota Crop and Livestock Reporting Service, 1990). In recent years, there has been an increase in the production of turkeys.

Transportation Facilities

The major highways in the county are U.S. Highways 71 and 212 and State Highways 4, 19, and 23. Twenty-one county highways are blacktopped. Graveled or paved county and township roads serve the rural areas. One railway in the northern part of the county serves Buffalo Lake, Hector, Bird Island, Olivia, Danube, Renville, and Sacred Heart. Another railway in the southern part of the county serves Fairfax, Franklin, and Morton.

Livestock and turkeys are generally shipped to market by truck. Most of the milk produced in the county is shipped by truck to processing plants. Grain elevators are located in most of the towns in the county. Corn and soybeans are processed in Minneapolis or sold out of state. Sweet corn is processed in Olivia or in canneries in the surrounding counties. Sugar beets are shipped to a processing plant near Renville.

Gneiss and granite bedrock is quarried near Morton and shipped throughout the United States for monumental stone use and other purposes (fig. 2).

Physiography, Drainage, and Geology

Renville County is part of the Olivia Till Plain formed by the Des Moines Lobe advance during the Wisconsin Age (Wright, 1972a). The surface of the county is nearly level or gently sloping. The topography is steeper near the Minnesota River and along its tributaries. The highest point in the county, which is in Osceola Township, is 1,125 feet above sea level. The lowest point is 800 feet above sea level. It is in an area along the Minnesota River near the Renville-Nicollet county line in Camp Township. The county has an average elevation of 1,050 to 1,100 feet.

The drainage network in the county started to form approximately 12,000 years ago as glacial ice began to melt (Wright, 1972b). Most drainage channels are weakly cut and have a low gradient. Much of this network has been supplemented by county and field ditches and tile lines throughout the county.

The county has 15 watersheds, 12 of which originate within the county. The main watersheds that flow into the Minnesota River are Limbo Creek, Sacred Heart Creek, Hawk Creek, and Chetomba Creek in the northwest; Beaver Creek and Birch Cooley Creek in the south and south-central parts of the county; and Fort Ridgely Creek and Rock Creek in the southeast. Hawk Creek and Chetomba Creek drain from Chippewa and Kandiyohi Counties. The main watersheds that flow into the Mississippi River are Buffalo Creek in the north-central part of the county and the South Fork of the Crow River in the northeast. Both watersheds drain from Kandiyohi County.

Precambrian metamorphic and igneous rocks, mainly gneiss and granite, form the lowermost geologic unit in Renville County. Outcrops of gneiss and granite bedrock occur only in the valley of the Minnesota River. The rock exposures were created by high-volume water discharges from Glacial Lake Agassiz. These water discharges resulted in the formation of Glacial River Warren, which is the presentday Minnesota River. They also resulted in the downcutting of the landscape to expose Precambrian bedrock (Matsch, 1972) in the



Figure 2.—A gneiss and granite quarry near Morton, in an area of Bechyn-Rock outcrop complex, 0 to 40 percent slopes. These rocks are among the oldest in North America.

Minnesota River Valley. This unit covers about 1 percent of the county.

Glacial sediments of the Pleistocene Epoch covered the entire county. They form the uppermost geologic unit in the county. As the glaciers melted, they left behind a variety of deposits. These deposits include till, glaciolacustrine deposits, and glacial outwash. Four kinds of till are recognized in Renville County. They are identified as Kandiyohi, Hawk Creek, Granite Falls, and New Ulm Tills. Only two of the tills, Kandiyohi and New

Ulm, have provided parent material for the formation of soils in the survey area.

The Kandiyohi Till, in the northeastern part of the county, is thought to be of Pre-Wisconsin age (Giencke and others, 1983-84). Evidence suggests that this till was buried and later thrust to the surface during the advance of the Wisconsin Age ice lobes. The general characteristics of this till are a clay or clay loam texture, a significant content of shale fragments, moderate amounts of carbonate, and a high bulk density (Crum

and Rust, 1986). Two theories have been proposed as to why this older till has not been covered by more recent advances. The older till is presently exposed either because it was protected by stagnant ice or because the ice of the more recent advances was very clean and nearly devoid of till (Crum and Rust, 1986). The Corvuso-Lura-Cosmos association, which is described under the heading "General Soil Map Units," includes areas of this till. The till covers about 5 percent of the county.

The Hawk Creek Till was deposited early in the Wisconsin advance of the Superior Lobe. This till is exposed as outcrops on side slopes in several places along the present Hawk Creek drainage system. It is distinguished from other deposits by its sandy texture, pink to reddish-brown color, and rock types from the Lake Superior Region (Matsch and others, 1972).

The Granite Falls Till overlies the Hawk Creek Till. Exposures of Granite Falls Till can be seen along tributary streams of the Minnesota River. The most distinctive characteristic of this till is the absence of shale or shale in only small amounts (1 to 5 percent). Small granitic rocks and carbonates make up the rock fragment content. Textures range from sandy loam to clay loam (Matsch and others, 1972).

The uppermost till is the New Ulm Till of the Des Moines Lobe. It is characterized by abundant shale fragments, appreciable amounts of carbonates, and granitic rocks. Textures of the most recent till range from loam to clay loam (Matsch, 1972). In places, a stone line or "boulder pavement" separates the New Ulm Till from the Granite Falls Till. The stone line between the tills is generally one stone thick and is composed of igneous or limestone rocks (Matsch and others, 1972). This glacial drift covers about 76 percent of the county.

A shallow temporary glacial lake, Glacial Lake Benson, covered portions of the northwestern part of the county. Glacial Lake Benson had an approximate depth of 50 feet and a shoreline elevation of 1,050 feet (Diedrick and Rust, 1975). The silty glacial lake sediment is thickest in the low areas of the plain. It covers about 12 percent of the county. Glacial outwash and meltwater channel deposits of sand and gravel

cover about 2 percent of the county. They are in areas along most of the creeks in the county. Alluvium derived from the glacial drift and deposited on flood plains is the most recent geologic deposit. It covers about 4 percent of the county.

Climate

The three tables at the end of this section give climate data for the survey area as recorded at Stewart in the period 1961 to 1990.

In winter, the average temperature is 15 degrees F and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Stewart on January 9, 1975, is -35 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest temperature, which occurred at Stewart on August 1, 1988, is 106 degrees.

Growing degree days 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 (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 28.31 inches. Of this, about 20.58 inches, or 73 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall on record was 4 inches at Stewart on June 21, 1957. Thunderstorms occur on about 38 days each year, and most occur in July.

The average seasonal snowfall is 45.1 inches. The greatest snow depth at any one time during the period of record was 39 inches. On an average, 15 days of the year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 12 inches.

The average relative humidity in midafternoon is about 59 percent. Humidity is higher at night, and the average at dawn is about 78 percent. The sun shines 69 percent of the time possible in summer and 51 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in April.

TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Stewart, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	° F	° F	° F	° F	° F	Units	In	In	In		In
January-----	21.1	1.7	11.4	48	-29	0	0.81	0.27	1.31	3	10.1
February-----	27.4	7.7	17.6	53	-26	2	.77	.28	1.18	2	8.0
March-----	40.4	21.6	31.0	71	-12	41	1.63	.89	2.28	4	9.3
April-----	57.9	35.0	46.5	87	14	228	2.65	1.32	3.80	6	2.6
May-----	71.8	46.3	59.0	92	26	570	2.85	1.43	4.08	7	.0
June-----	80.8	56.3	68.6	98	40	842	4.20	2.17	5.97	7	.0
July-----	84.7	60.9	72.8	98	46	1,001	3.92	2.11	5.50	6	.0
August-----	81.6	58.0	69.8	96	41	914	3.93	1.88	5.69	6	.0
September---	73.0	48.8	60.9	92	28	602	3.03	1.56	4.32	6	.0
October-----	61.2	37.8	49.5	85	18	302	2.13	.71	3.43	4	.6
November-----	41.5	24.2	32.9	67	-3	43	1.56	.35	2.61	3	6.2
December-----	25.7	8.3	17.0	51	-22	2	.83	.35	1.29	2	8.3
Yearly:											
Average---	55.6	33.9	44.7	---	---	---	---	---	---	---	---
Extreme---	106	-35	---	100	-31	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,546	28.31	21.76	32.91	56	45.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Stewart, 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. 23	May 12	May 19
2 years in 10 later than--	Apr. 18	May 5	May 14
5 years in 10 later than--	Apr. 8	Apr. 23	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 6	Sept. 26	Sept. 15
2 years in 10 earlier than--	Oct. 11	Oct. 1	Sept. 20
5 years in 10 earlier than--	Oct. 22	Oct. 10	Sept. 28

GROWING SEASON

(Recorded in the period 1961-90 at Stewart, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	<u>Days</u>	<u>Days</u>	<u>Days</u>
9 years in 10	166	141	128
8 years in 10	173	149	134
5 years in 10	184	164	145
2 years in 10	196	179	156
1 year in 10	202	187	162

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General Soil Map Units

The general soil map shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit 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 or miscellaneous areas can be identified on the map. Likewise, areas that 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general map units in this survey have been grouped for broad interpretive purposes. Each of the broad groups and the map units in each group are described on the following pages.

Nearly Level to Moderately Steep Soils on Ground Moraines

1. Canisteo-Okoboji-Nicollet Association

Setting

Landform: Moraines

Position on the landform: Canisteo—flats and rims of depressions; Nicollet—low summits and back slopes; Okoboji—depressions (fig. 3)

Slope range: 0 to 3 percent

Composition

Percent of survey area: 33

Extent of components in the association:

- Canisteo and similar soils—29 percent
- Okoboji and similar soils—20 percent

- Nicollet and similar soils—16 percent
- Minor soils—35 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Okoboji

Drainage class: Very poorly drained

Parent material: Alluvium or glaciolacustrine deposits over till

Surface texture: Silty clay loam or mucky silty clay loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Minor Soils

- Clarion and similar soils
- Omsrud and similar soils
- Storden and similar soils
- Harps and similar soils
- Webster and similar soils

2. Clarion-Nicollet-Webster Association

Setting

Landform: Moraines

Position on the landform: Clarion—shoulders, back slopes, and summits; Nicollet—low summits and back slopes; Webster—flats and drainageways (fig. 4)

Slope range: 0 to 5 percent

Composition

Percent of survey area: 7

Extent of components in the association:

- Clarion and similar soils—45 percent
- Nicollet and similar soils—12 percent
- Webster and similar soils—11 percent
- Minor soils—32 percent

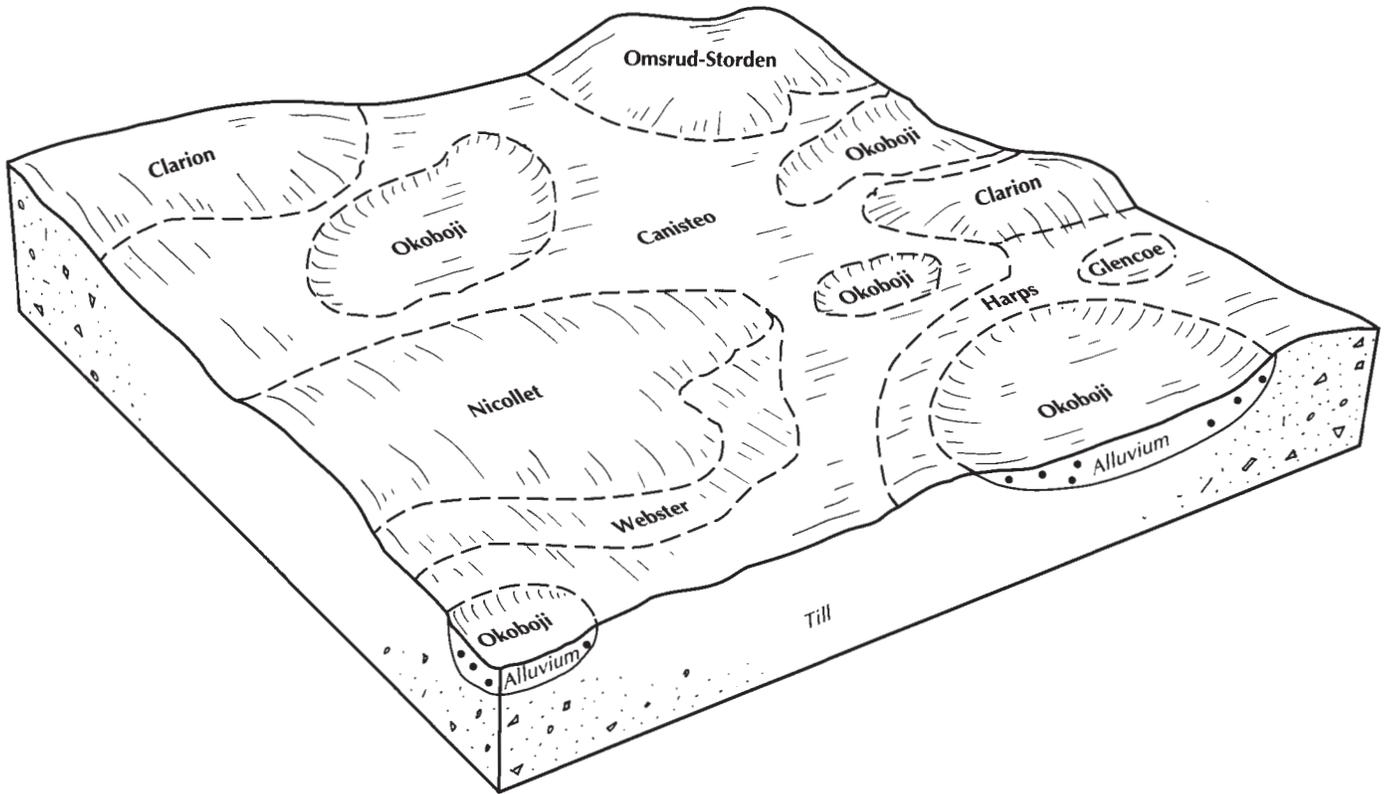


Figure 3.—Typical pattern of soils and parent material in the Canisteo-Okoboji-Nicollet association.

Soil Properties and Qualities

Clarion

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Webster

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Minor Soils

- Canisteo and similar soils
- Glencoe and similar soils
- Okoboji and similar soils
- Omsrud and similar soils
- Storden and similar soils
- Swanlake and similar soils

3. Canisteo-Nicollet-Clarion Association

Setting

Landform: Moraines

Position on the landform: Canisteo—flats and rims of depressions; Nicollet—low summits and back slopes; Clarion—shoulders, back slopes, and summits

Slope range: 0 to 5 percent

Composition

Percent of survey area: 2

Extent of components in the association:

- Canisteo and similar soils—35 percent
- Nicollet and similar soils—16 percent
- Clarion and similar soils—14 percent
- Minor soils—35 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained

Parent material: Till

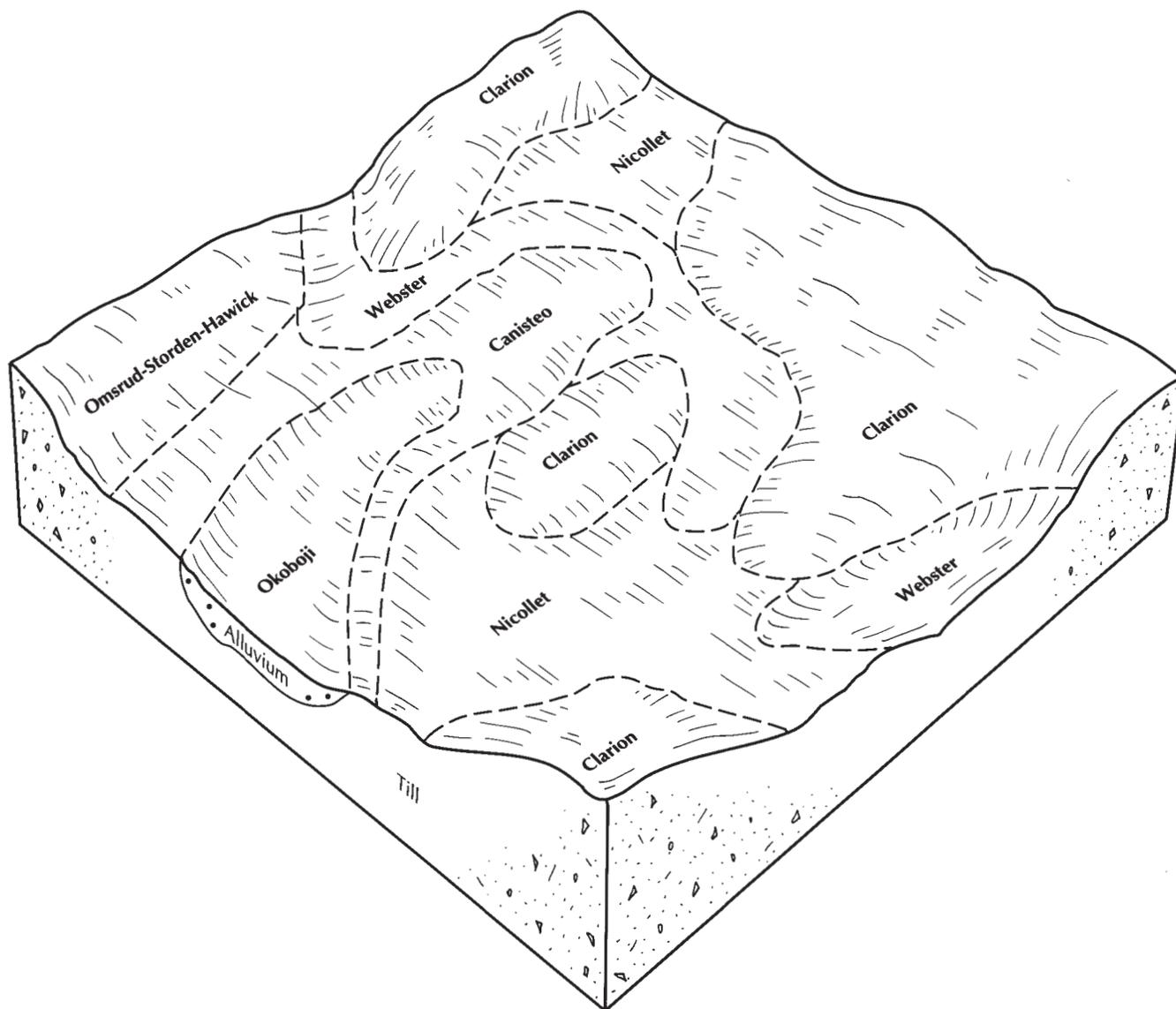


Figure 4.—Typical pattern of soils and parent material in the Clarion-Nicollet-Webster association.

Surface texture: Clay loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam

Clarion

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Minor Soils

- Klossner and similar soils

- Glencoe and similar soils
- Okoboji and similar soils
- Omsrud and similar soils
- Storden and similar soils
- Swanlake and similar soils
- Webster and similar soils

4. Clarion-Canisteo-Webster Association

Setting

Landform: Moraines

Position on the landform: Clarion—shoulders, back

slopes, and summits; Canisteo—flats and rims of depressions; Webster—flats and drainageways
Slope range: 0 to 5 percent

Composition

Percent of survey area: 2

Extent of components in the association:

- Clarion and similar soils—37 percent
- Canisteo and similar soils—19 percent
- Webster and similar soils—12 percent
- Minor soils—32 percent

Soil Properties and Qualities

Clarion

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Canisteo

Drainage class: Poorly drained and very poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Webster

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam

Minor Soils

- Nicollet and similar soils
- Klossner and similar soils
- Glencoe and similar soils
- Okobojo and similar soils
- Omsrud and similar soils
- Storden and similar soils
- Swanlake and similar soils

5. Harps-Okobojo-Normania Association

Setting

Landform: Moraines

Position on the landform: Harps—rims of depressions; Okobojo—depressions; Normania—low summits and back slopes

Slope range: 0 to 3 percent

Composition

Percent of survey area: 19

Extent of components in the association:

- Harps and similar soils—34 percent
- Okobojo and similar soils—20 percent
- Normania and similar soils—11 percent
- Minor soils—35 percent

Soil Properties and Qualities

Harps

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam

Okobojo

Drainage class: Very poorly drained

Parent material: Alluvium or glaciolacustrine deposits over till

Surface texture: Silty clay loam or mucky silty clay loam

Normania

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Loam

Minor Soils

- Seaforth and similar soils
- Ves and similar soils
- Amiret and similar soils
- Webster and similar soils

6. Amiret-Normania-Webster Association

Setting

Landform: Moraines

Position on the landform: Amiret—shoulders, back slopes, and summits; Normania—low summits and back slopes; Webster—flats and drainageways

Slope range: 0 to 5 percent

Composition

Percent of survey area: 7

Extent of components in the association:

- Amiret and similar soils—28 percent
- Normania and similar soils—25 percent
- Webster and similar soils—12 percent
- Minor soils—35 percent

Soil Properties and Qualities

Amiret

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Normania

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Loam

Webster

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Minor Soils

- Ves and similar soils
- Swanlake and similar soils
- Seaforth and similar soils
- Harps and similar soils
- Canisteo and similar soils
- Okobojo and similar soils
- Glencoe and similar soils

7. Harps-Nicollet Association**Setting**

Landform: Moraines

Position on the landform: Harps—rims of depressions;
Nicollet—low summits and back slopes

Slope range: 0 to 3 percent

Composition

Percent of survey area: 2

Extent of components in the association:

- Harps and similar soils—40 percent
- Nicollet and similar soils—25 percent
- Minor soils—35 percent

Soil Properties and Qualities**Harps**

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam or silty clay loam

Minor Soils

- Okobojo and similar soils
- Glencoe and similar soils
- Omsrud and similar soils
- Clarion and similar soils
- Swanlake and similar soils
- Webster and similar soils

Nearly Level to Sloping Soils on Silt- or Clay-Mantled Ground Moraines**8. Leen-Okobojo-Crooksford Association****Setting**

Landform: Moraines

Position on the landform: Leen—flats and rims of depressions; Okobojo—depressions; Crooksford—back slopes and summits (fig. 5)

Slope range: 0 to 5 percent

Composition

Percent of survey area: 7

Extent of components in the association:

- Leen and similar soils—40 percent
- Okobojo and similar soils—19 percent
- Crooksford and similar soils—16 percent
- Minor soils—25 percent

Soil Properties and Qualities**Leen**

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Silty clay loam

Okobojo

Drainage class: Very poorly drained

Parent material: Alluvium or glaciolacustrine deposits over till

Surface texture: Silty clay loam

Crooksford

Drainage class: Moderately well drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Silt loam

Minor Soils

- Amiret and similar soils
- Swanlake and similar soils
- Ves and similar soils
- Seaforth and similar soils
- Louris and similar soils
- Chetomba and similar soils

9. Amiret-Leen-Crooksford Association**Setting**

Landform: Moraines

Position on the landform: Amiret—back slopes and shoulders; Leen—flats and rims of depressions; Crooksford—low summits and back slopes (fig. 6)

Slope range: 0 to 5 percent

Composition

Percent of survey area: 5

Extent of components in the association:

- Amiret and similar soils—26 percent
- Leen and similar soils—24 percent
- Crooksford and similar soils—20 percent
- Minor soils—30 percent

Soil Properties and Qualities**Amiret**

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

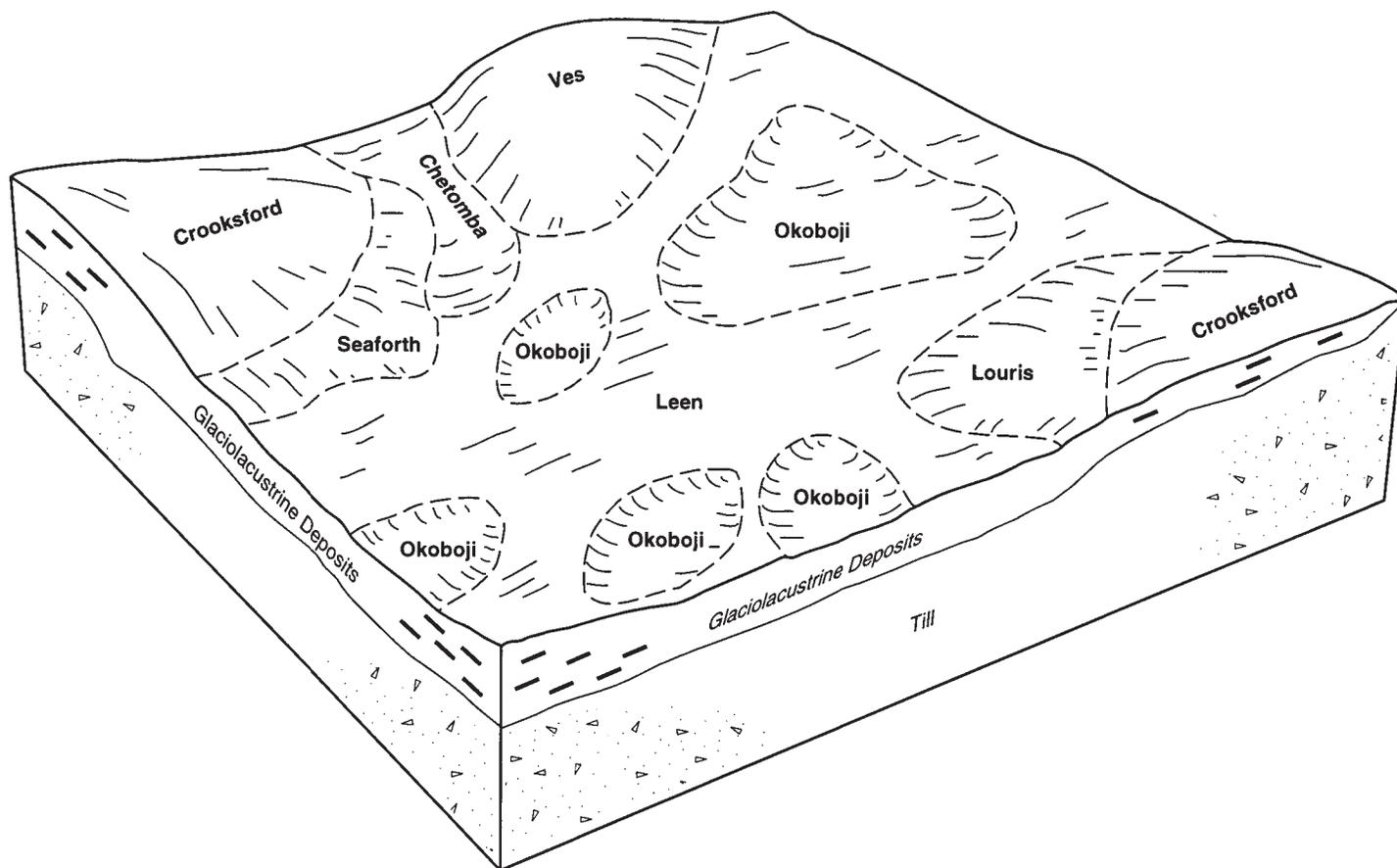


Figure 5.—Typical pattern of soils and parent material in the Leen-Okoboji-Crooksford association.

Leen

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Silty clay loam

Crooksford

Drainage class: Moderately well drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Silt loam

Minor Soils

- Okoboji and similar soils
- Chetomba and similar soils
- Louris and similar soils
- Seaforth and similar soils
- Ves and similar soils
- Swanlake and similar soils

10. Corvuso-Lura-Cosmos Association

Setting

Landform: Moraines

Position on the landform: Corvuso—flats and rims of depressions; Lura—depressions; Cosmos—flats
Slope range: 0 to 2 percent

Composition

Percent of survey area: 5

Extent of components in the association:

- Corvuso and similar soils—28 percent
- Lura and similar soils—25 percent
- Cosmos and similar soils—15 percent
- Minor soils—32 percent

Soil Properties and Qualities

Corvuso

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over dense till

Surface texture: Clay loam

Lura

Drainage class: Very poorly drained

Parent material: Lacustrine deposits

Surface texture: Silty clay

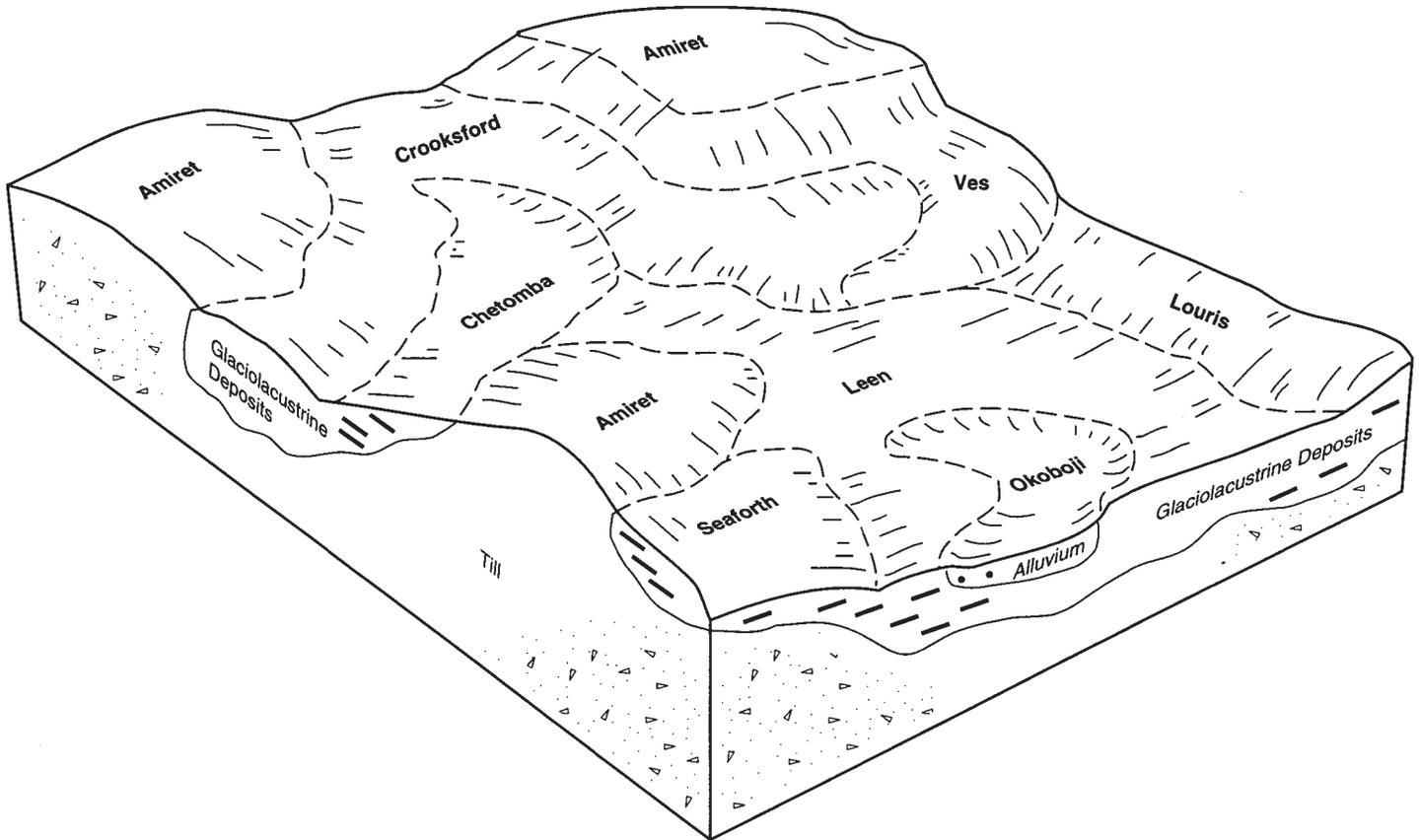


Figure 6.—Typical pattern of soils and parent material in the Amiret-Leen-Crooksford association.

Cosmos

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over dense till

Surface texture: Silty clay

Minor Soils

- Kandiyohi and similar soils
- Nicollet and similar soils
- Strout and similar soils
- Arkton and similar soils
- Webster and similar soils

Nearly Level to Sloping Soils on Outwash Plains

11. Calco-Danube-Mayer Association

Setting

Landform: Flood plains, glacial meltwater channels, outwash plains, and terraces

Position on the landform: Calco and Danube—flats;

Mayer—depressions

Slope range: 0 to 2 percent

Composition

Percent of survey area: 1

Extent of components in the association:

- Calco and similar soils—30 percent
- Danube and similar soils—24 percent
- Mayer and similar soils—15 percent
- Minor soils—31 percent

Soil Properties and Qualities

Calco

Drainage class: Poorly drained

Parent material: Alluvium

Surface texture: Silty clay loam

Danube

Drainage class: Poorly drained

Parent material: Alluvium over glacial outwash

Surface texture: Silty clay

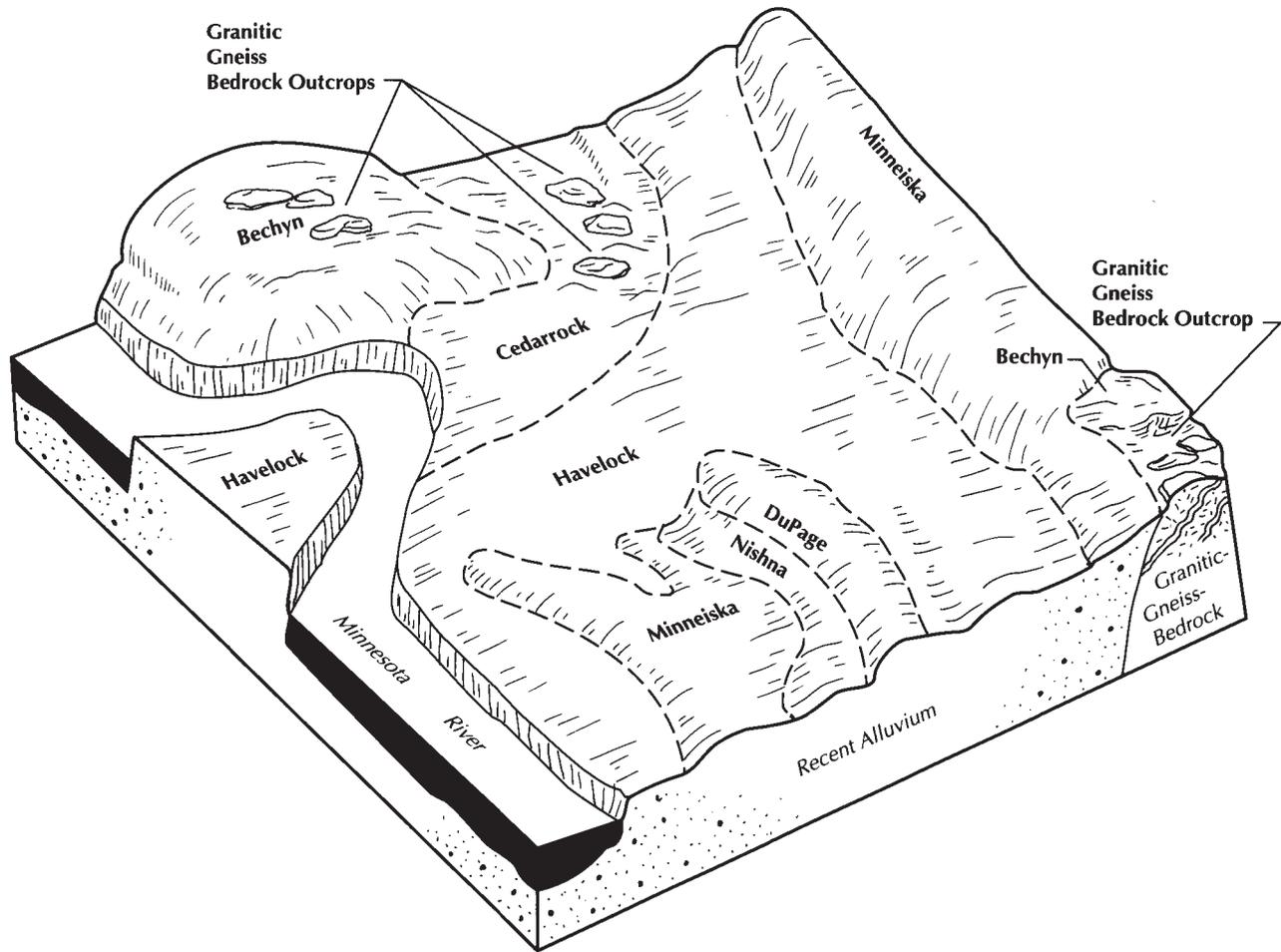


Figure 7.—Typical pattern of soils and parent material in the Havelock-Minneiska-Bechyn association.

Mayer

Drainage class: Very poorly drained

Parent material: Glacial outwash

Surface texture: Clay loam

Minor Soils

- Ves and similar soils
- Amiret and similar soils
- Havelock and similar soils
- Normania and similar soils

12. Dickinson-Estherville-Linder Association

Setting

Landform: Outwash plains and terraces

Position on the landform: Dickinson—summits and back

slopes; Estherville—summits and shoulders;

Linder—low summits

Slope range: 0 to 6 percent

Composition

Percent of survey area: 1

Extent of components in the association:

- Dickinson and similar soils—35 percent
- Estherville and similar soils—20 percent
- Linder and similar soils—10 percent
- Minor soils—35 percent

Soil Properties and Qualities

Dickinson

Drainage class: Well drained

Parent material: Glacial outwash

Surface texture: Loam

Estherville*Drainage class:* Somewhat excessively drained*Parent material:* Glacial outwash*Surface texture:* Loam**Linder***Drainage class:* Somewhat poorly drained*Parent material:* Glacial outwash*Surface texture:* Loam**Minor Soils**

- Biscay and similar soils
- Fairhaven and similar soils
- Hanska and similar soils
- Lemond and similar soils

Gently Sloping to Very Steep Soils on Uplands**13. Swanlake-Terril Association****Setting***Landform:* Moraines*Position on the landform:* Swanlake—shoulders, summits, and back slopes; Terril—foot slopes*Slope range:* 2 to 50 percent**Composition***Percent of survey area:* 4*Extent of components in the association:*

- Swanlake and similar soils—45 percent
- Terril soils—20 percent
- Minor soils—35 percent

Soil Properties and Qualities**Swanlake***Drainage class:* Well drained*Parent material:* Till*Surface texture:* Loam**Terril***Drainage class:* Moderately well drained*Parent material:* Colluvium over till*Surface texture:* Loam**Minor Soils**

- Ves and similar soils
- Storden and similar soils
- Delft and similar soils
- Minneiska and similar soils

14. Storden-Terril Association**Setting***Landform:* Moraines*Position on the landform:* Storden—shoulders, summits,

and back slopes; Terril—foot slopes

Slope range: 6 to 50 percent**Composition***Percent of survey area:* 0.2*Extent of components in the association:*

- Storden and similar soils—40 percent
- Terril soils—25 percent
- Minor soils—35 percent

Soil Properties and Qualities**Storden***Drainage class:* Well drained*Parent material:* Till*Surface texture:* Loam**Terril***Drainage class:* Moderately well drained*Parent material:* Colluvium over till*Surface texture:* Loam**Minor Soils**

- Ves and similar soils
- Swanlake and similar soils
- Delft and similar soils
- Minneiska and similar soils

Nearly Level to Very Steep Soils on Flood Plains and Stream Terraces**15. Havelock-Minneiska-Bechyn Association****Setting***Landform:* Flood plains and terraces*Position on the landform:* Havelock—flats; Minneiska—flats and alluvial fans; Bechyn—summits and shoulders (fig. 7)*Slope range:* 0 to 40 percent**Composition***Percent of survey area:* 2*Extent of components in the association:*

- Havelock and similar soils—30 percent
- Minneiska and similar soils—20 percent
- Bechyn and similar soils—15 percent
- Minor soils—35 percent

Soil Properties and Qualities**Havelock***Drainage class:* Poorly drained*Parent material:* Alluvium*Surface texture:* Clay loam**Minneiska***Drainage class:* Moderately well drained

Parent material: Alluvium

Surface texture: Silt loam

Bechyn

Drainage class: Somewhat excessively drained

Parent material: Alluvium over bedrock

Surface texture: Loam

Minor Components

- Cedarrock and similar soils
- Du Page and similar soils
- Nishna and similar soils
- Areas of rock outcrop

16. Calco-Du Page Association

Setting

Landform: Flood plains

Position on the landform: Flats

Slope range: 0 to 2 percent

Composition

Percent of survey area: 0.2

Extent of components in the association:

- Calco and similar soils—51 percent
- Du Page and similar soils—29 percent
- Minor soils—20 percent

Soil Properties and Qualities

Calco

Drainage class: Poorly drained

Parent material: Alluvium

Surface texture: Silty clay loam

Du Page

Drainage class: Moderately well drained

Parent material: Alluvium

Surface texture: Loam

Minor Soils

- Minneiska and similar soils
- Havelock and similar soils
- Nishna and similar soils

Nearly Level to Moderately Steep Soils on Flood Plains, Stream Terraces, and Ground Moraines

17. Havelock-Mayer-Omsrud Association

Setting

Landform: Flood plains, outwash plains, and moraines

Position on the landform: Havelock—flats; Mayer—flats;

Omsrud—summits and back slopes

Slope range: 0 to 18 percent

Composition

Percent of survey area: 1.4

Extent of components in the association:

- Havelock and similar soils—30 percent
- Mayer and similar soils—20 percent
- Omsrud and similar soils—15 percent
- Minor soils—35 percent

Soil Properties and Qualities

Havelock

Drainage class: Poorly drained

Parent material: Alluvium

Surface texture: Clay loam

Mayer

Drainage class: Poorly and very poorly drained

Parent material: Glacial outwash

Surface texture: Loam

Omsrud

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Minor Soils

- Swanlake and similar soils
- Clarion and similar soils
- Storden and similar soils
- Calco and similar soils
- Linder and similar soils

18. Havelock-Ves-Mayer Association

Setting

Landform: Flood plains, moraines, and outwash plains

Position on the landform: Havelock—flats; Ves—back slopes and summits; Mayer—flats

Slope range: 0 to 18 percent

Composition

Percent of survey area: 1

Extent of components in the association:

- Havelock and similar soils—40 percent
- Ves and similar soils—17 percent
- Mayer and similar soils—13 percent
- Minor soils—30 percent

Soil Properties and Qualities

Havelock

Drainage class: Poorly drained

Parent material: Alluvium

Surface texture: Clay loam

Ves

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Mayer

Drainage class: Poorly drained

Parent material: Glacial outwash

Surface texture: Loam

Minor Soils

- Estherville and similar soils
- Coland and similar soils
- Linder and similar soils

19. Coland-Clarion-Hawick Association

Setting

Landform: Flood plains, moraines, and outwash plains

Position on the landform: Coland—flats; Clarion—back slopes and summits; Hawick—back slopes, summits, and shoulders

Slope range: 0 to 12 percent

Composition

Percent of survey area: 0.2

Extent of components in the association:

- Coland and similar soils—30 percent
- Clarion and similar soils—25 percent

- Hawick and similar soils—10 percent

- Minor soils—35 percent

Soil Properties and Qualities

Coland

Drainage class: Poorly drained

Parent material: Alluvium

Surface texture: Clay loam

Clarion

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Hawick

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Coarse sandy loam

Minor Components

- Estherville and similar soils
- Havelock and similar soils
- Hanlon and similar soils
- Rushriver and similar soils
- Mayer and similar soils
- Udipsamments and gravel pits in open excavations

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Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Factors of Soil Formation

Soils are formed by processes generated by the interaction of five major factors. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief (landscape setting); and the length of time that the processes of soil formation have acted on the soil material (Jenny, 1941). The factors of soil formation are so closely interrelated that the effects of any one factor cannot be easily determined unless conditions are specified for the other factors.

Climate

Climate is an important factor in determining the kind of vegetation, animals, bacteria, and other organisms in or on the soil. It determines the intensity of physical and chemical activities in the soil, mainly through the effects of precipitation and temperature.

Renville County has a subhumid, midcontinental climate characterized by cold winters and hot summers. Freezing of the soil in the winter slows the soil-forming processes. Alternate periods of freezing and thawing, especially in the spring, play a role in the development of soil structure. Freezing and thawing also help to disintegrate parts of glacial debris, and frost heaving helps to mix the soil material. Precipitation during the frost-free period transfers water-soluble and colloidal material down through the soil.

To a large extent, climate was responsible for the growth of prairie vegetation. As a result of this plant cover, the soils have a dark surface layer. Prairie vegetation and cool temperatures promote the accumulation of organic matter, and most of the soils in the county have a high content of organic matter.

Living Organisms

Plants, animals, bacteria, and other organisms are active factors of soil formation. They aid in the breakdown of parent material and in the formation and decomposition of organic matter. Vegetation affects soil formation by leaving plant residue on the soil and by transferring plant nutrients from the subsoil to the surface layer.

Native vegetation in Renville County was dominantly tall and mid prairie grasses. The main grasses on the uplands were bluestems, indiagrass, and sideoats grama. Wet areas supported prairie cordgrass, reedgrass, and sedges. Some scattered areas were forested. The most common tree species in the forested areas were oak, elm, and ash.

Animals also affect soil formation. Earthworms eat decomposed plant matter and mix it with the soil. Channels created by earthworms provide aeration and water movement through the soil profile. Larger animals also mix the soil by burrowing. Human activities have influenced some of the soil-forming processes. Because of farming, accelerated erosion of the surface layer has occurred in the more sloping areas. In some areas the natural granular structure of the surface soil under native vegetation has become blocky or cloddy because of cultivation. Artificial drainage has changed the moisture condition of many soils.

Relief

Relief and landscape position are important factors in the formation of soils. Relief affects erosion, the distribution of water, the movement of parent material, soil moisture, and soil temperature. The more sloping soils are generally better drained and less extensively leached than the nearly level or concave soils because more water runs off the surface. The well drained Ves soils are examples. They are well aerated and have bright internal colors because of oxidation. Okoboji and other soils in depressional areas commonly are characterized by slow internal water movement and a high water table. They have a thicker and darker

surface layer that has a higher content of organic matter than the surface layer of better drained soils. Also, the subsoil has a dull grayish color and is mottled. In gently sloping areas where internal drainage is good, soil profiles generally are strongly developed and extend to a greater depth than those in the steeper areas.

The degree of profile development is mostly a function of the amount of water passing through the soil. Aspect affects the temperature of the soil. South-facing slopes are warmer and drier than north-facing slopes. Consequently, vegetation commonly is more sparse on south-facing slopes.

Parent Material

The soils in Renville County formed mainly in till, till mantled with glaciolacustrine deposits, glacial outwash, or alluvium. A small percentage of the soils in the survey area formed in coprogenous earth, organic deposits, or material weathered from gneiss or granitic bedrock.

The most common parent material in the survey area is till. It was deposited by ice as an unsorted mixture of clay, silt, sand, pebbles, and rocks. Most of the till in the survey area was deposited about 12,000 years ago (Wright, 1972b). Canisteo, Clarion, Nicollet, and Webster soils are some of the principal soils in the county that formed in till.

In the northwestern part of the county, a silty glaciolacustrine mantle of varying thickness overlies the till. Chetomba, Okoboji, and Prinsburg soils formed in thick glaciolacustrine deposits. Crooksford and Louris soils formed in the thin mantle of glaciolacustrine deposits overlying the till.

As glacial ice began to melt, large amounts of water flowed across the survey area. This meltwater carried tons of soil material with it. 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 include Estherville, Dickinson, and Wadena soils. Some of these soils are distant from present-day watercourses. In areas where the water flow was fast, low-gradient channels were created within the outwash. Soils that formed in these meltwater channels include Biscay and Mayer soils.

The present-day rivers in the county still carry some material as they constantly cut at streambanks. This parent material, called alluvium, is deposited on flood plains as the water volume decreases. Alluvium is generally finer textured than outwash and in most cases is much younger. Soils that formed in alluvium include Calco, Du Page, Havelock, and Minneiska soils.

Time

Soil characteristics are affected by the length of time involved in the soil-forming processes. The age of the soil is evidenced by changes in the morphology or appearance of the profile. In areas where relief and drainage are favorable, enough time has elapsed for the development of mature soil profiles. Soils on steep slopes have immature or thin profiles because the soil-forming processes have not been effective. Soils that formed in alluvium along streams and rivers are immature or weakly developed because the alluvial material is young. Because fresh deposits are added to the surface when the streams and rivers overflow, distinct, mature horizons have not had time to develop.

The soils in Renville County are geologically young. The parent material of most of the soils was deposited during or after the last glacial period, which ended only about 12,000 years ago (Wright, 1972b). A young soil has more natural plant nutrients and commonly is more fertile than an older soil. It has many of the properties of the parent material because the processes of soil formation have not had time to alter the material to any significant extent.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). 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. The table "Classification of the Soils" in Parts I and II of this publication 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 Endoaquolls (*Endo*, meaning within, 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 Endoaquolls.

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, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Endoaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Amiret-----	Calcic Hapludolls, fine-loamy, mixed, mesic
Arkton-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Bechyn-----	Lithic Hapludolls, loamy, mixed, mesic
Biscay-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Blue Earth-----	Mollic Fluvaquents, fine-silty, mixed (calcareous), mesic
Calco-----	Cumulic Haplaquolls, fine-silty, mixed (calcareous), mesic
Calcousta-----	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Canisteco-----	Typic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Cedarrock-----	Cumulic Epiaquolls, fine-loamy, mixed (calcareous), mesic
Chetomba-----	Typic Endoaquolls, fine-silty, mixed, mesic
Claron-----	Typic Hapludolls, fine-loamy, mixed, mesic
Coland-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Cordova-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Coriff-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Corvuso-----	Typic Calciaquolls, fine, mesic
Cosmos-----	Vertic Epiaquolls, fine, montmorillonitic, mesic
Crippin-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Crooksford-----	Calcic Hapludolls, fine-silty, mixed, mesic
Danube-----	Typic Calciaquolls, coarse-silty over sandy or sandy-skeletal, mesic
Delft-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Dickinson-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Dickman-----	Typic Hapludolls, sandy, mixed, mesic
Du Page-----	Cumulic Hapludolls, fine-loamy, mixed, mesic
Estherville-----	Typic Hapludolls, sandy, mixed, mesic
Fairhaven-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Fieldon-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Glencoe-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Grogan-----	Typic Hapludolls, coarse-silty, mixed, mesic
Hanlon-----	Cumulic Hapludolls, coarse-loamy, mixed, mesic
Hanska-----	Typic Endoaquolls, coarse-loamy, mixed, mesic
Harps-----	Typic Calciaquolls, fine-loamy, mesic
Havelock-----	Cumulic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Hawick-----	Entic Hapludolls, sandy, mixed, mesic
Kandiyohi-----	Aquertic Hapludolls, fine, montmorillonitic, mesic
Klossner-----	Terric Medisaprists, loamy, mixed, euic, mesic
Leen-----	Typic Calciaquolls, fine-silty, mixed, mesic
Lemond-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Linder-----	Aquic Hapludolls, coarse-loamy, mixed, mesic
Louris-----	Aquic Calciudolls, fine-silty, mixed, mesic
Lowlein-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Lura-----	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Mayer-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic
Minneiska-----	Mollic Udifluvents, coarse-loamy, mixed (calcareous), mesic
Muskego-----	Limnic Medisaprists, coprogenous, euic, mesic
Nicollet-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Nishna-----	Vertic Endoaquolls, fine, montmorillonitic (calcareous), mesic
Normania-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Okoboji-----	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Omsrud-----	Typic Hapludolls, fine-loamy, mixed, mesic
Prinsburg-----	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Rolfe-----	Typic Argialbolls, fine, montmorillonitic, mesic
Rushriver-----	Mollic Fluvaquents, coarse-loamy, mixed (calcareous), mesic
Seaforth-----	Aquic Calciudolls, fine-loamy, mixed, mesic
Storden-----	Typic Eutrochrepts, fine-loamy, mixed, mesic
Strout-----	Vertic Hapludolls, fine, montmorillonitic, mesic
Swanlake-----	Typic Calciudolls, fine-loamy, mixed, mesic
Terril-----	Cumulic Hapludolls, fine-loamy, mixed, mesic
Udipsamments-----	Udipsamments
Ves-----	Calcic Hapludolls, fine-loamy, mixed, mesic
Wadena-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Webster-----	Typic Endoaquolls, fine-loamy, mixed, mesic

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
27A	Dickinson loam, 0 to 2 percent slopes-----	1,057	0.2
27B	Dickinson loam, 2 to 6 percent slopes-----	1,025	0.2
35	Blue Earth mucky silt loam, 0 to 1 percent slopes-----	2,221	0.4
39A	Wadena loam, 0 to 2 percent slopes-----	890	0.1
39B	Wadena loam, 2 to 6 percent slopes-----	474	*
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded-----	4,440	0.7
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes-----	13,143	2.1
94C	Terril loam, 6 to 12 percent slopes-----	267	*
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes-----	14,498	2.3
112	Harps clay loam, 0 to 2 percent slopes-----	30,051	4.8
113	Webster clay loam, 0 to 2 percent slopes-----	37,100	5.9
118	Crippin loam, moderately fine substratum, 1 to 3 percent slopes-----	7,957	1.3
128C2	Grogan silt loam, 6 to 15 percent slopes, eroded-----	90	*
130	Nicollet clay loam, 1 to 3 percent slopes-----	48,493	7.7
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes-----	29,376	4.6
156	Fairhaven silt loam, 0 to 2 percent slopes-----	646	0.1
211	Lura silty clay, depressional, 0 to 1 percent slopes-----	1,425	0.2
227	Lemond loam, 0 to 2 percent slopes-----	388	*
247	Linder loam, 0 to 2 percent slopes-----	1,601	0.3
255	Mayer loam, 0 to 2 percent slopes-----	3,861	0.6
282	Hanska loam, 0 to 2 percent slopes-----	326	*
318	Mayer clay loam, depressional, 0 to 1 percent slopes-----	387	*
327A	Dickman sandy loam, 0 to 2 percent slopes-----	1,048	0.2
327B	Dickman sandy loam, 2 to 6 percent slopes-----	1,312	0.2
327C	Dickman sandy loam, 6 to 12 percent slopes-----	221	*
336	Delft loam, 1 to 3 percent slopes-----	1,146	0.2
386	Okoboji mucky silty clay loam, depressional, 0 to 1 percent slopes-----	10,916	1.7
392	Biscay loam, 0 to 2 percent slopes-----	1,171	0.2
423	Seaforth loam, 1 to 3 percent slopes-----	16,538	2.6
446	Normania loam, 1 to 3 percent slopes-----	15,486	2.4
463A	Minneiska loam, 0 to 2 percent slopes, occasionally flooded-----	1,892	0.3
463B	Minneiska loam, 1 to 4 percent slopes, rarely flooded-----	711	0.1
519	Klossner muck, depressional, calcareous, 0 to 1 percent slopes-----	474	*
525	Muskego muck, depressional, 0 to 1 percent slopes-----	258	*
539	Klossner muck, depressional, 0 to 1 percent slopes-----	1,225	0.2
574	Du Page loam, 0 to 2 percent slopes, occasionally flooded-----	982	0.2
575	Nishna silty clay, 0 to 2 percent slopes, occasionally flooded-----	505	*
595F	Swanlake loam, 18 to 50 percent slopes-----	2,863	0.5
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded-----	420	*
770C2	Ves-Terril complex, 6 to 15 percent slopes, eroded-----	1,048	0.2
810	Coriff-Fieldon complex, 0 to 2 percent slopes-----	320	*
817	Canisteo-Seaforth complex, 0 to 3 percent slopes-----	1,988	0.3
875C	Hawick-Estherville complex, 6 to 12 percent slopes-----	365	*
887B	Clarion-Swanlake complex, 2 to 6 percent slopes-----	37,100	5.9
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes-----	16,785	2.7
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes-----	5,000	0.8
927	Harps-Seaforth-Okoboji, depressional, complex, 0 to 3 percent slopes-----	9,019	1.4
954C2	Ves-Storden complex, 6 to 12 percent slopes, eroded-----	6,326	1.0
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes-----	88,984	14.1
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded-----	364	*
960F	Storden-Omsrud complex, 18 to 50 percent slopes-----	220	*
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes-----	1,776	0.3
999C2	Ves-Storden-Hawick complex, 6 to 12 percent slopes, eroded-----	1,091	0.2
1030	Pits, gravel-Udipsamments complex-----	1,017	0.2
1080	Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes-----	1,724	0.3
1100	Nicollet silty clay loam, 1 to 3 percent slopes-----	1,997	0.3
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes-----	1,749	0.3
1159B	Strout-Arkton complex, 2 to 6 percent slopes-----	1,368	0.2
1162A	Kandiyohi clay, 0 to 2 percent slopes-----	3,414	0.5
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes-----	15,178	2.4
1193	Cosmos silty clay, 0 to 2 percent slopes-----	5,121	0.8

See footnote at end of table.

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1205	Leen-Okoboji, depressional, complex, 0 to 2 percent slopes-----	19,511	3.1
1242F	Swanlake-Terril complex, 18 to 50 percent slopes-----	5,068	0.8
1261B	Bechyn loam, 2 to 6 percent slopes-----	301	*
1262	Seaforth silt loam, 1 to 3 percent slopes-----	2,952	0.5
1267	Cedarrock silty clay loam, 0 to 2 percent slopes, frequently flooded-----	488	*
1268	Hanlon loam, 1 to 3 percent slopes, rarely flooded-----	649	0.1
1269	Lowlein silt loam, 0 to 2 percent slopes-----	191	*
1270D	Bechyn-Rock outcrop complex, 0 to 40 percent slopes-----	2,022	0.3
1285	Chetomba silty clay loam, 0 to 2 percent slopes-----	5,566	0.9
1286	Prinsburg silty clay loam, 0 to 2 percent slopes-----	9,522	1.5
1287	Calco silty clay loam, ponded, 0 to 1 percent slopes, frequently flooded-----	395	*
1355B	Amiret-Swanlake complex, 2 to 6 percent slopes-----	34,100	5.4
1356	Water, miscellaneous-----	295	*
1369A	Crooksford silt loam, 1 to 3 percent slopes-----	12,423	2.0
1369B	Crooksford silt loam, 3 to 5 percent slopes-----	3,151	0.5
1370B	Amiret loam, 2 to 5 percent slopes-----	4,574	0.7
1371B	Crooksford-Swanlake complex, 3 to 6 percent slopes-----	6,193	1.0
1373C	Omsrud-Storden-Hawick complex, 6 to 12 percent slopes, eroded-----	2,319	0.4
1374	Havelock clay loam, 0 to 2 percent slopes, occasionally flooded-----	5,970	0.9
1375D	Storden-Ves complex, 12 to 18 percent slopes, eroded-----	700	0.1
1376C	Omsrud-Storden complex, 6 to 12 percent slopes, eroded-----	4,556	0.7
1382	Louris silt loam, 1 to 3 percent slopes-----	3,632	0.6
1386B	Amiret-Swanlake-Hawick complex, 2 to 6 percent slopes-----	1,595	0.3
1388B	Terril loam, moderately wet, 2 to 6 percent slopes-----	1,802	0.3
1389	Havelock silt loam, 0 to 2 percent slopes, frequently flooded-----	1,556	0.2
1390	Leen silty clay loam, 0 to 2 percent slopes-----	12,058	1.9
1392B	Grogan silt loam, moderately wet, 1 to 4 percent slopes-----	365	*
1802	Calcousta-Okoboji complex, depressional, 0 to 1 percent slopes-----	2,972	0.5
1833	Coland clay loam, 0 to 2 percent slopes, occasionally flooded-----	1,439	0.2
1834	Coland clay loam, 0 to 2 percent slopes, frequently flooded-----	330	*
1845A	Estherville loam, 0 to 2 percent slopes-----	1,219	0.2
1845B	Estherville loam, 2 to 6 percent slopes-----	2,360	0.4
1900	Okoboji-Canisteco complex, depressional, 0 to 1 percent slopes-----	15,917	2.5
1917	Nishna silty clay loam, 0 to 1 percent slopes, frequently flooded-----	436	*
1958	Danube silty clay, 0 to 2 percent slopes-----	3,092	0.5
1999	Minneiska-Rushriver complex, 0 to 2 percent slopes, frequently flooded-----	1,343	0.2
	Water-----	2,200	0.3
	Total-----	632,100	100.0

* Less than 0.1 percent.

Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each series description is followed by descriptions of the detailed soil map units associated with the series.

Characteristics of the soil and the material in which it formed are identified for each soil 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" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). 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 on the detailed maps in Part III of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given in Part II of this survey.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus

they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes 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 if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit. The principal hazards and limitations to be considered in planning for specific uses are described in Part II of this survey.

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 layers, 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 layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the

basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Dickman sandy loam, 2 to 6 percent slopes, is a phase of the Dickman series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or undifferentiated groups.

A *complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits, gravel, component in the map unit Pits, gravel-Udipsamments complex is an example.

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of this survey 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 or miscellaneous areas.

Amiret Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 5 percent

Taxonomic class: Fine-loamy, mixed, mesic Calcic
Hapludolls

Typical Pedon

Amiret loam, in an area of Amiret-Swanlake-Hawick complex, 2 to 6 percent slopes, 175 feet north and

2,000 feet east of the southwest corner of sec. 13, T. 114 N., R. 37 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common fine roots; 4 percent gravel; neutral; abrupt smooth boundary.

A—7 to 12 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common fine roots; 4 percent gravel; neutral; clear smooth boundary.

Bw—12 to 20 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; common fine roots; 2 percent gravel; neutral; clear smooth boundary.

Bk1—20 to 30 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few fine roots; carbonates segregated in common light gray (10YR 7/2) rounded fine soft masses; 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—30 to 50 inches; olive brown (2.5Y 4/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; few fine roots; few strong brown (7.5YR 5/6) iron concentrations on ped exteriors; carbonates segregated in common light gray (10YR 7/2) rounded fine soft masses; 6 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—50 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; few strong brown (7.5YR 5/6) iron stains on ped exteriors; few fine black (10YR 2/1) manganese accumulations in ped interiors; carbonates segregated in few light gray (10YR 7/2) rounded fine soft masses; 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 36 inches

Thickness of the mollic epipedon: 7 to 20 inches

Content of rock fragments: 2 to 8 percent gravel throughout the profile

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5
 Chroma—3 or 4
 Texture—loam or clay loam

Bk horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—3 or 4
 Texture—loam or clay loam

C horizon:

Hue—2.5Y or 10YR
 Value—4 to 6
 Chroma—2 to 4
 Texture—loam or clay loam

1355B—Amiret-Swanlake complex, 2 to 6 percent slopes

Composition

Amiret and similar soils: About 70 percent
 Swanlake and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Amiret—summits and back slopes; Swanlake—shoulders and summits
Slope range: Amiret—2 to 5 percent; Swanlake—4 to 6 percent

Component Description

Amiret

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

Swanlake

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1370B—Amiret loam, 2 to 5 percent slopes

Composition

Amiret and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and back slopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning

these uses, see Part II of this publication:

- Agronomy section

1386B—Amiret-Swanlake-Hawick complex, 2 to 6 percent slopes

Composition

Amiret and similar soils: About 40 percent

Swanlake and similar soils: About 30 percent

Hawick and similar soils: About 15 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Amiret—summits and back slopes; Swanlake and Hawick—shoulders and summits

Slope range: Amiret—2 to 5 percent; Swanlake—4 to 6 percent; Hawick—2 to 6 percent

Component Description

Amiret

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

Swanlake

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

Hawick

Surface layer texture: Coarse sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Excessively drained

Dominant parent material: Outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 3.3 inches (low)

Organic matter content in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Arkton Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Dense till

Slope range: 4 to 6 percent

Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Arkton clay loam, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 1,700 feet west and 550 feet south of the northeast corner of sec. 12, T. 117 N., R. 31 W., in Meeker County:

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 25 inches; light olive brown (2.5Y 5/4) clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine soft white (10YR 8/2) calcium carbonate concentrations distributed uniformly throughout the horizon; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk2—25 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse prismatic structure parting to moderate fine angular blocky; firm; common coarse distinct light brownish gray (2.5Y 6/2) iron

depletions; common fine soft white (10YR 8/2) calcium carbonate concentrations distributed uniformly throughout the horizon; few dark yellowish brown (10YR 4/6) iron concentrations in ped interiors; few black (10YR 2/1) manganese concentrations; about 1 percent gravel; about 4 percent cobbles; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 12 inches

Other features: Some pedons have a C horizon.

Ap horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—clay loam

Content of gravel—1 to 2 percent

Content of cobbles and stones—0 to 4 percent

Bk horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay, silty clay, or clay loam

Content of gravel—2 to 5 percent

Content of cobbles and stones—1 to 4 percent

Bechyn Series

Depth class: Shallow

Drainage class: Somewhat excessively drained

Permeability: Moderate

Landform: Terraces

Parent material: Alluvium over bedrock

Slope range: 0 to 40 percent

Taxonomic class: Loamy, mixed, mesic Lithic Hapludolls

Typical Pedon

Bechyn loam, in an area of Bechyn-Rock outcrop complex, 0 to 40 percent slopes, 2,600 feet south and 800 feet east of the northwest corner of sec. 18, T. 113 N., R. 35 W.

A—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; common fine roots; 4 percent gravel; neutral; clear wavy boundary.

Bw—9 to 15 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; few fine roots; 8 percent gravel; neutral; abrupt wavy boundary.

2R—15 inches; granitic gneiss.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches

Depth to bedrock: 12 to 20 inches

Content of rock fragments: 0 to 10 percent gravel throughout the profile

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Bw horizon:

Hue—10YR or 7.5YR

Value—3 or 4

Chroma—1 to 4

Texture—loam, fine sandy loam, or sandy loam

1261B—Bechyn loam, 2 to 6 percent slopes

Composition

Bechyn and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Terraces

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: 8 to 20 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Alluvium over bedrock

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)

Organic matter content in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cedarrock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1270D—Bechyn-Rock outcrop complex, 0 to 40 percent slopes

Composition

Bechyn and similar soils: About 65 percent
 Rock outcrop: About 25 percent
 Inclusions: About 10 percent

Setting

Landform: Terraces
Slope range: 0 to 40 percent

Component Description

Bechyn

Surface layer texture: Loam
Depth to bedrock: 8 to 20 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Alluvium over bedrock
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 3.1 inches (low)
Organic matter content in the surface layer: About 3.5 percent (moderate)

Rock outcrop

Type of bedrock: Unweathered granite
Flooding: None
Depth to the water table: More than 6 feet

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cedarrock and similar soils
- Delft and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Biscay Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part and rapid in the lower part

Landform: Outwash plains
Parent material: Glacial outwash
Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Endoaquolls

Typical Pedon

Biscay loam, 0 to 2 percent slopes, 1,750 feet north and 200 feet west of the southeast corner of sec. 27, T. 112 N., R. 33 W.

Ap—0 to 8 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; few fine roots; 1 percent gravel; slightly acid; clear smooth boundary.

A—8 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; 1 percent gravel; slightly acid; clear smooth boundary.

Bg—17 to 24 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; weak medium subangular blocky structure; friable; few fine prominent strong brown (7.5YR 5/6) iron concentrations; few fine roots; 2 percent gravel; neutral; clear smooth boundary.

2BCg—24 to 33 inches; dark grayish brown (2.5Y 4/2) sand; single grain; loose; few fine faint grayish brown (2.5Y 5/2) iron depletions and few fine prominent strong brown (7.5YR 4/6) iron concentrations; 7 percent gravel; neutral; gradual smooth boundary.

2Cg—33 to 60 inches; grayish brown (2.5Y 5/2) coarse sand; single grain; loose; 14 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 50 inches
Thickness of the mollic epipedon: 16 to 24 inches
Thickness of the loamy mantle: 20 to 40 inches

Ap horizon:

Hue—10YR or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—loam
 Content of rock fragments—0 to 2 percent gravel

A horizon:

Hue—10YR or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—loam or clay loam
 Content of rock fragments—0 to 2 percent gravel

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—1 to 3

Texture—sandy clay loam, loam, or clay loam
Content of rock fragments—0 to 2 percent gravel

2Cg horizon:

Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—sand, coarse sand, loamy sand, or the
gravelly analogs of these textures
Content of rock fragments—5 to 35 percent gravel

392—Biscay loam, 0 to 2 percent slopes**Composition**

Biscay and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Outwash plains
Position on the landform: Drainageways and flats
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 5.9 inches (low)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Linder and similar soils
- Estherville and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Lake beds
Parent material: Coprogenous earth
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic
Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silt loam, 0 to 1 percent slopes, 1,550 feet south and 200 feet west of the northeast corner of sec. 22, T. 116 N., R. 35 W.

- Ap—0 to 9 inches; black (5Y 2.5/1) mucky silt loam (coprogenous earth), dark gray (5Y 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; 3 percent snail-shell fragments; slightly effervescent; slightly alkaline; clear smooth boundary.
- Cg1—9 to 22 inches; black (5Y 2.5/1) mucky silty clay loam (coprogenous earth), dark gray (5Y 4/1) dry; weak fine subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/6) iron concentrations; 5 percent snail-shell fragments; strongly effervescent; slightly alkaline; clear smooth boundary.
- Cg2—22 to 60 inches; black (5Y 2.5/1) silty clay loam (coprogenous earth), dark gray (5Y 4/1) dry; massive with distinct fine bedding planes; friable; common fine faint olive gray (5Y 4/2) iron depletions; 7 percent snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Content of snail shells: 0 to 10 percent snail-shell fragments throughout the profile
Thickness of the coprogenous sediments: 30 to more than 60 inches

Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—mucky silt loam

Cg horizons:

Hue—10YR, 2.5Y, or 5Y
Value—2 to 4
Chroma—1 or 2
Texture—silty clay loam, silt loam, clay loam, or the mucky analogs of these textures

35—Blue Earth mucky silt loam, 0 to 1 percent slopes

Composition

Blue Earth and similar soils: About 95 percent
Inclusions: About 5 percent

Setting

Landform: Lake beds
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Coprogenous earth
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)
Organic matter content in the surface layer: About 17.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Calco Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Calco silty clay loam, 0 to 2 percent slopes,

occasionally flooded, 2,250 feet north and 500 feet west of the southeast corner of sec. 19, T. 115 N., R. 38 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; many medium roots; strongly effervescent; slightly alkaline; clear smooth boundary.

A1—9 to 14 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine prominent olive brown (2.5Y 4/4) iron concentrations; few fine gypsum crystals; strongly effervescent; slightly alkaline; clear smooth boundary

A2—14 to 40 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine prominent olive brown (2.5Y 4/4) iron concentrations; few fine gypsum crystals; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg—40 to 60 inches; dark gray (5Y 4/1) silty clay loam; massive; friable; few fine prominent brown (7.5YR 4/4) iron concentrations and few fine and medium prominent light brownish gray (2.5Y 6/2) iron depletions; few medium light gray (10YR 7/2) segregated soft masses of carbonates; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 30 to 50 inches

Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

A horizon:

Hue—10YR, 2.5, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam, silt loam, or the mucky analogs of these textures

Cg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 6

Chroma—0 or 1

Texture—silty clay loam, silt loam, or clay loam

85—Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded

Composition

Calco and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Nishna and similar soils
- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

610—Calco silty clay loam, 0 to 1 percent slopes, frequently flooded

Composition

Calco and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flood plains

Position on the landform: Flats and swales

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 12.7 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Rushriver and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1287—Calco silty clay loam, ponded, 0 to 1 percent slopes, frequently flooded

Composition

Calco and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Nishna and similar soils
- Prinsburg and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Calcousta Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Lacustrine deposits over till

Slope range: 0 to 1 percent

Taxonomic class: Fine-silty, mixed (calcareous), mesic
Typic Endoaquolls

Typical Pedon

Calcousta silty clay loam, in an area of Calcousta-Okobojo complex, depressional, 0 to 1 percent slopes, 900 feet south and 475 feet west of the northeast corner of sec. 29, T. 116 N., R. 37 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak medium granular structure; friable; common fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 12 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg1—12 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg2—24 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; carbonates segregated in few fine light gray (2.5Y 7/2) soft masses; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg—33 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; common medium prominent strong brown (7.5YR 5/6) iron concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 8 to 18 inches

Other features: Some pedons have a Bkg horizon.

Ap and A horizons:

Hue—10YR 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 loam or silt loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—silty clay loam or silt loam

1802—Calcousta-Okobojo complex, depressional, 0 to 1 percent slopes

Composition

Calcousta and similar soils: About 50 percent

Okobojo and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Calcousta—moraines; Okobojo—lake plains and moraines

Position on the landform: Calcousta—rims of depressions and flats; Okobojo—depressions

Slope range: 0 to 1 percent

Component Description

Calcousta

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 12.5 inches (high)

Organic matter content in the surface layer: About 9 percent (very high)

Okobojo

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)
Organic matter content in the surface layer: About 14 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Harps and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Canisteo Series

Depth class: Very deep
Drainage class: Very poorly drained and poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Canisteo clay loam, in an area of Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes, 30 feet south and 80 feet east of the northwest corner of sec. 25, T. 114 N., R. 34 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; common fine roots; 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A1—10 to 16 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; few fine roots; 3 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

A2—16 to 21 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; few mixed areas of olive gray (5Y 4/2); weak fine subangular blocky structure; friable; few fine roots; 3 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bkg1—21 to 28 inches; olive gray (5Y 5/2) clay loam; weak medium subangular blocky structure; friable; few fine prominent strong brown (7.5Y 4/6) iron concentrations; 3 percent gravel; disseminated carbonates; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkg2—28 to 46 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; common medium prominent strong brown (7.5YR 4/6) iron concentrations; 5 percent gravel; carbonates segregated in common light gray (10YR 7/2) fine soft masses; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg—46 to 60 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; common fine faint gray (5Y 5/1) iron depletions and many medium prominent yellowish brown (10YR 5/6) iron concentrations; 4 percent gravel; carbonates segregated in few light gray (10YR 7/2) fine soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 14 to 24 inches

Content of rock fragments: 2 to 8 percent gravel throughout the profile

Ap horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam or silty clay loam

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam, silty clay loam, or loam

ABg horizon (if it occurs):

Hue—10YR, 2.5Y, or 5Y

Value—2 to 5

Chroma—1 or 2

Texture—loam, clay loam, or silty clay loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

Cg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—loam or clay loam

86—Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Rims of depressions and flats
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Okobojo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

817—Canisteo-Seaforth complex, 0 to 3 percent slopes

Composition

Canisteo and similar soils: About 60 percent
 Seaforth and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Canisteo—rims of depressions; Seaforth—rises
Slope range: Canisteo—0 to 2 percent; Seaforth—1 to 3 percent

Component Description

Canisteo

Surface layer texture: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches (high)
Organic matter content in the surface layer: About 6 percent (high)

Seaforth

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okobojo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

956—Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 65 percent

Glencoe and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Canisteo—rims of depressions and flats; Glencoe—depressions

Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent

Component Description

Canisteo

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.9 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

Glencoe

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)

Organic matter content in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Harps and similar soils
- Crippin and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cedarrock Series

Depth class: Moderately deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Flood plains

Parent material: Alluvium over bedrock

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed (calcareous), mesic Cumulic Epiaquolls

Typical Pedon

Cedarrock silty clay loam, 0 to 2 percent slopes, frequently flooded, 650 feet south and 500 feet east of the northwest corner of sec. 17, T. 114 N., R. 37 W., in Redwood County:

A1—0 to 14 inches; black (N 2/0) silty clay loam, black (10YR 2/0) dry; weak fine subangular blocky structure; friable; common fine and medium roots; strongly effervescent; slightly alkaline; clear smooth boundary.

A2—14 to 21 inches; black (N 2/0) clay loam, black (10YR 2/0) dry; weak medium subangular blocky structure; friable; few fine roots; 1 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

A3—21 to 28 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; 2 percent snail-shell fragments; few fine roots; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg—28 to 34 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure; friable; few fine distinct dark yellowish brown (10YR 4/4) iron concentrations; 2 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2R—34 inches; granitic gneiss.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 24 to 40 inches

Depth to bedrock: 20 to 40 inches

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam or clay loam

Bg horizon:

Hue—10YR or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay loam, clay loam, sandy clay loam, or loam

1267—Cedarrock silty clay loam, 0 to 2 percent slopes, frequently flooded

Composition

Cedarrock and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats and swales

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: 24 to 40 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium over bedrock

Flooding: Frequent

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)

Organic matter content in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils
- Nishna and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Chetomba Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines and lake plains

Parent material: Lacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, mixed, mesic Typic Endoaquolls

Typical Pedon

Chetomba silty clay loam, 0 to 2 percent slopes, 2,600 feet south and 900 feet west of the northeast corner

of sec. 19, T. 115 N., R. 36 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A1—8 to 16 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—16 to 23 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

Bg—23 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam; weak medium subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; neutral; clear smooth boundary.

Cg1—31 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—43 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; common fine prominent strong brown (7.5YR 5/8) iron concentrations; few fine dark brown (7.5YR 3/2) manganese concretions; 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

Depth to glacial till: 40 to 60 inches

Ap and A horizons:

Hue—10YR 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 loam or silt loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 4

Texture—silty clay loam or silt loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 4

Texture—clay loam or loam
Content of rock fragments—2 to 8 percent gravel

Slope range: 2 to 18 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

1285—Chetomba silty clay loam, 0 to 2 percent slopes

Composition

Chetomba and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines
Position on the landform: Flats and swales
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: More than 80 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Prinsburg and similar soils
- Crooksford and similar soils
- Okobojo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Clarion Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till

Typical Pedon

Clarion loam, moderately fine substratum, 2 to 5 percent slopes (fig. 8), 1,875 feet south and 575 feet west of the northeast corner of sec. 20, T. 114 N., R. 33 W.

- Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; 2 percent gravel; moderately acid; abrupt smooth boundary.
- A—7 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; 2 percent gravel; moderately acid; clear smooth boundary.
- Bw1—13 to 17 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; 3 percent gravel; neutral; gradual smooth boundary.
- Bw2—17 to 25 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; 4 percent gravel; neutral; gradual smooth boundary.
- C1—25 to 34 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 4 percent gravel; carbonates segregated in few medium soft white (10YR 8/2) masses; strongly effervescent; moderately alkaline; gradual smooth boundary.
- C2—34 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct grayish brown (10YR 5/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; 8 percent gravel; carbonates segregated in few medium soft white (10YR 8/2) masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 50 inches
Thickness of the mollic epipedon: 10 to 22 inches
Content of rock fragments: 2 to 8 percent gravel throughout the profile

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 clay 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 clay loam

102B—Clarion loam, moderately fine substratum, 2 to 5 percent slopes

Composition

Clarion and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and back slopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

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

Composition

Clarion and similar soils: About 70 percent
 Swanlake and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Clarion—summits and back slopes; Swanlake—shoulders and summits
Slope range: Clarion—2 to 5 percent; Swanlake—4 to 6 percent

Component Description

Clarion

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Organic matter content in the surface layer: About 4.5 percent (high)

Swanlake

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

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

Composition

Clarion and similar soils: About 50 percent
 Storden and similar soils: About 20 percent
 Hawick and similar soils: About 15 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Clarion—summits and back slopes; Storden and Hawick—shoulders and summits

Slope range: Clarion—2 to 5 percent; Storden—4 to 6 percent; Hawick—2 to 6 percent

Component Description

Clarion

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)

Organic matter content in the surface layer: About 4.5 percent (high)

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 2.9 inches (very low)

Organic matter content in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Coland Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate or moderately rapid

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Coland clay loam, 0 to 2 percent slopes, occasionally flooded, 300 feet south and 750 feet west of the northeast corner of sec. 35, T. 115 N., R. 37 W.

A1—0 to 18 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

A2—18 to 23 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

A3—23 to 39 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

A4—39 to 54 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Cg—54 to 60 inches; black (5Y 2.5/1) clay loam, very dark gray (5Y 3/1) dry; massive; friable; neutral.

Range in Characteristics

Depth to carbonates: 48 inches or more

Thickness of the mollic epipedon: 36 inches or more

Other features: Some pedons have an AC horizon.

A horizon:

Hue—10YR or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—clay loam or loam

Cg horizon:

Hue—2.5Y, 5Y, or neutral
 Value—2 to 5
 Chroma—0 to 2
 Texture—clay loam or loam; thin strata ranging from silty clay to loamy sand

1833—Coland clay loam, 0 to 2 percent slopes, occasionally flooded

Composition

Coland and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Flood plains
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Occasional
Depth to the water table: 1 to 3 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 12.1 inches (high)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils
- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1834—Coland clay loam, 0 to 2 percent slopes, frequently flooded

Composition

Coland and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Flood plains
Position on the landform: Flats and swales
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Depth to the water table: 1 to 3 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils
- Biscay and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cordova Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Cordova clay loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 200 feet

south and 2,300 feet west of the northeast corner of sec. 11, T. 115 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; firm; 2 percent gravel; slightly acid; abrupt smooth boundary.

A1—8 to 12 inches; black (10YR 2/1) clay loam, dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; 3 percent gravel; slightly acid; clear smooth boundary.

A2—12 to 22 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; 2 percent gravel; neutral; clear smooth boundary.

Btg1—22 to 31 inches; olive gray (5Y 4/2) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine prominent yellowish brown (10YR 5/8) iron concentrations; few distinct very dark gray (10YR 3/1) clay films on faces of peds; 3 percent gravel; neutral; clear wavy boundary.

Btg2—31 to 39 inches; olive gray (5Y 4/2) clay loam; weak coarse prismatic structure; firm; common fine prominent yellowish brown (10YR 5/8) iron concentrations; few distinct very dark gray (10YR 3/1) clay films on faces of peds; 4 percent gravel; neutral; gradual wavy boundary.

Cg—39 to 60 inches; olive gray (5Y 5/2) loam; massive; friable; common fine prominent yellowish brown (10YR 5/6) and few fine prominent dark brown (7.5YR 4/4) iron concentrations; 5 percent gravel; carbonates segregated in few light gray (2.5Y 7/2) fine soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches

Thickness of the mollic epipedon: 10 to 24 inches

Content of rock fragments: 2 to 6 percent gravel throughout the profile

Ap horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—clay loam or loam

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or silty clay loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

978—Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes

Composition

Cordova and similar soils: About 60 percent

Rolfe and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Cordova—drainageways and flats; Rolfe—depressions

Slope range: Cordova—0 to 2 percent; Rolfe—0 to 1 percent

Component Description

Cordova

Surface layer texture: Clay loam

Depth to bedrock: More than 80 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

Rolfe

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Coriff Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid in the upper part; moderate in the lower part

Landform: Outwash plains

Parent material: Glacial outwash over till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Coriff loam, in an area of Coriff-Fieldon complex, 0 to 2 percent slopes, 300 feet north and 2,100 feet west of the southeast corner of sec. 17, T. 118 N., R. 33 W., in Kandiyohi County:

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; clear wavy boundary.

Bg1—18 to 24 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg2—24 to 33 inches; light olive gray (5Y 6/2) loamy fine sand; weak medium subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/4) iron concentrations;

slightly effervescent; slightly alkaline; abrupt smooth boundary.

2Cg—33 to 60 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common medium distinct yellowish brown (10YR 5/4) iron concentrations; 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 12 to 22 inches

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—0 to 10 percent gravel

Bg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, loamy fine sand, or sand

Content of rock fragments—0 to 10 percent gravel

2Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—2 to 8 percent gravel

810—Coriff-Fieldon complex, 0 to 2 percent slopes

Composition

Coriff and similar soils: About 50 percent

Fieldon and similar soils: About 45 percent

Inclusions: About 5 percent

Setting

Landform: Coriff—outwash plains; Fieldon—outwash plains and terraces

Position on the landform: Coriff—flats and slight rises; Fieldon—rims of depressions and flats

Slope range: 0 to 2 percent

Component Description

Coriff

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.9 inches (high)

Organic matter content in the surface layer: About 8 percent (very high)

Fieldon

Surface layer texture: Fine sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 6.3 inches (moderate)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hanska and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Corvuso Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine, mesic Typic Calciaquolls

Typical Pedon

Corvuso clay loam, in an area of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes, 2,200 feet west and 50 feet south of the northeast corner of sec. 34, T. 117 N., R. 32 W., in Meeker County:

Ap—0 to 8 inches; black (N 2/0) clay loam, black (N 2/0) dry; weak fine angular blocky structure; friable; about 1 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak—8 to 11 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; carbonates disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg1—11 to 15 inches; gray (5Y 5/1) clay; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; common threads and masses of calcium carbonate disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg2—15 to 28 inches; olive gray (5Y 5/2) clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; common threads and masses of calcium carbonate disseminated throughout; 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2BCg—28 to 60 inches; olive gray (5Y 5/2) clay loam; weak medium prismatic structure parting to weak fine angular blocky; very firm; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; few threads and masses of calcium carbonate; 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 10 to 20 inches

Ap horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—clay loam

Content of rock fragments—0 to 1 percent gravel

Ak horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—clay loam, silty clay loam, or silty clay

Content of rock fragments—0 to 1 percent gravel

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay, clay loam, silty clay loam, or silty clay

Content of rock fragments—0 to 5 percent gravel

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6
 Chroma—1 or 2
 Texture—clay loam, silty clay, or clay
 Content of rock fragments—1 to 8 percent gravel

1169—Corvuso-Lura, depressional, complex, 0 to 2 percent slopes

Composition

Corvuso and similar soils: About 60 percent
 Lura and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Corvuso—rims of depressions and flats; Lura—depressions
Slope range: Corvuso—0 to 2 percent; Lura—0 to 1 percent

Component Description

Corvuso

Surface layer texture: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Organic matter content in the surface layer: About 5.5 percent (high)

Lura

Surface layer texture: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Organic matter content in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Kandiyohi and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cosmos Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Cosmos silty clay, 0 to 2 percent slopes (fig. 9), 125 feet south and 250 feet east of the northwest corner of sec. 14, T. 116 N., R. 32 W.

Ap—0 to 8 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; weak fine angular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—8 to 19 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine and medium angular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

ABg—19 to 23 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak medium angular blocky; firm; few fine roots; neutral; clear smooth boundary.

Bg—23 to 38 inches; olive gray (5Y 4/2) clay; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; few fine roots; few distinct very dark gray (10YR 3/1) pressure faces; neutral; gradual wavy boundary.

2Cg1—38 to 48 inches; olive gray (5Y 5/2) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; common medium prominent dark brown (7.5YR 4/4) iron concentrations; carbonates segregated in few fine light gray (10YR 7/2) soft accumulations; 2 percent gravel; slightly effervescent; slightly

alkaline; gradual wavy boundary.

2Cg2—48 to 60 inches; olive gray (5Y 5/2) silty clay loam; weak coarse subangular blocky structure; friable; common medium prominent strong brown (7.5YR 5/6) iron concentrations; carbonates segregated in few fine light gray (10YR 7/2) soft accumulations; few fine prominent yellowish red (5YR 4/8) iron concentrations; 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

Ap and A horizons:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—silty clay loam or silty clay

Content of rock fragments—0 to 1 percent gravel

ABg horizon:

Hue—10YR or neutral

Value—3

Chroma—0 or 1

Texture—silty clay loam or silty clay

Content of rock fragments—0 to 1 percent gravel

Bg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay loam, silty clay, or clay

Content of rock fragments—0 to 1 percent gravel

2Cg horizon:

Hue—5Y or 2.5Y

Value—5 or 6

Chroma—1 or 2

Texture—clay loam, clay, or silty clay loam

Content of rock fragments—1 to 5 percent gravel

1193—Cosmos silty clay, 0 to 2 percent slopes

Composition

Cosmos and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains

Position on the landform: Drainageways and flats

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corvuso and similar soils
- Kandiyohi and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Crippin Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Crippin loam, moderately fine substratum, 1 to 3 percent slopes, 700 feet south and 900 feet west of the northeast corner of sec. 26, T. 116 N., R. 31 W.

Ap—0 to 7 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—7 to 10 inches; black (N 2/0) loam, black (10YR 2/1) dry; moderate medium subangular blocky structure; friable; few fine roots; 2 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

BA—10 to 16 inches; mixed dark gray (10YR 4/1) and very dark gray (10YR 3/1) loam; weak medium subangular blocky structure; friable; 4 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bw—16 to 26 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; 4 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk—26 to 35 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 5/6) iron concentrations and few fine distinct grayish brown (2.5Y 5/2) iron depletions; carbonates segregated in common light gray (10YR 7/2) medium soft masses; 6 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine and medium prominent reddish yellow (7.5YR 6/6) iron concentrations and common fine distinct grayish brown (2.5Y 5/2) iron depletions; carbonates segregated in few light gray (10YR 7/2) fine and medium soft masses; 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 12 to 24 inches

Content of rock fragments: 2 to 8 percent gravel throughout the profile

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 clay loam

BA horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—1

Texture—loam or clay loam

Bw and Bk horizons:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

118—Crippin loam, moderately fine substratum, 1 to 3 percent slopes

Composition

Crippin and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Crooksford Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Lake plains and moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 1 to 5 percent

Taxonomic class: Fine-silty, mixed, mesic Calcic Hapludolls

Typical Pedon

Crooksford silt loam, 3 to 5 percent slopes, 450 feet north and 200 feet east of the southwest corner of sec. 20, T. 115 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—8 to 15 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

BA—15 to 21 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine roots; neutral; clear smooth boundary.

Bw—21 to 27 inches; brown (10YR 4/3) silt loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; neutral; gradual smooth boundary.

2Bk1—27 to 33 inches; light olive brown (2.5Y 5/4) loam; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; few fine roots; 2 percent gravel; carbonates segregated in common light gray (10YR 7/2) fine soft masses; strongly effervescent; moderately alkaline; clear smooth boundary.

2Bk2—33 to 43 inches; light olive brown (2.5Y 5/4) loam; massive; friable; many medium distinct grayish brown (2.5Y 5/2) iron depletions and few fine and medium distinct yellowish brown (10YR 5/6) iron concentrations; 8 percent gravel; carbonates segregated in common light gray (10YR 7/2) fine and medium soft masses; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C—43 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions and common fine distinct yellowish brown (10YR 5/6) iron concentrations; 6 percent gravel; carbonates segregated in few light gray (10YR 7/2) medium and coarse soft masses; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 28 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the silt mantle: 15 to 30 inches

Other features: Some pedons have a 2Bw horizon.

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

BA horizon:

Hue—10YR

Value—3 or 4

Chroma—2 or 3

Texture—silt loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—silt loam

2Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—1 to 8 percent gravel

2C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—1 to 8 percent gravel

1369A—Crooksford silt loam, 1 to 3 percent slopes

Composition

Crooksford and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 80 inches

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 12.0 inches (high)

Organic matter content in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1369B—Crooksford silt loam, 3 to 5 percent slopes

Composition

Crooksford and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Rises

Slope range: 3 to 5 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 80 inches

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Organic matter content in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1371B—Crooksford-Swanlake complex, 3 to 6 percent slopes

Composition

Crooksford and similar soils: About 60 percent
Swanlake and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Rises

Slope range: Crooksford—3 to 5 percent; Swanlake—4 to 6 percent

Component Description

Crooksford

Surface layer texture: Silt loam

Depth to bedrock: More than 80 inches

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)

Organic matter content in the surface layer: About 5 percent (high)

Swanlake

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Webster and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Danube Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow to moderate in the upper part; moderately rapid or rapid in the lower part

Landform: Outwash plains

Parent material: Alluvium over glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Coarse-silty over sandy or sandy-skeletal, mesic Typic Calciaquolls

Typical Pedon

Danube silty clay, 0 to 2 percent slopes, 1,600 feet north and 2,150 feet west of the southeast corner of sec. 29, T. 116 N., R. 36 W.

Apk—0 to 9 inches; black (N 2/0) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; few fine roots; disseminated carbonates; violently effervescent; slightly alkaline; clear smooth boundary.

Ak—9 to 19 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; few fine roots; disseminated carbonates; violently effervescent; slightly alkaline; abrupt smooth boundary.

Bg—19 to 31 inches; grayish brown (2.5Y 5/2) silt loam; weak medium platy structure parting to weak fine subangular blocky; friable; many fine prominent yellowish brown (10YR 5/6) iron concentrations; few fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2BCg—31 to 35 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak coarse subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; 4 percent

gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg—35 to 60 inches; dark grayish brown (2.5Y 4/2) loamy sand; single grain; loose; common fine prominent yellowish brown (10YR 5/6) iron concentrations; 12 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 10 to 24 inches

Depth to sand and gravel: 20 to 40 inches

Apk and Ak horizons:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

Bg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—silt loam or silty clay loam

2BCg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—0 to 10 percent gravel

2Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—loamy sand, sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent gravel

1958—Danube silty clay, 0 to 2 percent slopes

Composition

Danube and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains

Position on the landform: Flats and slight rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium over glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 7.3 inches (moderate)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Wadena and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Delft Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow or moderate

Landform: Moraines

Parent material: Colluvium over till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Delft loam, 1 to 3 percent slopes, 1,320 feet south and 2,270 feet west of the northeast corner of sec. 17, T. 113 N., R. 34 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 1 percent gravel; neutral; abrupt smooth boundary.

A1—10 to 19 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

A2—19 to 26 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; 2 percent gravel; neutral; gradual smooth boundary.

AB—26 to 30 inches; mixed very dark gray (10YR 3/1)

and dark grayish brown (2.5Y 4/2) clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; few faint black (10YR 2/1) organic coatings on faces of peds; 1 percent gravel; neutral; clear smooth boundary.

Bg—30 to 49 inches; dark grayish brown (2.5Y 4/2) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine prominent yellowish brown (10YR 5/8) iron concentrations; common faint very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; 3 percent gravel; neutral; gradual smooth boundary.

Cg—49 to 60 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common medium prominent yellowish brown (10YR 5/8) iron concentrations; common black (10YR 2/1) manganese concentrations in ped interiors; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 60 inches

Thickness of the mollic epipedon: 24 to 60 inches

Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Content of rock fragments—1 to 5 percent gravel

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or clay loam

Content of rock fragments—1 to 5 percent gravel

AB horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—1 to 5 percent gravel

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

Content of rock fragments—1 to 5 percent gravel

Cg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—1 to 10 percent gravel

336—Delft loam, 1 to 3 percent slopes**Composition**

Delft and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Drainageways

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: 1 to 3 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Webster and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dickinson Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid in the upper part; rapid in the lower part

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickinson loam, 0 to 2 percent slopes, 150 feet north

and 125 feet west of the southeast corner of sec. 7, T. 116 N., R. 37 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common fine roots; neutral; abrupt smooth boundary.

A—8 to 17 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

Bw1—17 to 23 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Bw2—23 to 32 inches; brown (10YR 4/3) fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

2BC—32 to 38 inches; brown (10YR 5/3) loamy fine sand; weak coarse subangular blocky structure; very friable; neutral; clear smooth boundary.

2C—38 to 60 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches

Thickness of the loamy mantle: 20 to 40 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 to 3

Texture—loam or fine sandy loam

Bw horizon:

Hue—10YR

Value—3 or 4

Chroma—2 or 3

Texture—fine sandy loam or sandy loam

2BC or 2C horizon:

Hue—10YR

Value—4 or 5

Chroma—3 to 6

Texture—loamy fine sand, loamy sand, fine sand, or sand

27A—Dickinson loam, 0 to 2 percent slopes**Composition**

Dickinson and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 5.5 inches (low)
Organic matter content in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hanska and similar soils
- Lemond and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

27B—Dickinson loam, 2 to 6 percent slopes**Composition**

Dickinson and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Dominant parent material: Glacial outwash
Flooding: None

Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 4.8 inches (low)
Organic matter content in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hanska and similar soils
- Lemond and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dickman Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 12 percent
Taxonomic class: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickman sandy loam, 0 to 2 percent slopes (fig. 10), 2,510 feet east and 1,115 feet south of the northwest corner of sec. 21, T. 113 N., R. 35 W.

- Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; friable; moderately acid; abrupt smooth boundary.
- A—10 to 14 inches; mixed black (10YR 2/1) and dark grayish brown (10YR 4/2) sandy loam; weak medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.
- Bw1—14 to 20 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; neutral; gradual wavy boundary.
- 2Bw2—20 to 33 inches; brown (10YR 4/3) fine sand; single grain; loose; neutral; gradual wavy boundary.
- 2C—33 to 60 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; neutral.

Range in Characteristics

- Depth to carbonates:* 30 inches or more
- Thickness of the mollic epipedon:* 10 to 20 inches
- Thickness of the loamy mantle:* 10 to 20 inches
- Ap horizon:*
 - Hue—10YR
 - Value—2 or 3
 - Chroma—1 or 2
 - Texture—sandy loam
 - Content of rock fragments—0 to 10 percent gravel
- A horizon:*
 - Hue—10YR
 - Value—2 to 4
 - Chroma—1 or 2
 - Texture—sandy loam or fine sandy loam
 - Content of rock fragments—0 to 10 percent gravel
- Bw horizon:*
 - Hue—10YR or 7.5YR
 - Value—3 or 4
 - Chroma—3 or 4
 - Texture—sandy loam or fine sandy loam
 - Content of rock fragments—0 to 10 percent gravel
- 2Bw horizon:*
 - Hue—10YR, 7.5YR, or 2.5Y
 - Value—4 to 6
 - Chroma—2 to 4
 - Texture—fine sand, sand, loamy sand, or loamy fine sand
 - Content of rock fragments—0 to 15 percent gravel
- 2C horizon:*
 - Hue—10YR, 7.5YR, or 2.5Y
 - Value—4 to 6
 - Chroma—2 to 4
 - Texture—sand, fine sand, or coarse sand
 - Content of rock fragments—0 to 15 percent gravel

327A—Dickman sandy loam, 0 to 2 percent slopes

Composition

Dickman and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Hanska and similar soils
- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

327B—Dickman sandy loam, 2 to 6 percent slopes

Composition

Dickman and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Hanska and similar soils
- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

327C—Dickman sandy loam, 6 to 12 percent slopes

Composition

Dickman and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Surface layer texture: Sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 4.1 inches (low)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hanska and similar soils
- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Du Page Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Du Page loam, 0 to 2 percent slopes, occasionally flooded, 1,900 feet north and 1,500 feet west of the southeast corner of sec. 19, T. 115 N., R. 38 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; slightly effervescent; slightly alkaline; clear smooth boundary.

A—9 to 42 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—42 to 60 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; massive; friable; few dark yellowish brown (10YR 4/4) iron concentrations in pores; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 24 to more than 60 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 to 3

Texture—loam or silt loam

C horizon:

Hue—10YR

Value—3 or 4

Chroma—1 to 4

Texture—loam, sandy loam, or sandy clay loam

574—Du Page loam, 0 to 2 percent slopes, occasionally flooded

Composition

Du Page and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flood plains
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Alluvium
Flooding: Occasional
Depth to the water table: 4 to 6 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils
- Rushriver and similar soils
- Nishna and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Estherville Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 12 percent
Taxonomic class: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Estherville loam, 0 to 2 percent slopes, 150 feet south and 2,475 feet west of the northeast corner of sec. 36, T. 112 N., R. 33 W.

- Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; neutral; abrupt smooth boundary.
- A—8 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; 2 percent gravel; neutral; clear smooth boundary.
- Bw—12 to 17 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; very friable; few fine roots; 10 percent gravel; neutral; clear wavy boundary.
- 2C1—17 to 25 inches; dark yellowish brown (10YR 4/4) gravelly sand; single grain; loose; 24 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
- 2C2—25 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; 18 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Thickness of the mollic epipedon: 7 to 20 inches
Thickness of the loamy mantle: 10 to 20 inches
Other features: Some pedons have a 2BC horizon.

Ap and A horizons:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or sandy loam
Content of rock fragments—0 to 15 percent gravel

Bw horizon:

Hue—10YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam or coarse sandy loam
Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR
Value—4 to 7
Chroma—2 to 6
Texture—coarse sand, sand, or the gravelly analogs of these textures
Content of rock fragments—10 to 35 percent gravel

1845A—Estherville loam, 0 to 2 percent slopes

Composition

Estherville and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1845B—Estherville loam, 2 to 6 percent slopes

Composition

Estherville and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None

Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Fairhaven Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the upper part; rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Fairhaven silt loam, 0 to 2 percent slopes, 2,400 feet north and 325 feet west of the southeast corner of sec. 23, T. 116 N., R. 37 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—9 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

Bw—18 to 33 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; neutral; clear wavy boundary.

2C1—33 to 52 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; 18 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2C2—52 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; common fine distinct dark yellowish brown (10YR 4/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches

Thickness of the mollic epipedon: 10 to 22 inches

Thickness of the upper mantle: 22 to 40 inches

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Bw horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

Texture—silt loam or loam

2C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 5

Texture—gravelly coarse sand, gravelly sand, coarse sand, or sand

Content of rock fragments—0 to 35 percent gravel

156—Fairhaven silt loam, 0 to 2 percent slopes

Composition

Fairhaven and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Flats and slight rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)

Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Hanska and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Fieldon Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid in the upper part; rapid in the lower part

Landform: Outwash plains

Parent material: Glaciolacustrine deposits or glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Fieldon fine sandy loam, in an area of Coriff-Fieldon complex, 0 to 2 percent slopes, 1,350 feet north and 2,400 feet east of the southwest corner of sec. 17, T. 118 N., R. 33 W., in Kandiyohi County:

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—10 to 17 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; strongly effervescent; moderately alkaline; clear wavy boundary.

Bg—17 to 27 inches; grayish brown (2.5Y 5/2) fine sandy loam; weak fine and medium subangular blocky structure; friable; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg—27 to 60 inches; grayish brown (2.5Y 5/2) fine sand; single grain; loose; common medium prominent yellowish brown (10YR 5/6) iron concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

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—fine sandy loam

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—fine sandy loam, very fine sandy loam, or loam

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—fine sandy loam, very fine sandy loam, sandy clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—dominantly fine sand or loamy fine sand; strata of finer textured material in some pedons

Glencoe Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Glencoe clay loam, in an area of Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes, 10 feet south and 550 feet west of the northeast corner of sec. 25, T. 114 N., R. 34 W.

Ap—0 to 10 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak very fine granular structure; friable; common fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

A1—10 to 18 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; 1 percent gravel; neutral; clear smooth boundary.

A2—18 to 26 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate very fine angular blocky structure; friable; 1 percent gravel; neutral; clear smooth boundary.

ABg—26 to 32 inches; black (5Y 2.5/1) clay loam, dark gray (5Y 4/1) dry; few gray (5Y 5/1) channel fillings; moderate very fine angular blocky structure; friable; common fine distinct olive (5Y 5/3) iron concentrations; 2 percent gravel; neutral; clear wavy boundary.

Bg—32 to 42 inches; gray (5Y 5/1) clay loam; moderate very fine subangular blocky structure; friable; common fine distinct olive (5Y 5/3) and common fine prominent brown (7.5YR 4/4) iron concentrations; 3 percent gravel; slightly alkaline; clear wavy boundary.

Cg—42 to 60 inches; olive gray (5Y 5/2) loam; massive; friable; many medium prominent strong brown (7.5Y 4/6) iron concentrations; few strong brown (7.5YR 5/8) iron concentrations; 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Thickness of the mollic epipedon: 24 to 46 inches

Ap and A horizons:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

Content of rock fragments—0 to 5 percent gravel

ABg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 4

Chroma—1 or 2

Texture—clay loam or silty clay loam

Content of rock fragments—0 to 5 percent gravel

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or silty clay loam

Content of rock fragments—0 to 5 percent gravel

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—2 to 8 percent gravel

Grogan Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Outwash plains and terraces

Parent material: Glaciolacustrine deposits

Slope range: 1 to 15 percent

Taxonomic class: Coarse-silty, mixed, mesic Typic Hapludolls

Typical Pedon

Grogan silt loam, moderately wet, 1 to 4 percent slopes, 200 feet south and 100 feet west of the northeast corner of sec. 28, T. 113 N., R. 35 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

AB—9 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; few very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; neutral; gradual wavy boundary.

Bw1—15 to 29 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

Bw2—29 to 38 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—38 to 60 inches; massive; friable; stratified, light olive brown (2.5Y 5/4) very fine sandy loam and silt loam; common fine prominent light brownish gray (10YR 6/2) iron depletions; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 10 to 18 inches

Other features: Some pedons have a Bk horizon.

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—silt loam

AB horizon:

Hue—10YR

Value—3

Chroma—2 or 3

Texture—silt loam

Bw horizon:

Hue—10YR

Value—4 or 5

Chroma—3 to 5

Texture—silt loam, loam, or very fine sandy loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 to 6

Texture—stratified very fine sandy loam, loamy very fine sand, or silt loam

128C2—Grogan silt loam, 6 to 15 percent slopes, eroded

Composition

Grogan and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Summits and back slopes

Slope range: 6 to 15 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils
- Terril and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1392B—Grogan silt loam, moderately wet, 1 to 4 percent slopes

Composition

Grogan and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Flats and slight rises
Slope range: 1 to 4 percent

Component Description

Surface layer texture: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Bechyn and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hanlon Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate or moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope range: 1 to 3 percent
Taxonomic class: Coarse-loamy, mixed, mesic Aquic Cumulic Hapludolls

Typical Pedon

Hanlon loam, 1 to 3 percent slopes, rarely flooded,

1,500 feet north and 1,000 feet west of the southeast corner of sec. 8, T. 115 N., R. 38 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common fine roots; neutral; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

A2—14 to 26 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; few fine roots; slightly alkaline; clear smooth boundary.

A3—26 to 34 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; slightly effervescent; slightly alkaline; gradual smooth boundary.

Bw1—34 to 48 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; 2 percent gravel; very few fine light gray (10YR 7/2) streaks of carbonates in root channels; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bw2—48 to 60 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak coarse subangular blocky structure; very friable; 2 percent gravel; very few fine light gray (10YR 7/2) streaks of carbonates in root channels; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches

Thickness of the mollic epipedon: 40 to more than 60 inches

Other features: Some pedons have a C horizon.

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 fine sandy loam

Bw horizon:

Hue—10YR
Value—3 or 4
Chroma—1 or 2

Texture—fine sandy loam or sandy loam

1268—Hanlon loam, 1 to 3 percent slopes, rarely flooded

Composition

Hanlon and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Slight rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Alluvium

Flooding: Rare

Depth to the water table: 3 to 5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.2 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Coland and similar soils
- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Hanska Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid in the upper part; rapid in the lower part

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Hanska loam, 0 to 2 percent slopes, 2,400 feet south and 2,500 feet west of the northeast corner of sec. 23, T. 113 N., R. 35 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A1—7 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.

A2—11 to 17 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; few fine prominent dark brown (7.5YR 3/4) iron concentrations; neutral; clear smooth boundary.

Bg1—17 to 21 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure; friable; few fine prominent strong brown (7.5YR 4/6) iron concentrations; neutral; gradual smooth boundary.

Bg2—21 to 26 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; neutral; gradual wavy boundary.

2Bg3—26 to 31 inches; olive gray (5Y 5/2) loamy sand; weak coarse subangular blocky structure; very friable; few medium distinct light olive brown (2.5Y 5/4) iron concentrations; neutral; gradual wavy boundary.

2Cg—31 to 60 inches; olive gray (5Y 5/2) sand; single grain; loose; 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 55 inches

Thickness of the mollic epipedon: 12 to 24 inches

Thickness of the loamy mantle: 20 to 40 inches

Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam or sandy loam

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—loam or sandy loam

2Bg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—2
 Texture—loamy sand or loamy coarse sand

2Cg horizon:

Hue—2.5Y or 5Y
 Value—3 to 6
 Chroma—2 to 4
 Texture—sand or coarse sand
 Content of rock fragments—0 to 10 percent gravel

282—Hanska loam, 0 to 2 percent slopes**Composition**

Hanska and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains
Position on the landform: Drainageways and flats
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches (moderate)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Harps Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mesic Typic Calciaquolls

Typical Pedon

Harps clay loam, 0 to 2 percent slopes (fig. 11), 1,625 feet south and 1,725 feet east of the northwest corner of sec. 12, T. 113 N., R. 32 W.

Apk—0 to 7 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; friable; 2 percent gravel; disseminated carbonates; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ak—7 to 13 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; friable; 2 percent gravel; disseminated carbonates; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg1—13 to 21 inches; gray (5Y 5/1) clay loam; weak medium subangular blocky structure; friable; 2 percent gravel; carbonates segregated in common white (10YR 8/1) medium and coarse soft masses; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—21 to 30 inches; olive gray (5Y 5/2) clay loam; weak medium subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/6) iron concentrations; 3 percent gravel; carbonates segregated in few white (10YR 8/1) medium soft masses; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg—30 to 60 inches; olive gray (5Y 5/2) loam; massive; friable; many medium prominent yellowish brown (10YR 5/6) iron concentrations; 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 12 to 24 inches
Content of rock fragments: 1 to 5 percent gravel throughout the profile

Apk and Ak horizons:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam or loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—clay loam or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—loam or clay loam

112—Harps clay loam, 0 to 2 percent slopes***Composition***

Harps and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Rims of depressions*Slope range:* 0 to 2 percent***Component Description****Surface layer texture:* Clay loam*Depth to bedrock:* More than 60 inches*Drainage class:* Poorly drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* 0.5 foot to 1.5 feet*Kind of water table:* Apparent*Available water capacity to 60 inches or root-limiting layer:* About 10.6 inches (high)*Organic matter content in the surface layer:* About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning

these uses, see Part II of this publication:

- Agronomy section

899—Harps-Okoboji, depressional, complex, 0 to 2 percent slopes***Composition***

Harps and similar soils: About 60 percent

Okoboji and similar soils: About 30 percent

Inclusions: About 10 percent

Setting*Landform:* Moraines*Position on the landform:* Harps—rims of depressions;
Okoboji—depressions*Slope range:* Harps—0 to 2 percent; Okoboji—0 to 1 percent***Component Description*****Harps***Surface layer texture:* Clay loam*Depth to bedrock:* More than 60 inches*Drainage class:* Poorly drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* 0.5 foot to 1.5 feet*Kind of water table:* Apparent*Available water capacity to 60 inches or root-limiting layer:* About 10.4 inches (high)*Organic matter content in the surface layer:* About 4 percent (high)**Okoboji***Surface layer texture:* Silty clay loam*Depth to bedrock:* More than 60 inches*Drainage class:* Very poorly drained*Dominant parent material:* Lacustrine deposits over till*Flooding:* None*Seasonal high water table:* 1 foot above to 1 foot below the surface*Kind of water table:* Apparent*Ponding duration:* Very long*Available water capacity to 60 inches or root-limiting layer:* About 11.6 inches (high)*Organic matter content in the surface layer:* About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

927—Harps-Seaforth-Okoboji, depressional, complex, 0 to 3 percent slopes

Composition

Harps and similar soils: About 40 percent
 Seaforth and similar soils: About 30 percent
 Okoboji and similar soils: About 25 percent
 Inclusions: About 5 percent

Setting

Landform: Moraines

Position on the landform: Harps—rims of depressions;
 Seaforth—rises; Okoboji—depressions

Slope range: Harps—0 to 2 percent; Seaforth—1 to 3 percent; Okoboji—0 to 1 percent

Component Description

Harps

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.8 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

Seaforth

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)

Organic matter content in the surface layer: About 4.5 percent (high)

Okoboji

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)

Organic matter content in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Havelock Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Havelock clay loam, 0 to 2 percent slopes, occasionally flooded, 100 feet north and 2,375 feet west of the southeast corner of sec. 9, T. 114 N., R. 37 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; common fine roots; slightly effervescent; slightly alkaline; clear smooth boundary.

A—9 to 23 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg—23 to 35 inches; very dark gray (10YR 3/1) clay

loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; few fine prominent brown (7.5YR 4/4) iron concentrations; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Cg—35 to 60 inches; olive gray (5Y 5/2), stratified loam, clay loam, and silt loam; massive; friable; common medium distinct light olive brown (2.5Y 5/4) and common fine prominent brown or dark brown (7.5YR 4/4) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 36 to 60 inches

Ap and A horizons:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—clay loam or silt loam

Bg horizon:

Hue—10YR or 2.5Y

Value—3

Chroma—1 or 2

Texture—clay loam or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—2

Texture—stratified clay loam, loam, silt loam, or sandy loam

1374—Havelock clay loam, 0 to 2 percent slopes, occasionally flooded

Composition

Havelock and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats and slight rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils
- Rushriver and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1389—Havelock silt loam, 0 to 2 percent slopes, frequently flooded

Composition

Havelock and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats and swales

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.4 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rushriver and similar soils
- Nishna and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hawick Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid or very rapid

Landform: Outwash plains, terraces, and moraines

Parent material: Glacial outwash

Slope range: 2 to 12 percent

Taxonomic class: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Hawick gravelly coarse sandy loam, in an area of Omsrud-Storden-Hawick complex, 6 to 12 percent slopes, eroded, 2,335 feet north and 1,550 feet west of the southeast corner of sec. 22, T. 112 N., R. 33 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) gravelly coarse sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; 30 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

AB—7 to 9 inches; very dark brown (10YR 2/2) and dark grayish brown (10YR 4/2) gravelly loamy coarse sand, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; 30 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bw—9 to 20 inches; dark brown (10YR 4/3) gravelly coarse sand; single grain; loose; 25 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

BC—20 to 28 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grain; loose; 25 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—28 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; 25 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 5 to 35 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—gravelly coarse sandy loam, coarse sandy loam, gravelly sandy loam, or gravelly loam

AB horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—gravelly loamy coarse sand, loamy coarse sand, gravelly loamy sand, or loamy sand

Bw and BC horizons:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—gravelly coarse sand, gravelly loamy coarse sand, gravelly loamy sand, or the nongravelly analogs of these textures

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—gravelly coarse sand, gravelly sand, or the nongravelly analogs of these textures

875C—Hawick-Estherville complex, 6 to 12 percent slopes

Composition

Hawick and similar soils: About 60 percent

Estherville and similar soils: About 25 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 2.8 inches (very low)

Organic matter content in the surface layer: About 2 percent (moderate)

Estherville

Surface layer texture: Sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 4.1 inches (low)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Wadena and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kandiyohi Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine, montmorillonitic, mesic Aquertic Hapludolls

Typical Pedon

Kandiyohi clay, 0 to 2 percent slopes (fig. 12), 900 feet south and 600 feet east of the northwest corner of sec. 15, T. 116 N., R. 32 W.

Ap—0 to 9 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine angular blocky structure; firm; common fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

A—9 to 15 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; weak fine prismatic structure parting to moderate very fine angular blocky; firm; few fine roots; 1 percent gravel; neutral; clear wavy boundary.

Bw—15 to 21 inches; dark grayish brown (2.5Y 4/2) clay; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; common distinct very dark grayish brown (10YR 3/2) pressure faces; 1 percent gravel; slightly alkaline; clear smooth boundary.

2Bk1—21 to 31 inches; light olive brown (2.5Y 5/3) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; common fine faint grayish brown (2.5Y 5/2) iron depletions and few fine prominent yellowish brown (10YR 5/6) iron concentrations; carbonates segregated in common light gray (10YR 7/2) fine soft masses; 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2Bk2—31 to 46 inches; light olive brown (2.5Y 5/3) clay loam; weak medium and coarse subangular blocky structure; firm; common medium and coarse distinct olive gray (5Y 5/2) iron depletions and common fine prominent dark yellowish brown (10YR 4/6) iron concentrations; carbonates segregated in common light gray (10YR 7/2) medium soft masses; 3 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C—46 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; common medium and coarse distinct olive gray (5Y 5/2) iron depletions and common fine and medium distinct dark yellowish brown (10YR 4/6) iron concentrations; carbonates segregated in few light gray (10YR 7/2) fine soft masses; 4 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches

Thickness of the mollic epipedon: 10 to 20 inches

Thickness of the upper mantle: 0 to 40 inches

Ap horizon:

Hue—10YR or 2.5Y

Value—2

Chroma—1 or 2

Texture—silty clay

Content of rock fragments—0 to 1 percent gravel

A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam, silty clay, or clay

Content of rock fragments—0 to 1 percent gravel

Bw horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—silty clay, clay, or silty clay loam

Content of rock fragments—0 to 1 percent gravel

2Bk horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—silty clay loam, clay loam, or clay

Content of rock fragments—1 to 5 percent gravel

2C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—silty clay loam, clay loam, or clay

Content of rock fragments—1 to 5 percent gravel

1162A—Kandiyohi clay, 0 to 2 percent slopes

Composition

Kandiyohi and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Flats and rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay

Depth to bedrock: More than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning

these uses, see Part II of this publication:

- Agronomy section

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: Moraines and lake plains

Parent material: Organic materials over till or glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Loamy, mixed, euic, mesic Terric Medisaprists

Typical Pedon

Klossner muck, depressional, 0 to 1 percent slopes, 500 feet north and 1,550 feet west of the southeast corner of sec. 20, T. 113 N., R. 32 W.

Oap—0 to 8 inches; muck (sapric material), black (N 2/0) rubbed and unrubbed; 25 percent fiber unrubbed, 6 percent rubbed; weak very fine subangular blocky structure; very friable; few fine roots; slightly acid; clear smooth boundary.

Oa—8 to 20 inches; muck (sapric material), black (N 2/0) rubbed and unrubbed; 20 percent fiber unrubbed, 4 percent rubbed; weak very fine subangular blocky structure; very friable; few fine roots; slightly acid; clear smooth boundary.

2A1—20 to 29 inches; black (N 2/0) mucky silty clay loam, black (10YR 2/1) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; few fine roots; neutral; gradual smooth boundary.

2A2—29 to 49 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; few fine prominent strong brown (7.5YR 4/6) iron concentrations; neutral; gradual smooth boundary.

2A3—49 to 60 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; friable; few fine prominent strong brown (7.5YR 4/6) iron concentrations; neutral.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches

Oap and Oa horizons:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—muck

2A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam, silt loam, clay loam, sandy clay loam, loam, or the mucky analogs of these textures

519—Klossner muck, depressional, calcareous, 0 to 1 percent slopes

Composition

Klossner and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 16.8 inches (high)

Organic matter content in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Muskego and similar soils
- Harps and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

539—Klossner muck, depressional, 0 to 1 percent slopes

Composition

Klossner and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 16.7 inches (high)

Organic matter content in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Canisteo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1080—Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes

Composition

Klossner and similar soils: About 30 percent

Okoboji and similar soils: About 30 percent

Glencoe and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Klossner

Surface layer texture: Muck

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 17.8 inches (high)

Organic matter content in the surface layer: About 42.5 percent (very high)

Okoboji

Surface layer texture: Mucky silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Seasonal high water table: 3 feet above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.2 inches (high)

Organic matter content in the surface layer: About 14 percent (very high)

Glencoe

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)

Organic matter content in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Harps and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Leen Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains and moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, frigid Typic Calciaquolls

Typical Pedon

Leen silty clay loam, 0 to 2 percent slopes, 2,575 feet north and 200 feet east of the southwest corner of sec. 20, T. 115 N., R. 36 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate fine subangular blocky structure; friable; common fine roots; strongly effervescent; slightly alkaline; clear smooth boundary.

Ak1—9 to 15 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; disseminated carbonates; violently effervescent; slightly alkaline; gradual smooth boundary.

Ak2—15 to 20 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; few fine roots; disseminated carbonates; violently effervescent; slightly alkaline; gradual smooth boundary.

Bkg—20 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam; weak medium subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/4) iron concentrations; few fine roots; disseminated carbonates; violently effervescent; slightly alkaline; clear smooth boundary.

Cg1—25 to 30 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—30 to 38 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; common fine prominent yellowish brown (10YR 5/6) iron concentrations and few fine faint light brownish gray (2.5Y 6/2) iron depletions; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2Cg3—38 to 60 inches; grayish brown (2.5Y 5/2) loam; massive; friable; many medium distinct light olive brown (2.5Y 5/4) and common medium prominent yellowish brown (10YR 5/6) iron concentrations; 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 8 to 24 inches

Thickness of the silt mantle: 24 to 40 inches

Ap and Ak horizons:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg or Bg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—silty clay loam or silt loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—silt loam or silty clay loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent gravel

1205—Leen-Okoboji, depressional, complex, 0 to 2 percent slopes

Composition

Leen and similar soils: About 60 percent

Okoboji and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Leen—rims of depressions and flats; Okoboji—depressions

Slope range: Leen—0 to 2 percent; Okoboji—0 to 1 percent

Component Description

Leen

Surface layer texture: Silty clay loam

Depth to bedrock: More than 80 inches

Drainage class: Poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

Okoboji

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.4 inches (high)

Organic matter content in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Louris and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1390—Leen silty clay loam, 0 to 2 percent slopes

Composition

Leen and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Flats and swales

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 80 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Louris and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lemond Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid in the upper part; rapid in the lower part

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Lemond loam, 0 to 2 percent slopes, 200 feet north and 400 feet west of the southeast corner of sec. 22, T. 113 N., R. 35 W.

Ap—0 to 8 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common fine and medium roots; strongly

effervescent; slightly alkaline; clear smooth boundary.

A1—8 to 12 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; friable; few fine roots; strongly effervescent; slightly alkaline; clear wavy boundary.

A2—12 to 19 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; clear wavy boundary.

AB—19 to 23 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bg—23 to 34 inches; olive gray (5Y 5/2) sandy loam; weak coarse subangular blocky structure; friable; few fine prominent strong brown (7.5YR 5/6) iron concentrations; few fine roots; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg—34 to 60 inches; pale olive (5Y 6/3) sand; single grain; loose; 6 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 14 to 24 inches

Thickness of the upper mantle: 20 to 40 inches

Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Content of rock fragments—0 to 5 percent gravel

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or sandy loam

Content of rock fragments—0 to 5 percent gravel

AB horizon:

Hue—10YR or 2.5Y

Value—3

Chroma—1 or 2

Texture—sandy loam or loam

Content of rock fragments—0 to 5 percent gravel

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam

Content of rock fragments—0 to 5 percent gravel

2Cg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—2 to 4
 Texture—sand, coarse sand, loamy sand, or loamy coarse sand
 Content of rock fragments—0 to 10 percent gravel

227—Lemond loam, 0 to 2 percent slopes**Composition**

Lemond and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Glacial outwash plains
Position on the landform: Flats and slight rises
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.6 inches (moderate)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Linder Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate or moderately rapid in the upper

part; very rapid in the lower part
Landform: Terraces and outwash plains
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Linder loam, 0 to 2 percent slopes, 60 feet north and 1,060 feet east of the southwest corner of sec. 25, T. 112 N., R. 33 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; friable; few fine roots; 3 percent gravel; neutral; clear smooth boundary.
 A—10 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; 3 percent gravel; neutral; clear smooth boundary.
 Bw—18 to 30 inches; dark brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; common fine distinct dark grayish brown (2.5Y 4/2) iron depletions and dark yellowish brown (10YR 4/6) iron concentrations; few fine roots; 7 percent gravel; neutral; clear wavy boundary.
 2C—30 to 60 inches; grayish brown (2.5Y 5/2) coarse sand; single grain; loose; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; 11 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches
Thickness of the mollic epipedon: 10 to 24 inches
Thickness of the loamy mantle: 20 to 40 inches

Ap horizon:

Hue—10YR
 Value—2
 Chroma—1 or 2
 Texture—loam
 Content of rock fragments—0 to 5 percent gravel

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—loam or sandy loam
 Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—2 or 3
 Texture—sandy loam
 Content of rock fragments—0 to 10 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 6

Texture—sand, coarse sand, gravelly sand, or gravelly coarse sand

Content of rock fragments—5 to 30 percent gravel

247—Linder loam, 0 to 2 percent slopes**Composition**

Linder and similar soils: About 85 percent

Inclusions: About 15 percent

Setting**Landform:** Glacial outwash plains and terraces**Position on the landform:** Flats and slight rises**Slope range:** 0 to 2 percent**Component Description****Surface layer texture:** Loam**Depth to bedrock:** More than 60 inches**Drainage class:** Somewhat poorly drained**Dominant parent material:** Glacial outwash**Flooding:** None**Depth to the water table:** 2 to 4 feet**Kind of water table:** Apparent**Available water capacity to 60 inches or root-limiting layer:** About 6.6 inches (moderate)**Organic matter content in the surface layer:** About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Mayer and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Louris Series**Depth class:** Very deep**Drainage class:** Somewhat poorly drained**Permeability:** Moderate**Landform:** Moraines**Parent material:** Glaciolacustrine deposits over till**Slope range:** 1 to 3 percent**Taxonomic class:** Fine-silty, mixed, mesic Aquic Calciudolls**Typical Pedon**

Louris silt loam, 1 to 3 percent slopes, 2,125 feet north and 250 feet east of the southwest corner of sec. 24, T. 116 N., R. 38 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—8 to 13 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; disseminated carbonates; violently effervescent; slightly alkaline; clear smooth boundary.

Bk—13 to 20 inches; dark grayish brown (2.5Y 4/2) silt loam; weak fine subangular blocky structure; friable; disseminated carbonates; violently effervescent; slightly alkaline; clear smooth boundary.

BC—20 to 27 inches; olive brown (2.5Y 4/4) silt loam; weak medium subangular blocky structure; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

C1—27 to 31 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine distinct grayish brown (2.5Y 5/2) iron depletions; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2C2—31 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine and medium distinct grayish brown (2.5Y 5/2) iron depletions and common fine distinct yellowish brown (10YR 5/6) iron concentrations; 6 percent gravel; carbonates segregated in few white (10YR 8/2) fine and medium soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics**Carbonates:** At the surface**Thickness of the mollic epipedon:** 7 to 16 inches**Thickness of the silt mantle:** 24 to 40 inches**Ap and Ak horizons:**

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 to 3

Texture—silt loam or silty clay loam

BC and C horizons:

Hue—2.5Y

Value—4 or 5

Chroma—4

Texture—silt loam or loam

2C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 to 6

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent gravel

1382—Louris silt loam, 1 to 3 percent slopes

Composition

Louris and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 80 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Leen and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lowlein Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderately rapid in the upper part; moderate in the lower part

Landform: Terraces

Parent material: Glacial outwash over till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Lowlein silt loam, 0 to 2 percent slopes, 2,125 feet north and 2,550 feet east of the southwest corner of sec. 21, T. 113 N., R. 35 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; 1 percent gravel; neutral; abrupt smooth boundary.

A1—7 to 11 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; 1 percent gravel; neutral; clear smooth boundary.

A2—11 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; clear wavy boundary.

Bw—15 to 32 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; clear wavy boundary.

2C—32 to 60 inches; olive brown (2.5Y 4/4) loam; massive; friable; common fine distinct grayish brown (2.5Y 5/2) iron depletions and common fine distinct dark yellowish brown (10YR 4/6) iron concentrations; 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches

Thickness of the mollic epipedon: 10 to 18 inches

Thickness of the upper mantle: 24 to 40 inches

Content of rock fragments: 1 to 10 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam or loam

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—fine sandy loam or sandy loam

2C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

1269—Lowlein silt loam, 0 to 2 percent slopes

Composition

Lowlein and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Hanska and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lura Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Slow in the upper part; moderately slow in the lower part

Landform: Moraines

Parent material: Lacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Lura silty clay, in an area of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes, 2,550 feet south and 350 feet east of the northwest corner of sec. 22, T. 116 N., R. 33 W.

Ap—0 to 9 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate fine angular blocky structure; firm; common fine roots; neutral; abrupt smooth boundary.

A1—9 to 17 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate medium angular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

A2—17 to 28 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate medium angular blocky structure; firm; neutral; gradual smooth boundary.

A3—28 to 43 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; firm; neutral; gradual smooth boundary.

Cg1—43 to 52 inches; olive gray (5Y 5/2) silty clay loam; massive; firm; common fine prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—52 to 60 inches; gray (5Y 5/1) silty clay; massive; firm; many fine prominent olive brown (2.5Y 4/4) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Thickness of the mollic epipedon: 24 to more than 60 inches

Ap and A horizons:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

Cg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay, silty clay loam, or clay

211—Lura silty clay, depressional, 0 to 1 percent slopes

Composition

Lura and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Organic matter content in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corvuso and similar soils
- Cosmos and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Mayer Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderate in the upper part; rapid in the lower part
Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Mayer loam, 0 to 2 percent slopes, 1,450 feet north and 250 feet west of the southeast corner of sec. 24, T. 115 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; common fine roots; 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 21 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; few fine roots; 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bg1—21 to 29 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine roots; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg2—29 to 37 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine roots; few black (10YR 2/1) manganese concentrations in ped interiors; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2Cg—37 to 60 inches; olive gray (5Y 5/2) gravelly coarse sand; single grain; loose; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; 20 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 14 to 24 inches

Thickness of the loamy mantle: 20 to 40 inches

Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or clay loam

Content of rock fragments—0 to 10 percent gravel

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam, clay loam, or silt loam

Content of rock fragments—0 to 10 percent gravel

Bg horizon:

Hue—10YR, 2.5Y, or 5Y
 Value—4 or 5
 Chroma—1 to 3
 Texture—loam, silt loam, or clay loam
 Content of rock fragments—0 to 10 percent gravel

2Cg horizon:

Hue—2.5Y or 5Y
 Value—3 to 5
 Chroma—1 to 3
 Texture—gravelly coarse sand, gravelly sand,
 coarse sand, or sand
 Content of rock fragments—10 to 35 percent gravel

255—Mayer loam, 0 to 2 percent slopes**Composition**

Mayer and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Glacial outwash plains
Position on the landform: Drainageways and flats
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.9 inches (moderate)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

318—Mayer clay loam, depressional, 0 to 1 percent slopes**Composition**

Mayer and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Glacial outwash plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 7.4 inches (moderate)
Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Estherville and similar soils
- Linder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Minneiska Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Flood plains and outwash plains
Parent material: Alluvium
Slope range: 0 to 4 percent

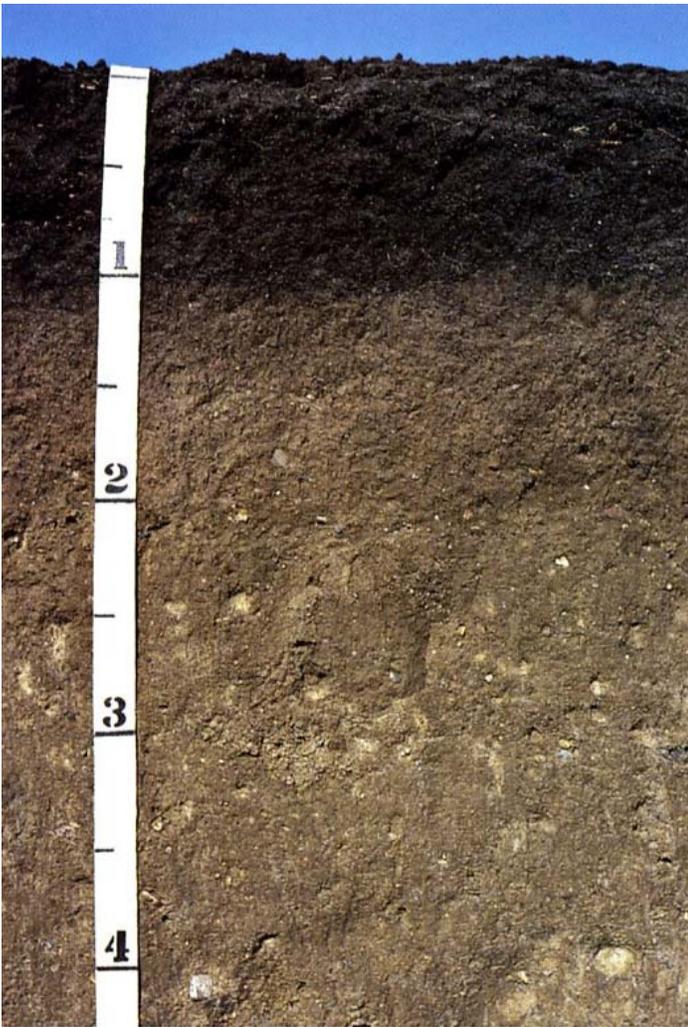


Figure 8.—Profile of Clarion loam in a cultivated field. The surface layer is about 12 inches thick. Depth is marked in feet.

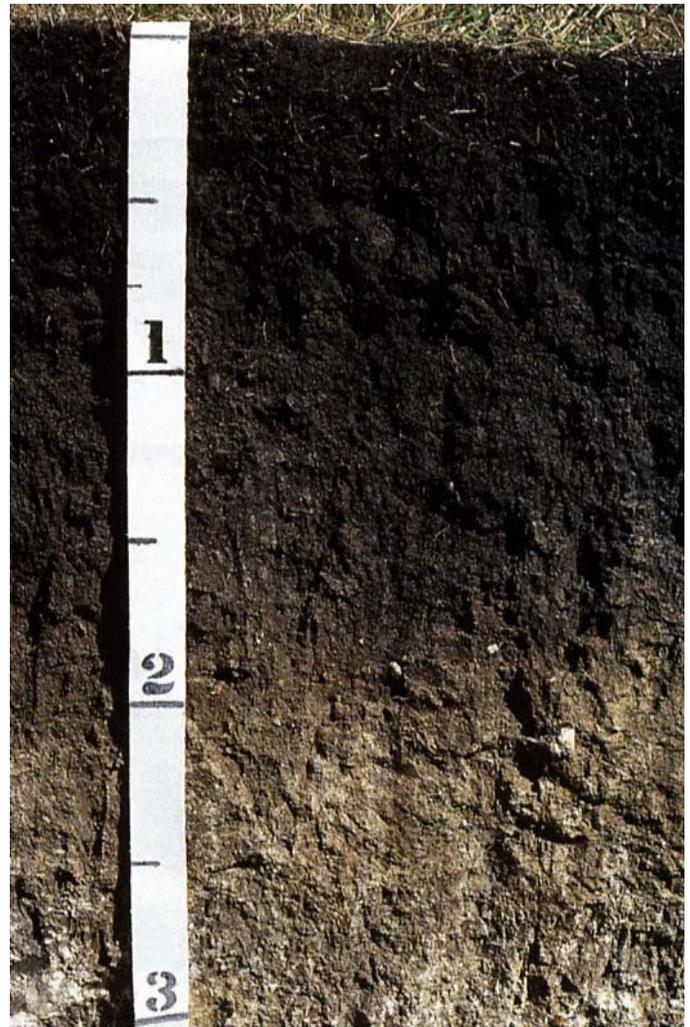


Figure 9.—Profile of Cosmos silty clay in a cultivated field. Horizon boundaries are wavy because of shrinking and swelling of the soil. Depth is marked in feet.



Figure 10.—Profile of Dickman sandy loam. Because of low available water capacity this soil is droughty. Depth is marked in feet.

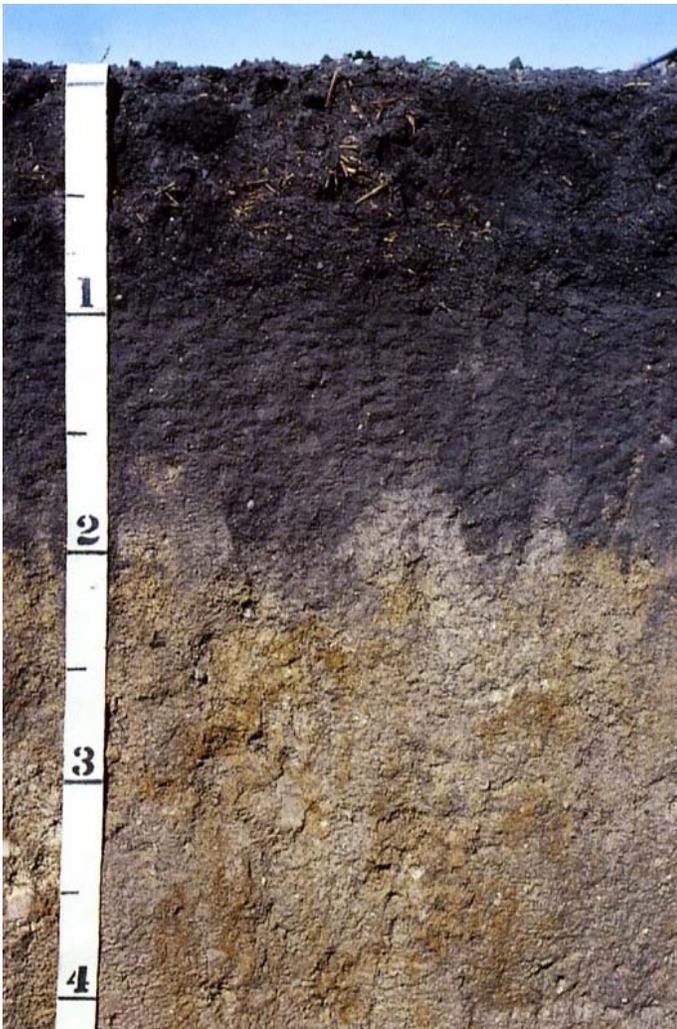


Figure 11.—Profile of Harps clay loam in a cultivated field. Iron concentrations and iron depletions (mottles) are in the subsoil. Depth is marked in feet.

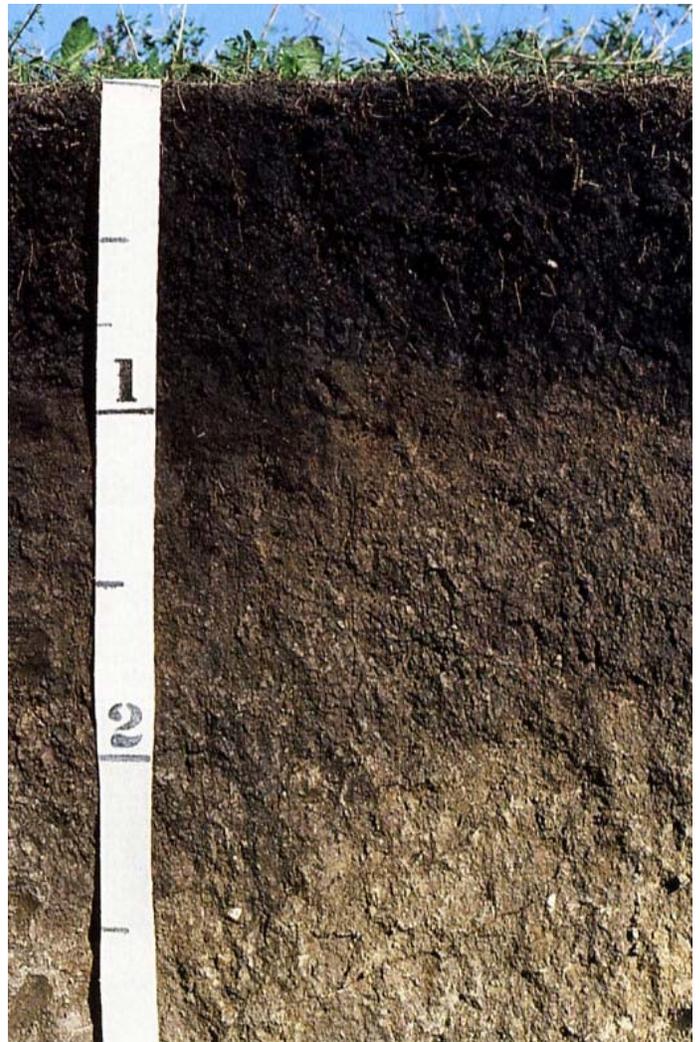


Figure 12.—Profile of Kandiyohi clay in a cultivated field. Calcium carbonates are below a depth of 2 feet. Depth is marked in feet.

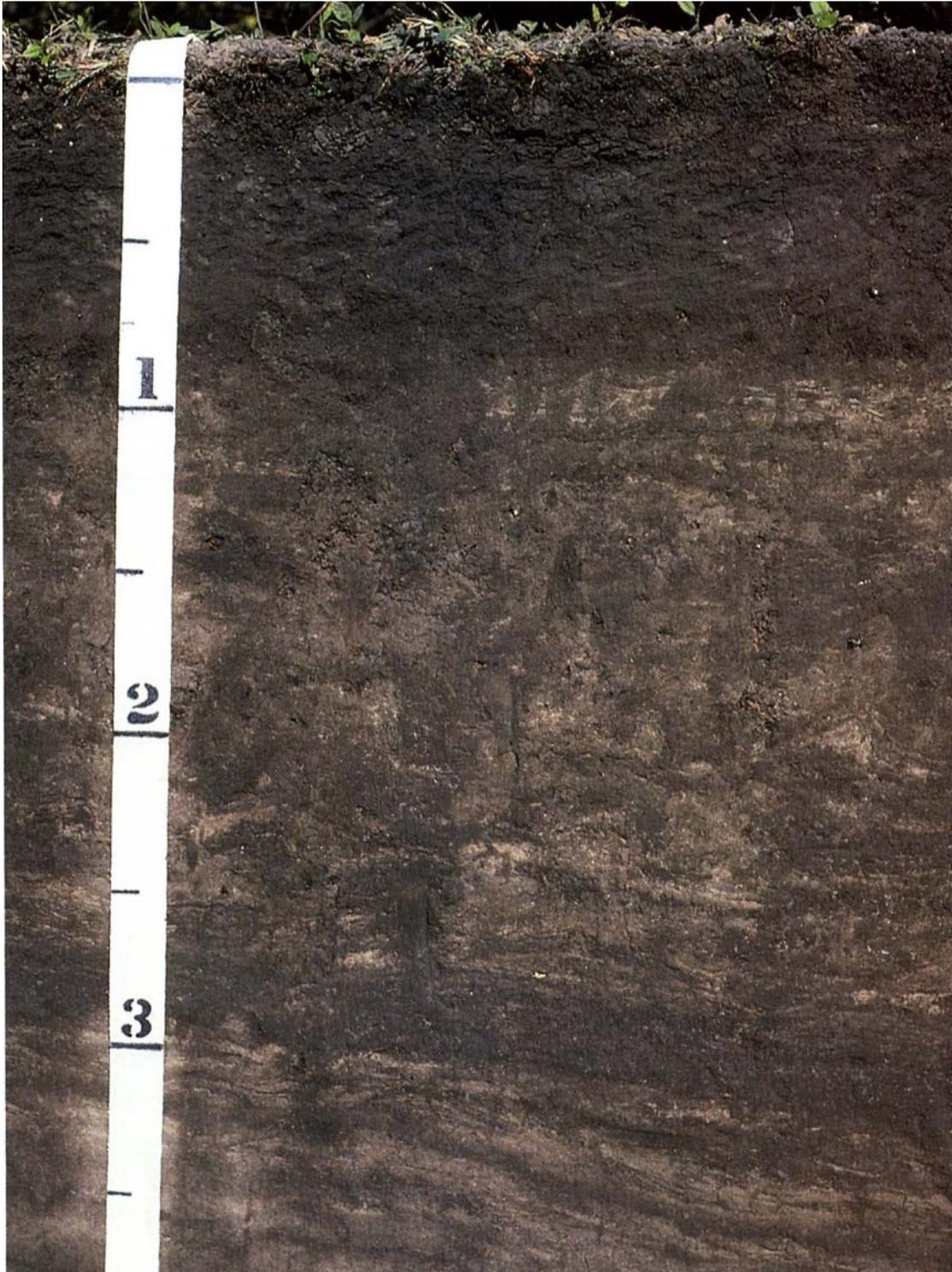


Figure 13.—Profile of Minneiska loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field. The surface layer is about 10 inches thick, and the underlying material is highly stratified. Depth is marked in feet.



Figure 14.—Profile of Muskego muck in a cultivated field. The muck is 18 inches thick over coprogenous earth. Note the snail shells in the coprogenous earth. Depth is marked in feet.

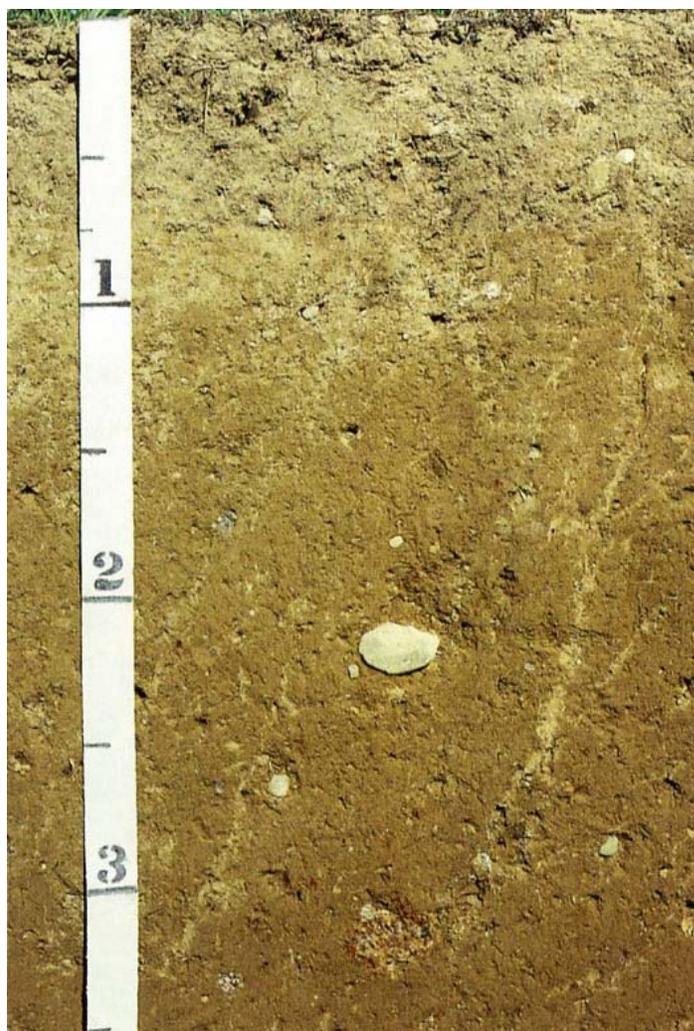


Figure 15.—Profile of Storden loam in a cultivated field. The surface layer is light colored because it has a low content of organic matter and contains calcium carbonates. Depth is marked in feet.

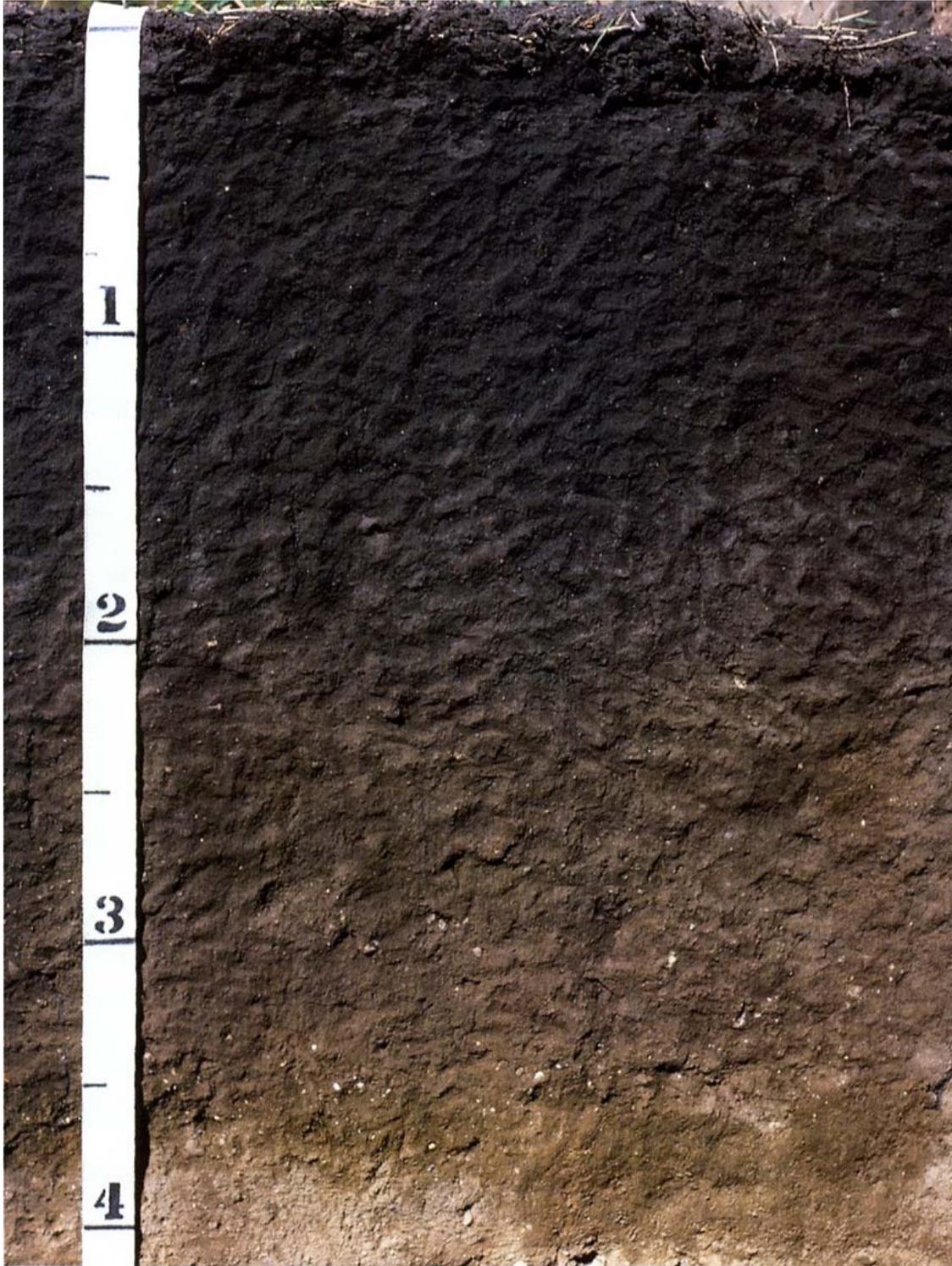


Figure 16.—Profile of Terril loam. The dark colors extend to a depth of about 42 inches. Depth is marked in feet.

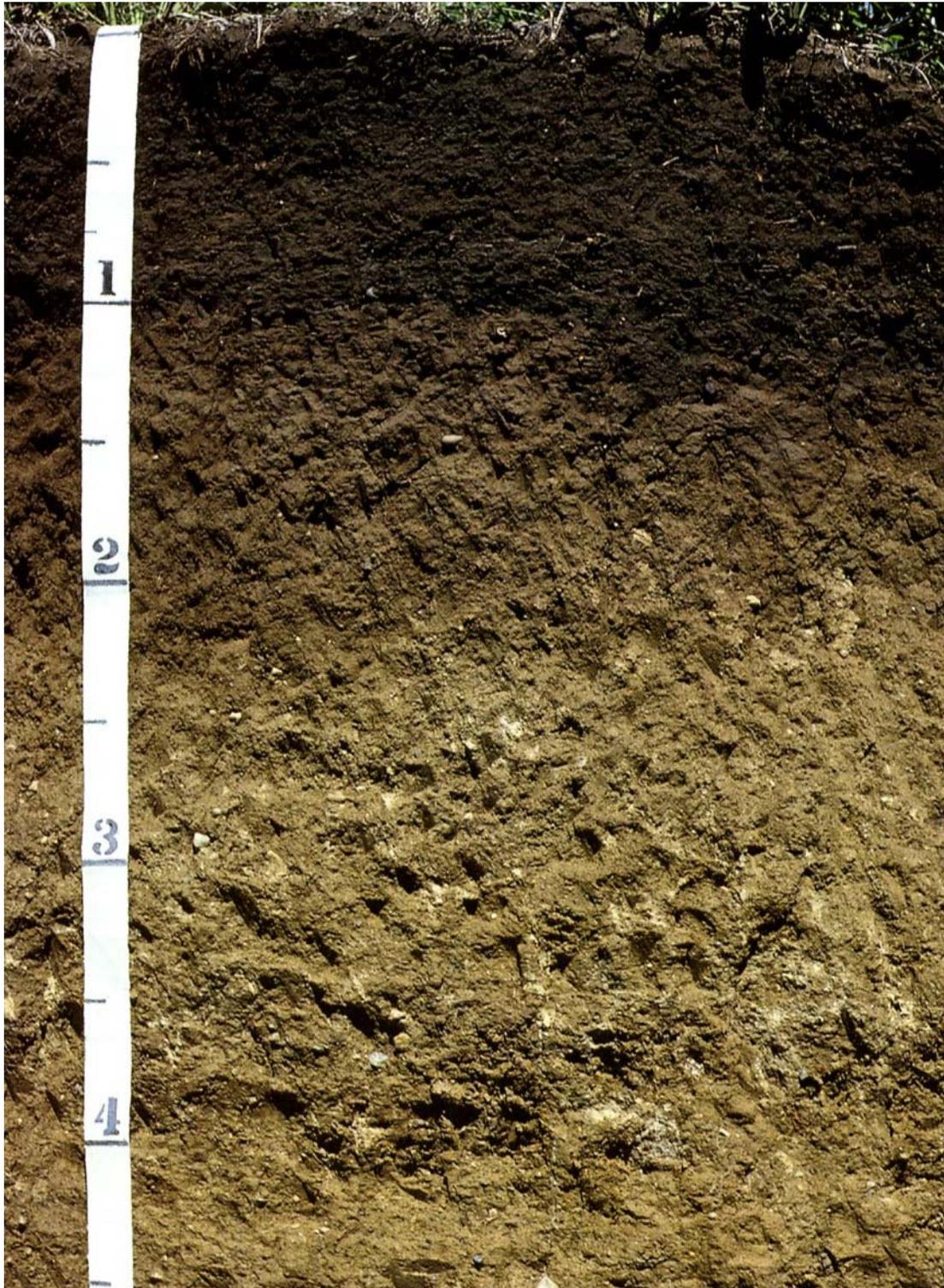


Figure 17.—Profile of Ves loam in a cultivated field. The light colored areas are calcium carbonates, which have been leached to a depth of about 30 inches. Depth is marked in feet.



Figure 18.—Profile of Wadena loam in a cultivated field. This soil has 3 feet of loam over gravelly coarse sand. Depth is marked in feet.

Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents

Typical Pedon

Minneiska loam, 0 to 2 percent slopes, occasionally flooded (fig. 13), 1,200 feet north and 980 feet east of the southwest corner of sec. 4, T. 112 N., R. 34 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; 2 percent snail-shell fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

C—9 to 60 inches; stratified very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), and dark grayish brown (10YR 4/2) loam, loamy sand, fine sandy loam, and loamy fine sand; weakly laminated; friable and very friable; 2 percent snail-shell fragments; slightly effervescent and strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam or loam

C horizon:

Hue—10YR or 2.5Y

Value—2 to 5

Chroma—2 or 3

Texture—stratified loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, fine sand, or sand

463A—Minneiska loam, 0 to 2 percent slopes, occasionally flooded

Composition

Minneiska and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats and rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 70 inches

Drainage class: Moderately well drained

Dominant parent material: Alluvium

Flooding: Occasional

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)

Organic matter content in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rushriver and similar soils
- Du Page and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

463B—Minneiska loam, 1 to 4 percent slopes, rarely flooded

Composition

Minneiska and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Glacial outwash plains

Position on the landform: Flats and slight rises

Slope range: 1 to 4 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 70 inches

Drainage class: Moderately well drained

Dominant parent material: Alluvium

Flooding: Rare

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.9 inches (high)

Organic matter content in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Terril and similar soils
- Du Page and similar soils
- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1999—Minneiska-Rushriver complex, 0 to 2 percent slopes, frequently flooded

Composition

Minneiska and similar soils: About 55 percent

Rushriver and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Flood plains

Position on the landform: Minneiska—flats and slight rises; Rushriver—flats and swales

Slope range: Minneiska—0 to 2 percent; Rushriver—0 to 1 percent

Component Description

Minneiska

Surface layer texture: Silt loam

Depth to bedrock: More than 70 inches

Drainage class: Moderately well drained

Dominant parent material: Alluvium

Flooding: Frequent

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)

Organic matter content in the surface layer: About 3.5 percent (moderate)

Rushriver

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)

Organic matter content in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

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: Moraines and lake plains

Parent material: Organic materials and coprogenous earth

Slope range: 0 to 1 percent

Taxonomic class: Coprogenous, euic, mesic Limnic Medisaprists

Typical Pedon

Muskego muck, depressional, 0 to 1 percent slopes (fig. 14), 150 feet south and 600 feet east of the northwest corner of sec. 35, T. 115 N., R. 31 W.

Oa—0 to 10 inches; muck (sapric material), black (N 2/0) rubbed and unrubbed; 20 percent fiber unrubbed, 5 percent rubbed; weak fine subangular blocky structure; very friable; common fine and medium roots; few dark brown (7.5YR 3/4) iron concentrations in root channels; neutral; abrupt smooth boundary.

Oa—10 to 20 inches; muck (sapric material), black (10YR 2/1) rubbed and unrubbed; 15 percent fiber unrubbed, 4 percent rubbed; moderate thick platy structure; very friable; few fine roots; common dark brown (7.5YR 4/4) iron concentrations in root channels; neutral; clear smooth boundary.

C1—20 to 42 inches; very dark gray (10YR 3/1) mucky silt loam (coprogenous earth); massive; slightly sticky; few fine roots; common dark brown (7.5YR 4/4) iron concentrations in root channels; 10 percent

snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

C2—42 to 60 inches; very dark gray (10YR 3/1) mucky silt loam (coprogenous earth); massive; slightly sticky; few fine roots; few dark brown (7.5YR 4/4) iron concentrations in root channels; 5 percent snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches

Oap and Oa horizons:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

Content of snail-shell fragments—0 to 2 percent

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 4

Chroma—1 to 3

Texture—mucky silt loam or mucky silty clay loam (coprogenous earth)

Content of snail-shell fragments—2 to 10 percent

525—Muskego muck, depressional, 0 to 1 percent slopes

Composition

Muskego and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 16.4 inches (high)

Organic matter content in the surface layer: About 75 percent (very high)

A typical soil series description with range in

characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Blue Earth and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Nicollet Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 1 to 3 percent slopes, 1,575 feet south and 225 feet east of the northwest corner of sec. 12, T. 113 N., R. 32 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

A—9 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; slightly acid; clear smooth boundary.

Bw1—16 to 20 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; 2 percent gravel; slightly acid; clear smooth boundary.

Bw2—20 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; 4 percent gravel; slightly acid; clear wavy boundary.

Bw3—26 to 35 inches; olive brown (2.5Y 4/4) clay loam; weak coarse prismatic structure parting to weak fine and medium subangular blocky; friable; few fine

distinct grayish brown (2.5Y 5/2) iron depletions and few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; 4 percent gravel; neutral; clear wavy boundary.

Bk—35 to 44 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; many medium distinct grayish brown (2.5Y 5/2) iron depletions and many medium prominent strong brown (7.5YR 5/6) iron concentrations; 4 percent gravel; carbonates segregated in common light gray (10YR 7/2) fine soft masses; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—44 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; many medium distinct grayish brown (2.5Y 5/2) iron depletions and many medium prominent strong brown (7.5YR 5/6) iron concentrations; 4 percent gravel; carbonates segregated in few light gray (10YR 7/2) fine and medium soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 48 inches

Thickness of the mollic epipedon: 10 to 24 inches

Content of rock fragments: 1 to 8 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam or silty clay loam

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam, silty clay loam, or loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—clay loam, silty clay loam, or loam

Bk and C horizons:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

130—Nicollet clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and back slopes

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1100—Nicollet silty clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and back slopes

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Nishna Series

Depth class: Very deep

Drainage class: Very poorly drained and poorly drained

Permeability: Slow

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Fine, montmorillonitic (calcareous), mesic Vertic Epiaquolls

Typical Pedon

Nishna silty clay, 0 to 2 percent slopes, occasionally flooded, 1,900 feet south and 1,300 feet west of the northeast corner of sec. 19, T. 115 N., R. 38 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine prominent dark reddish brown (5YR 3/3) iron concentrations; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A—9 to 30 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; few fine prominent dark gray (5Y 4/1) iron depletions and olive brown (2.5Y 4/4) iron concentrations; 2 percent snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg—30 to 52 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium

subangular blocky structure; firm; few fine prominent olive brown (2.5Y 4/4) iron concentrations; 2 percent snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg—52 to 60 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; massive; friable; common fine prominent olive brown (2.5Y 4/4) iron concentrations; 2 percent snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: More than 24 inches

Content of snail shells: 0 to 5 percent snail-shell fragments throughout the profile

Ap and A horizons:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay or silty clay loam

Bg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3

Chroma—0 or 1

Texture—silty clay or silty clay loam

Cg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 or 4

Chroma—0 or 1

Texture—silty clay loam or silty clay

575—Nishna silty clay, 0 to 2 percent slopes, occasionally flooded

Composition

Nishna and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay

Depth to bedrock: More than 80 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 7.3 inches (moderate)
Organic matter content in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils
- Rushriver and similar soils
- Du Page and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1917—Nishna silty clay loam, 0 to 1 percent slopes, frequently flooded

Composition

Nishna and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Flood plains

Position on the landform: Flats and swales

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 7.4 inches (moderate)

Organic matter content in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rushriver and similar soils
- Havelock and similar soils
- Nishna and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Normania Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Normania loam, 1 to 3 percent slopes, 1,175 feet south and 650 feet west of the northeast corner of sec. 15, T. 115 N., R. 36 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; friable; common fine roots; 3 percent gravel; slightly acid; clear smooth boundary.

AB—10 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; common olive brown (2.5Y 4/3) wormcasts; few fine roots; 3 percent gravel; neutral; clear smooth boundary.

Bw—14 to 20 inches; olive brown (2.5Y 4/3) loam; weak medium subangular blocky structure; friable; few very fine roots; 3 percent gravel; neutral; clear smooth boundary.

Bk—20 to 29 inches; grayish brown (2.5Y 5/2) loam; weak coarse subangular blocky structure; friable; few very fine roots; 5 percent gravel; carbonates disseminated; violently effervescent; slightly alkaline; clear smooth boundary.

C—29 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions and common medium distinct yellowish brown (10YR 5/6) iron concentrations; 8 percent gravel; carbonates segregated in few light gray (10YR 7/2) fine soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches

Thickness of the mollic epipedon: 10 to 20 inches

Content of rock fragments: 3 to 8 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

AB horizon:

Hue—10YR or 2.5Y

Value—3

Chroma—1 or 2

Texture—loam or clay loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—loam or clay loam

Bk horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

446—Normania loam, 1 to 3 percent slopes**Composition**

Normania and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and back slopes

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.8 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Okoboji Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow

Landform: Moraines and lake plains

Parent material: Alluvium or lacustrine deposits over till

Slope range: 0 to 1 percent

Taxonomic class: Fine, montmorillonitic, mesic Cumulic Vertic Epiaquolls

Typical Pedon

Okoboji silty clay loam, depressional, 0 to 1 percent slopes, 1,025 feet south and 450 feet east of the northwest corner of sec. 27, T. 114 N., R. 34 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A1—8 to 19 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—19 to 28 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few fine faint dark grayish brown (2.5Y 4/2) iron depletions; neutral; clear smooth boundary.

Bg1—28 to 35 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; weak medium subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations and many medium faint olive gray

(5Y 4/2) iron depletions; neutral; gradual smooth boundary.

Bg2—35 to 44 inches; olive gray (5Y 5/2) silty clay loam; weak medium subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg—44 to 60 inches; olive gray (5Y 5/2) silty clay loam; massive; friable; common medium prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 56 inches

Thickness of the mollic epipedon: 24 to 48 inches

Other features: Some pedons have a 2Cg horizon of loam or clay loam.

Ap and A horizons:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2

Chroma—0 or 1

Texture—silty clay loam or mucky silty clay loam

Bg horizon:

Hue—10YR, 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

386—Okoboji mucky silty clay loam, depressional, 0 to 1 percent slopes

Composition

Okoboji and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Alluvium over till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.0 inches (high)

Organic matter content in the surface layer: About 14 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Harps and similar soils
- Klossner and similar soils
- Blue Earth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

134—Okoboji silty clay loam, depressional, 0 to 1 percent slopes

Composition

Okoboji and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Depressions

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Organic matter content in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Harps and similar soils
- Canisteo and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1900—Okoboji-Canisteo complex, depressional, 0 to 1 percent slopes

Composition

Okoboji and similar soils: About 70 percent
Canisteo and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Okoboji—lake plains and moraines;
Canisteo—moraines

Position on the landform: Okoboji—depressions;
Canisteo—rims of depressions

Slope range: 0 to 1 percent

Component Description

Okoboji

Surface layer texture: Mucky silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over Wisconsin till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)

Organic matter content in the surface layer: About 14 percent (very high)

Canisteo

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Seaforth and similar soils
- Harps and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Omsrud Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 6 to 40 percent

Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Omsrud loam, in an area of Storden-Omsrud complex, 12 to 18 percent slopes, eroded, 2,500 feet north and 200 feet west of the southeast corner of sec. 23, T. 115 N., R. 31 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw—9 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; few fine roots; about 2 percent gravel; neutral; gradual wavy boundary.

Bk—18 to 36 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; common threads and masses of calcium carbonate; about 5 percent gravel; strongly effervescent and violently effervescent; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few threads of calcium carbonate; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 50 inches

Thickness of the mollic epipedon: 10 to 22 inches

Content of rock fragments: 2 to 8 percent gravel throughout the profile

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 clay loam

Bw horizon:

Hue—10YR

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Bk and C horizons:

Hue—10YR or 2.5Y

Value—5

Chroma—4

Texture—loam or clay loam

1373C—Omsrud-Storden-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Omsrud and similar soils: About 45 percent

Storden and similar soils: About 30 percent

Hawick and similar soils: About 15 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Omsrud—summits and back slopes; Storden and Hawick—shoulders and summits

Slope range: 6 to 12 percent

Component Description

Omsrud

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)

Organic matter content in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1376C—Omsrud-Storden complex, 6 to 12 percent slopes, eroded

Composition

Omsrud and similar soils: About 50 percent

Storden and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Omsrud—summits and back slopes; Storden—shoulders and summits

Slope range: 6 to 12 percent

Component Description**Omsrud**

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1030—Pits, gravel-Udipsamments complex**Composition**

Pits: About 45 percent

Udipsamments: About 45 percent

Inclusions: About 10 percent

Setting

Landform: Glacial outwash plains and terraces

Slope range: Udipsamments—0 to 30 percent

Component Description**Pits**

Dominant parent material: Glacial outwash

Udipsamments

Surface layer texture: Sand

Depth to bedrock: More than 60 inches

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

Additional information specific to this map unit is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Prinsburg Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines and lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Prinsburg silty clay loam, 0 to 2 percent slopes, 175 feet north and 1,600 feet west of the southeast corner of sec. 1, T. 116 N., R. 37 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak medium granular structure; friable; common fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 19 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkg—19 to 29 inches; grayish brown (2.5Y 5/2) silt

loam; weak medium subangular blocky structure; friable; few fine distinct light yellowish brown (2.5Y 6/4) iron concentrations; few fine roots; disseminated carbonates; violently effervescent; moderately alkaline; clear smooth boundary.

Bg—29 to 36 inches; dark grayish brown (2.5Y 4/2) silt loam; weak medium subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; few fine roots; strongly effervescent; slightly alkaline; gradual wavy boundary.

Cg1—36 to 46 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; common medium prominent yellowish brown (10YR 5/8) iron concentrations; strongly effervescent; slightly alkaline; gradual wavy boundary.

2Cg2—46 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; common fine distinct olive brown (2.5Y 4/4) iron concentrations; 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 12 to 24 inches

Depth to glacial till: 40 to 60 inches

Ap and A horizons:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg and Bg horizons:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—silt loam or silty clay loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—silt loam or silty clay loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—2 to 8 percent gravel

1286—Prinsburg silty clay loam, 0 to 2 percent slopes

Composition

Prinsburg and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and moraines

Position on the landform: Flats and swales

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 80 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)

Organic matter content in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Louris and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Rolfe Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

Taxonomic class: Fine, montmorillonitic, mesic Typic Argialbolls

Typical Pedon

Rolfe silt loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 700 feet north and 825 feet east of the southwest corner of sec. 23, T. 115 N., R. 35 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky

structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

E—13 to 21 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; weak medium platy structure; very friable; few fine distinct dark yellowish brown (10YR 4/4) iron concentrations; common fine roots; slightly acid; abrupt smooth boundary.

Btg1—21 to 30 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate fine angular blocky structure; firm; few fine prominent yellowish brown (10YR 5/6) iron concentrations; few fine roots; common faint black (10YR 2/1) clay films on faces of peds; neutral; clear smooth boundary.

Btg2—30 to 40 inches; dark gray (5Y 4/1) silty clay; moderate fine prismatic structure parting to weak fine angular blocky; firm; few fine prominent yellowish brown (10YR 5/6) iron concentrations; few fine roots; common prominent black (10YR 2/1) clay films on faces of peds; neutral; clear smooth boundary.

2Btg3—40 to 51 inches; olive gray (5Y 4/2) clay loam; moderate medium prismatic structure parting to weak medium angular blocky; firm; common fine prominent yellowish brown (10YR 5/6) iron concentrations; few prominent black (10YR 2/1) clay films on faces of peds; 3 percent gravel; neutral; gradual smooth boundary.

2BCg—51 to 60 inches; olive gray (5Y 5/2) clay loam; massive; friable; common medium prominent yellowish brown (10YR 5/6) iron concentrations; few black (10YR 2/1) clay coatings in root channels; 4 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 42 to more than 60 inches

Thickness of the mollic epipedon: 10 to 24 inches

Depth to glacial till: 30 to 45 inches

Other features: Some pedons have a 2Cg horizon.

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam

Content of rock fragments—0 to 3 percent

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1

Texture—silt loam

Content of rock fragments—0 to 3 percent gravel

Btg horizon:

Hue—10YR or 5Y

Value—3 to 6

Chroma—1 or 2

Texture—silty clay or clay

Content of rock fragments—0 to 3 percent gravel

2Btg horizon:

Hue—5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

Content of rock fragments—0 to 10 percent gravel

2BCg horizon:

Hue—5Y

Value—4 or 5

Chroma—2 or 3

Texture—clay loam or loam

Content of rock fragments—0 to 10 percent gravel

Rushriver Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate in the upper part; moderate to rapid in the lower part

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Rushriver very fine sandy loam, in an area of Minneiska-Rushriver complex, 0 to 2 percent slopes, frequently flooded, 1,400 feet south and 1,800 feet east of the northwest corner of sec. 4, T. 110 N., R. 26 W., in Nicollet County:

A—0 to 46 inches; mixed very dark gray (10YR 3/1), dark gray (10YR 4/1), and dark grayish brown (10YR 4/2) very fine sandy loam stratified with silt loam and loamy fine sand, dark gray (10YR 4/1) dry; weak very thin platy structure; very friable; few fine prominent dark reddish brown (5YR 3/4) and common fine prominent brown (7.5YR 4/4) iron concentrations; strongly to slightly effervescent; slightly alkaline; gradual wavy boundary.

C—46 to 60 inches; mixed dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) loamy very fine sand stratified with silt loam and loamy fine sand; massive; very friable; many fine and medium prominent dark brown (7.5YR 4/4) iron concentrations; strongly to slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

A horizon:

Hue—10YR to 5Y or neutral

Value—2 to 4

Chroma—0 to 2

Texture—very fine sandy loam

Content of rock fragments—0 to 5 percent gravel

2C horizon:

Hue—10YR to 5Y

Value—3 to 6

Chroma—1 to 3

Texture—loamy very fine sand, loamy sand, fine sand, sand, or coarse sand; strata of silt loam, fine sandy loam, sandy loam, or loam

Content of rock fragments—0 to 10 percent gravel

Seaforth Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, mesic Aquic Calciudolls

Typical Pedon

Seaforth loam, 1 to 3 percent slopes, 2,450 feet north and 880 feet west of the southeast corner of sec. 23, T. 115 N., R. 36 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; 3 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 17 inches; grayish brown (2.5Y 5/2) loam; weak fine subangular blocky structure; friable; few very fine roots; 4 percent gravel; carbonates disseminated; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—17 to 23 inches; grayish brown (2.5Y 5/2) loam; weak fine subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; few very fine roots; 4 percent gravel; carbonates disseminated; violently effervescent; slightly alkaline; clear smooth boundary.

Bk3—23 to 38 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; common fine and medium distinct grayish brown (2.5Y 5/2) iron depletions and common fine distinct

yellowish brown (10YR 5/6) iron concentrations; few red (2.5YR 4/6) iron concentrations; 6 percent gravel; carbonates segregated in common light gray (10YR 7/2) medium and coarse soft masses; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—38 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium and coarse distinct grayish brown (2.5Y 5/2) iron depletions and common medium distinct yellowish brown (10YR 5/6) iron concentrations; few strong brown (7.5YR 5/8) iron concentrations; 6 percent gravel; carbonates segregated in few light gray (10YR 7/2) medium soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 8 to 20 inches

Content of rock fragments: 2 to 10 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or silt loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

423—Seaforth loam, 1 to 3 percent slopes

Composition

Seaforth and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)

Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1262—Seaforth silt loam, 1 to 3 percent slopes

Composition

Seaforth and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Rises

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silt loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)

Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chetomba and similar soils
- Leen and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Storden Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines and escarpments

Parent material: Till

Slope range: 4 to 50 percent

Taxonomic class: Fine-loamy, mixed, mesic Typic Eutrochrepts

Typical Pedon

Storden loam (fig. 15), in an area of Omsrud-Storden complex, 6 to 12 percent slopes, eroded, 1,530 feet north and 325 feet west of the southeast corner of sec. 33, T. 113 N., R. 34 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam; weak medium subangular blocky structure; friable; 3 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 34 inches; brown (10YR 5/3) loam; weak fine subangular blocky structure; friable; few fine distinct yellowish brown (10YR 5/8) relict mottles; common fine threads and coatings of calcium carbonate; 3 percent gravel; strongly effervescent and violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—34 to 55 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few fine distinct yellowish brown (10YR 5/8) and common fine distinct light brownish gray (10YR 6/2) relict mottles; common fine threads and coatings of calcium carbonate; 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—55 to 60 inches; yellowish brown (10YR 5/4) loam; massive; common fine distinct yellowish brown (10YR 5/8) and common fine distinct gray (10YR 6/1) relict mottles; friable; 6 percent coarse fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Content of rock fragments: 2 to 10 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—4 or 5

Chroma—2 or 3

Texture—loam

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 6

Texture—loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 6

Texture—loam or clay loam

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils
- Terril and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

960D2—Storden-Omsrud complex, 12 to 18 percent slopes, eroded**Composition**

Storden and similar soils: About 65 percent

Omsrud and similar soils: About 20 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Storden—back slopes and shoulders; Omsrud—back slopes

Slope range: 12 to 18 percent

Component Description**Storden**

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

960F—Storden-Omsrud complex, 18 to 50 percent slopes**Composition**

Storden and similar soils: About 70 percent

Omsrud and similar soils: About 15 percent

Inclusions: About 15 percent

Setting

Landform: Escarpments

Position on the landform: Storden—back slopes and shoulders; Omsrud—back slopes

Slope range: Storden—18 to 50 percent; Omsrud—18 to 40 percent

Component Description**Storden**

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils
- Terril and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1375D—Storden-Ves complex, 12 to 18 percent slopes, eroded

Composition

Storden and similar soils: About 60 percent

Ves and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Storden—shoulders and summits; Ves—summits and back slopes

Slope range: 12 to 18 percent

Component Description

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Ves

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils
- Terril and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Strout Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderately slow or slow

Landform: Moraines

Parent material: Dense till

Slope range: 2 to 6 percent

Taxonomic class: Fine, montmorillonitic, mesic Vertic Hapludolls

Typical Pedon

Strout clay, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 900 feet south and 2,550 feet east of the northwest corner of sec. 9, T. 116 N., R. 32 W.

Ap—0 to 10 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; 2 percent gravel; neutral; abrupt smooth boundary.

Bw—10 to 23 inches; olive brown (2.5Y 4/4) clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots; few distinct dark grayish brown (2.5Y 4/2) pressure faces; 2 percent gravel; neutral; gradual smooth boundary.

Bk1—23 to 32 inches; light olive brown (2.5Y 5/4) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine distinct olive gray (5Y 5/2) iron depletions; few fine roots; carbonates segregated in common light gray

(10YR 7/2) fine soft masses and few light gray (10YR 7/2) fine threads; 2 percent gravel; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—32 to 45 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; firm; common medium distinct olive gray (5Y 5/2) iron depletions; few yellowish red (5YR 4/6) iron concentrations; carbonates segregated in many light gray (10YR 7/2) medium soft masses; 3 percent gravel; violently effervescent; slightly alkaline; gradual smooth boundary.

C—45 to 60 inches; light olive brown (2.5Y 5/4) clay loam; firm; common coarse distinct grayish brown (2.5Y 5/2) iron depletions; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches

Thickness of the mollic epipedon: 8 to 24 inches

Content of rock fragments: 1 to 8 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—clay, clay loam, or silty clay loam

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—clay loam, silty clay loam, or clay

C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—clay loam, silty clay loam, or clay

1159B—Strout-Arkton complex, 2 to 6 percent slopes

Composition

Strout and similar soils: About 70 percent

Arkton and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Strout—summits and back slopes; Arkton—shoulders and summits

Slope range: Strout—2 to 6 percent; Arkton—4 to 6 percent

Component Description

Strout

Surface layer texture: Clay

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 8.2 inches (moderate)

Organic matter content in the surface layer: About 4.5 percent (high)

Arkton

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Organic matter content in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Swanlake Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines and escarpments

Parent material: Till

Slope range: 4 to 50 percent

Taxonomic class: Fine-loamy, mixed, mesic Entic
Hapludolls

Typical Pedon

Swanlake loam, in an area of Amiret-Swanlake complex, 2 to 6 percent slopes, 1,525 feet south and 200 feet east of the northwest corner of sec. 13, T. 114 N., R. 37 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; few fine roots; 5 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 20 inches; olive brown (2.5Y 4/4) loam; weak fine subangular blocky structure; friable; few fine roots; 3 percent gravel; carbonates disseminated; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—20 to 32 inches; olive brown (2.5Y 4/4) loam; weak fine subangular blocky structure; friable; few fine roots; carbonates segregated in common light gray (10YR 7/2) fine soft masses; 3 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

C1—32 to 53 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few fine prominent yellowish red (5YR 4/6) iron concentrations; carbonates segregated in few light gray (10YR 7/2) medium threads; 5 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C2—53 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine distinct grayish brown (2.5Y 5/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; few yellowish red (5YR 4/6) iron concentrations; carbonates segregated in few light gray (10YR 7/2) fine threads and few light gray (10YR 7/2) fine soft masses; 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 14 inches

Content of rock fragments: 2 to 10 percent gravel throughout the profile

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—loam or clay loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 5

Texture—loam or clay loam

595F—Swanlake loam, 18 to 50 percent slopes

Composition

Swanlake and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Escarpments

Position on the landform: Back slopes and shoulders

Slope range: 18 to 50 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Organic matter content in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils
- Terril and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1242F—Swanlake-Terril complex, 18 to 50 percent slopes

Composition

Swanlake and similar soils: About 50 percent
 Terril and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Escarpments
Position on the landform: Swanlake—back slopes and shoulders; Terril—foot slopes and toe slopes
Slope range: Swanlake—18 to 50 percent; Terril—18 to 25 percent

Component Description

Swanlake

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Organic matter content in the surface layer: About 3 percent (moderate)

Terril

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Terril Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines and escarpments
Parent material: Colluvium over till
Slope range: 2 to 25 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Terril loam, moderately wet, 2 to 6 percent slopes (fig. 16), 1,400 feet north and 1,625 feet west of the southeast corner of sec. 4, T. 112 N., R. 34 W.

- Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.
- A1—9 to 27 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.
- A2—27 to 35 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
- BA—35 to 40 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; friable; neutral; gradual smooth boundary.
- Bw—40 to 47 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; gradual smooth boundary.
- BC—47 to 60 inches; brown (10YR 5/3) loam; massive; friable; few fine faint yellowish brown (10YR 5/4) iron concentrations; few strong brown (7.5YR 5/6) iron stains on ped exteriors; 6 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 40 to 60 inches
Thickness of the mollic epipedon: 24 to 40 inches
Other features: Some pedons have a C horizon.

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 clay loam

BA horizon:

Hue—10YR
 Value—3
 Chroma—2 or 3
 Texture—loam or clay loam

Bw horizon:

Hue—10YR
 Value—3 or 4
 Chroma—2 to 4
 Texture—loam or clay loam

BC horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—3 or 4
 Texture—loam or clay loam
 Content of rock fragments—2 to 8 percent gravel

94C—Terril loam, 6 to 12 percent slopes**Composition**

Terril and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: More than 6 feet
Available water capacity to 60 inches or root-limiting layer: About 11.4 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1388B—Terril loam, moderately wet, 2 to 6 percent slopes**Composition**

Terril and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Foot slopes and toe slopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.4 inches (high)
Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Ves Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 6 to 18 percent
Taxonomic class: Fine-loamy, mixed, mesic Calcic Hapludolls

Typical Pedon

Ves loam (fig. 17), in an area of Ves-Storden complex, 6 to 12 percent slopes, eroded, 1,000 feet south and

850 feet west of the northeast corner of sec. 13, T. 114 N., R. 37 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; common fine roots; 3 percent gravel; neutral; abrupt smooth boundary.

Bw—10 to 22 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; 3 percent gravel; neutral; clear smooth boundary.

Bk—22 to 31 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; carbonates segregated in common light gray (10YR 7/2) rounded fine soft masses; 4 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

BCK—31 to 38 inches; dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure; friable; few fine prominent yellowish red (5YR 4/6) iron concentrations; carbonates segregated in common light gray (10YR 7/2) rounded fine soft masses; 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; few fine prominent yellowish red (5YR 4/6) iron concentrations; few fine distinct gray (10YR 5/1) iron depletions; carbonates segregated in few light gray (10YR 7/2) rounded fine soft masses; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 33 inches

Thickness of the mollic epipedon: 7 to 20 inches

Content of rock fragments: 2 to 8 percent gravel throughout the profile

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—3 or 4

Texture—loam or clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 or 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 or 4

Texture—loam or clay loam

770C2—Ves-Terril complex, 6 to 15 percent slopes, eroded

Composition

Ves and similar soils: About 60 percent

Terril and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Ves—back slopes and shoulders; Terril—foot slopes and toe slopes

Slope range: 6 to 15 percent

Component Description

Ves

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

Terril

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning

these uses, see Part II of this publication:

- Agronomy section

954C2—Ves-Storden complex, 6 to 12 percent slopes, eroded

Composition

Ves and similar soils: About 65 percent
Storden and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Ves—summits and back slopes; Storden—shoulders and summits

Slope range: 6 to 12 percent

Component Description

Ves

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning

these uses, see Part II of this publication:

- Agronomy section

999C2—Ves-Storden-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Ves and similar soils: About 35 percent
Storden and similar soils: About 35 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Ves—back slopes; Storden and Hawick—back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Ves

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Organic matter content in the surface layer: About 4 percent (high)

Storden

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: More than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 2.9 inches (very low)

Organic matter content in the surface layer: About 2 percent (moderate)

A typical soil series description with range in

characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Delft and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wadena Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate in the upper part; very rapid in the lower part

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 6 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Wadena loam, 0 to 2 percent slopes (fig. 18), 250 feet south and 2,175 feet east of the northwest corner of sec. 1, T. 114 N., R. 37 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

A1—9 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; neutral; clear smooth boundary.

A2—14 to 18 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; few black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Bw1—18 to 27 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Bw2—27 to 37 inches; dark yellowish brown (10YR 4/4) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; 2 percent gravel; neutral; abrupt smooth boundary.

2C—37 to 60 inches; dark yellowish brown (10YR 4/4)

gravelly coarse sand; single grain; loose; 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 50 inches

Thickness of the mollic epipedon: 12 to 24 inches

Thickness of the loamy mantle: 24 to 40 inches

Ap and A horizons:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 10 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—3 or 4

Texture—loam or sandy loam

Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 4

Texture—gravelly coarse sand, gravelly sand, coarse sand, or sand

Content of rock fragments—5 to 35 percent gravel

39A—Wadena loam, 0 to 2 percent slopes

Composition

Wadena and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Glacial outwash plains and terraces

Position on the landform: Flats and slight rises

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 7.6 inches (moderate)

Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the

“Soil Properties” section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

39B—Wadena loam, 2 to 6 percent slopes

Composition

Wadena and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Glacial outwash plains and terraces

Position on the landform: Flats and slight rises

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: More than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: More than 6 feet

Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)

Organic matter content in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1356—Water, miscellaneous

Composition

Water: 100 percent

Component Description

- Agricultural, industrial, or municipal wastewater storage ponds

Webster Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till and lacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Webster clay loam, 0 to 2 percent slopes, 1,125 feet north and 375 feet east of the southwest corner of sec. 27, T. 113 N., R. 33 W.

Ap—0 to 7 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; few fine and medium roots; 3 percent gravel; slightly acid; clear smooth boundary.

A—7 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; few fine and medium roots; 2 percent gravel; slightly acid; gradual smooth boundary.

Bg1—16 to 22 inches; dark gray (2.5Y 4/1) clay loam; weak medium subangular blocky structure; friable; few fine distinct olive gray (5Y 4/2) iron concentrations; few fine and medium roots; 2 percent gravel; few faint very dark gray (10YR 3/1) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

Bg2—22 to 32 inches; grayish brown (2.5Y 5/2) clay loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; few fine roots; 2 percent gravel; neutral; clear smooth boundary.

Bkg—32 to 43 inches; olive gray (5Y 5/2) loam; weak coarse subangular blocky structure; friable; few medium prominent yellowish brown (10YR 5/6) iron concentrations; 3 percent gravel; carbonates segregated in common white (10YR 8/2) fine soft masses; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg—43 to 60 inches; olive gray (5Y 5/2) loam; massive friable; common coarse prominent strong brown (7.5YR 5/6) iron concentrations; 2 percent gravel; carbonates segregated in few white (10YR 8/2) fine soft masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches

Thickness of the mollic epipedon: 14 to 20 inches

Ap and A horizons:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam or silty clay loam

Content of rock fragments—0 to 3 percent gravel

Bg and Bkg horizons:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

Content of rock fragments—0 to 3 percent gravel

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent gravel

113—Webster clay loam, 0 to 2 percent slopes**Composition**

Webster and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Drainageways and flats

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Nicollet and similar soils
- Normania and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1101—Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes**Composition**

Webster and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Flats and swales

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: More than 60 inches

Drainage class: Poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Organic matter content in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas 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

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

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, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed

limestone, per unit area, with the same degree of distortion.

- 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 loosen the subsoil and bring clods to the surface.
- 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.
- Coarse textured soil.** Sand or loamy sand.
- Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.
- Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.
- 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 or miscellaneous areas 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 or miscellaneous areas are somewhat similar in all areas.
- Compressible** (in tables). Excessive decrease in volume of soft soil under load.
- Concretions.** Grains, pellets, or nodules of various

sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where wind erosion is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

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.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—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 (or contour farming). 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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

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.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet

close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these. *Very poorly drained.*—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

Drainage, surface. Runoff, or surface flow of water, from an area.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are

removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry 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 inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

Foot slope. The geomorphic component that forms the inner, gently inclined surface at the base of a hill slope. The surface is dominantly concave. In terms of gradational processes, a foot slope is a transition zone between an upslope site of erosion (back slope) and a downslope site of deposition (toe slope).

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

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.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their

relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

Glacial drift. 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. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glaciofluvial deposits. 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.

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 as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

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. Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

High-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue

from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

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 of mineral soil 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, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 soil material. 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.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it 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.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

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

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well-sorted, generally fine-textured, stratified deposits, commonly containing varves.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lake shore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

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-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

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.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

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. 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.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

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. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. An extensive area of glaciofluvial material that was deposited by meltwater streams.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Parts per million (ppm). The concentration of a substance in the soil, such as phosphorus or potassium, in one million parts of air-dried soil on a weight per weight basis.

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 movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects 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:

Extremely slow	less than 0.01 inch
Very slow	0.01 to 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, such as 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.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very 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.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth).

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

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	less than 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

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a

change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

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.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

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. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.
- Shale.** Sedimentary rock formed by the hardening of a clay deposit.
- Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.
- Shoulder.** The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in origin.
- Shrink-swell** (in tables). 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.
- Slippage** (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.
- Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.
- Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.
- Soft bedrock.** Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.
- Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.
- Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

- Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.
- Stone line.** A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.
- Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.
- Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.
- Stripcropping.** Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform, such as a hill, mountain, or tableland. It usually refers to a high interfluvial area of gentler slope that is flanked by steeper hillslopes, e.g., mountain fronts or tableland escarpments.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine due to uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to

a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Till plain. An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.

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. Toe slopes are commonly gentle and linear in profile.

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.

Toxicity (in tables). Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

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.

Variation. 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 or 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 oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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